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A Study of the Euro-dollar Market: Its Origin and Interaction with U.S. Monetary Policy

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

David H. Resler

* * * * *

The Ohio State University
1977

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FIELDS OF STUDY

Economic Theory
Monetary Theory
International Trade
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CHAPTER I

INTRODUCTION

As a market for dollar-denominated deposits in banks outside the United States, the Euro-dollar market poses a number of interesting problems and questions for economists and policy-makers. Among the more important issues are the market's effect on world liquidity, world inflation, balance-of-payments problems, and the conduct of independent monetary policy by both the U. S. and the rest of the world. An extensive body of literature, dealing most predominantly with these questions, has been developed. This thesis adds to that literature by examining the factors contributing to the origin and growth of the market, the market's impact on world liquidity, and the interaction between Euro-dollar activity and the U. S. money supply process.

As a first step in examining these issues, the appropriate analytic framework must be developed. Understanding the origin and development of the market proves valuable in establishing its nature and function. Several general studies ([7], [17], [20], [41], [46], and [49]) of the Euro-dollar market offer a broad discussion of the market's function, its origin and probable effects on a variety of the issues noted above. While most scholars examine a variety of "causes" for the birth and growth of the market, few provide any theoretical explanation for its evolution. Work by Brunner and Meltzer [11] on the
evolution of a medium of exchange, provides a useful theoretical framework for understanding the market's development. In a footnote, they portray the market as one that has evolved from successful attempts by traders to economize on transactions and information costs. Chapter II develops this theme demonstrating the consistency of this theoretical approach with more ad hoc explanations of the market's origin. By emphasizing the key role of the market in providing efficient, short-term intermediary functions, the market's birth is viewed as a logical consequence of special contemporary circumstances and a growing, interrelated world economy. The analysis also leads to the implication that government regulation may, by raising the cost of more traditional transactions chains, encourage the growth of alternative intermediary processes, such as the Euro-dollar market.

Interest in the Euro-dollar market intensified in the early 1960s as fears that continued U. S. payments deficits coupled with the Euro-dollar market could generate an important expansion of world liquidity. The initial approach of most scholars was to examine this liquidity creation in terms of a multiplier paradigm. Representative of the basic arguments are the articles of Friedman [23], Klopstock [38], and Machlup [42]. Appealing to a domestic money-multiplier analogy, the controversy seemed to settle on the empirical question of the size and extent of leakages from the deposit expansion process (see especially, [23] and [38]). Empirical studies estimating the Euro-dollar multiplier ([29], [30], [40], and [43]) produced widely divergent results and shed little productive light on the controversy. (Makin's estimates [43] were much larger than the others. In another analysis
he found both theoretical and empirical evidence for declining Euro-dollar reserves. Appendix 3.1 generalizes his reserves-model to take specific account of information and search cost features of the market.) Chapter III investigates the legitimacy of the multiplier analogy to a domestic money supply process. Parameters of the multiplier are endogenized analogously to domestic money supply analysis. While this method seems promising, there are serious deficiencies of the multiplier paradigm as applied to the Euro-dollar market. Chapter III stresses the difficulty in identifying the Euro-dollar "base" which, however defined, also responds to interest rate changes. It is argued that since the Euro-dollar base can not be accurately identified or distinguished from "created" Euro-dollars, estimated multipliers probably overstate the role of independent liquidity creation. These fundamental definitional and empirical considerations alone argue against any meaningful interpretation of the market's liquidity producing role. Other, more theoretical approaches challenge the legitimacy of the multiplier paradigm ([29], [31], [50], [54]) and emphasize, instead, the market's distributive function. Chapter III offers both these arguments as reason to reject the multiplier analysis and suggests that there is little reason to suspect important, independent (and observable) liquidity creation from the Euro-dollar market.

While there seems to be little reason to fear a strong independent impact on world liquidity from the market, its nature and function may generate indirect effects on domestic money supplies. If so, control of monetary aggregates by the central bank may be impaired.
An analysis of the market's impact on the domestic U. S. money-supply has essentially been neglected. Hewson and Sakakibara (e.g., [31], and [32]) have considered the impact of the market on monetary policy but their focus has been primarily on interest-rate effects. Their general equilibrium model is viewed as inappropriate for an examination of the Euro-dollar market's impact on the U. S. money supply process under differing initial conditions. (A discussion of this problem is given in Appendix 4.1.) In Chapter IV a theoretical analysis of the U. S. money supply process is offered. The model specifically includes the potential impact of Euro-dollar activity. This multiplier approach lays the foundation for a more quantitative assessment of the Euro-dollar's influence on U. S. policy objectives. The model emphasizes that policy is probably impaired most when restrictive credit measures combine with Regulation Q interest-rate ceilings to encourage deposit-leakages and borrowing-injections from the Euro-dollar market. Though this approach has serious weaknesses owing to the difficulty in distinguishing actual from potential effects of Euro-dollar activity on the U. S. money supply, it does underscore the conditions under which policy is most likely to be hampered.

Chapter V builds upon these conditions in specifying structural demand and supply equations that relate to Euro-dollar borrowing by U. S. banks and overall depositing. Previous studies have empirically examined Euro-dollar borrowing (e.g., [8], [33]) and still others have investigated Euro-dollar depositing ([31], [43]). None of this previous work, however, has combined the two as separate but integrated markets each with its own demand and supply relationship. Further, past
empirical studies have failed to consider the effect of the special relationship between U. S. banks and their branch Euro-banks in the borrowing market. The model presented in Chapter V attempts to account for this relationship specifically. It also examines the differential interest rate effects on borrowing and lending that are likely to arise from Regulation Q ceilings. The model includes a pair of equations linking the Euro-dollar market to the U. S. money supply. This provides the framework for estimating the impact of various factors (interest rates, regulatory constraints, and policy actions) under different conditions. Since the model specifies both demand and supply equations for both borrowing and depositing, a two-stage, least-squares estimation procedure is employed to reduce the simultaneous equation bias. The chapter discusses several problems encountered in specifying and estimating the structural equations.

Chapter VI summarizes the main points made in the dissertation. It also offers some conclusions about the role and functioning of the Euro-dollar market as well as its implications for policy actions in the future.
CHAPTER II

THE ORIGIN OF THE EURO-DOLLAR MARKET

Basic Definitions

Before formally presenting a theoretical examination of the origin of the Euro-dollar market, some basic terms require definition. First, a Euro-dollar deposit is simply a deposit of U. S. dollars placed with a foreign bank. The bank need not be European, although most Euro-dollar deposits are with European banks. Recently the West Indies and Japan have experienced a rapid growth of dollar deposits placed at their own banks. In 1973 alone, the volume of Euro-dollar deposits in the Bahamas grew by 90%. Nevertheless, the largest share of Euro-dollars are held at European banks. Euro-dollar is a generic term without a specific geographic dimension and is used to designate a dollar deposit in a foreign bank. Another term frequently encountered in the Euro-dollar literature is the dollar certificate-of-deposit. These deposits are not strictly the same as a Euro-dollar deposit even though most sources of Euro-dollar data do not distinguish the two. A dollar certificate-of-deposit is a negotiable instrument, unlike ordinary Euro-dollar deposits, and are traded in a well-developed secondary market. These dollar c.d.s had their origin in London in 1966 and account for roughly 10% of all Euro-dollar deposits [5, 1975].
Second, a Euro-dollar loan is any dollar-denominated loan offered by a non-U.S. bank and is repayable in dollars. These loans vary in maturity from call to fairly long-term loans with maturities of up to ten years. (Table 2.1 presents data categorizing the maturities of both Euro-currency claims and liabilities.) One important feature of the market, is the willingness of Euro-banks to "tailor" maturities to the needs of their customers. The bulk of Euro-dollar loans are short-term in nature with maturities under one year and most commonly three months or less. Further, many longer-term Euro-dollar loans are merely "commitments" of Euro-banks to a longer term loan with the interest rate being renegotiated every 90 or every 180 days.

Third, a Euro-bank is any non-U.S. bank that accepts deposits and grants loans in U.S. dollars. While domestic U.S. banks are not Euro-banks they have played an important role in the Euro-dollar system as borrowers. U.S. branch banks located in foreign countries are Euro-banks if they accept dollar deposits. In addition, Euro-banks often place dollar deposits with U.S. banks and have been viewed by some authors as precautionary reserves of the Euro-banks.

While the focus of this thesis is on the Euro-dollar market specifically, the above definitions can be modified to refer to any deposit (or loan), denominated in a currency other than that of the country in which the deposit is received. Thus a Deutsch-mark deposit in the United Kingdom is a Euro-mark. Although other currencies have played a growing role in the Euro-currency market, dollar deposits account for about 80% of the Euro-currency market [6, 1975].
Table 2.1. The Maturity Structure of the Euro-Currency Market.*

A. Foreign Currency Liabilities of U.K. Banks (in millions of U.S. dollars).** Percentages are given in parentheses.

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<tr>
<td>Less than 8 days</td>
<td>32148 (22)</td>
<td>33307.2 (21)</td>
<td>33859.2 (22)</td>
</tr>
<tr>
<td>8 days-1 month</td>
<td>31269.6 (21)</td>
<td>31305.6 (20)</td>
<td>30916.8 (20)</td>
</tr>
<tr>
<td>1 month-3 months</td>
<td>39465.6 (26)</td>
<td>42242.4 (27)</td>
<td>44282.4 (28)</td>
</tr>
<tr>
<td>3 months-6 months</td>
<td>26702.4 (18)</td>
<td>30744.0 (19)</td>
<td>29258.4 (19)</td>
</tr>
<tr>
<td>6 months-1 year</td>
<td>11349.6 (8)</td>
<td>11522.4 (7)</td>
<td>9523.2 (6)</td>
</tr>
<tr>
<td>1 year-3 years</td>
<td>3244.8 (2)</td>
<td>3201.6 (2)</td>
<td>3643.2 (2)</td>
</tr>
<tr>
<td>More than 3 years</td>
<td>5095.2 (3)</td>
<td>5577.6 (4)</td>
<td>5618.4 (4)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>149,275.2</td>
<td>157,900.8</td>
<td>157,029.6</td>
</tr>
</tbody>
</table>

B. Foreign Currency Claims of U.K. Banks (in millions of U.S. dollars).**

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<tbody>
<tr>
<td>Less than 8 days</td>
<td>27288.0 (18)</td>
<td>27566.4 (17)</td>
<td>26978.4 (17)</td>
</tr>
<tr>
<td>8 days-1 month</td>
<td>29337.6 (19)</td>
<td>26464.8 (17)</td>
<td>26632.8 (17)</td>
</tr>
<tr>
<td>1 month-3 months</td>
<td>33739.2 (23)</td>
<td>39043.2 (25)</td>
<td>38748.0 (25)</td>
</tr>
<tr>
<td>3 months-6 months</td>
<td>25255.2 (17)</td>
<td>27770.4 (18)</td>
<td>26388.0 (17)</td>
</tr>
<tr>
<td>6 months-1 year</td>
<td>11536.8 (8)</td>
<td>12206.4 (8)</td>
<td>10500.0 (7)</td>
</tr>
<tr>
<td>1 year-3 years</td>
<td>7502.4 (5)</td>
<td>7860.0 (5)</td>
<td>9040.8 (6)</td>
</tr>
<tr>
<td>More than 3 years</td>
<td>14865.6 (10)</td>
<td>16831.2 (11)</td>
<td>18835.2 (12)</td>
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<tr>
<td><strong>Total</strong></td>
<td>149,524.8</td>
<td>157,742.4</td>
<td>157,123.2</td>
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* Figures include interbank deposits and include all non-Sterling deposits.

** All figures were converted from Sterling to dollars at $2.40/£.


(Percentages may total to more than 100 due to rounding.)
A Brief History of the Market and Summary of Alternative Views of Its Origins

A number of economists have written extensively on the origin and growth of Euro-dollar deposits. (See, for instance, [7], [20], [46], and [53].) Most of these writers have focused on the institutional origins of the market. Einzig [20, p. 3] notes that foreign-denominated deposits have a long history dating to the late nineteenth century and, perhaps, to the Middle Ages. Today's Euro-dollar market, however, has its roots in post-World War II Europe and the special circumstances of the world in that era. World War II left Europe shattered and in social and economic disarray and the United States emerged as the dominant economic force in the world, assuming much of the burden of the economic re-development of Europe through the Marshall Plan. This direct aid coupled with U.S. balance-of-payments deficits generated a dollar flow to foreigners who began depositing them with banks in Europe. This practice merely replicated similar behavior after World War I. (Some authors have attributed a special role to the development of the Euro-dollar market to Communist-bloc countries. In the early 1950s, for instance, many Communist central banks placed dollar deposits in European banks to avoid the political risk associated with direct depositing in U.S. banks.)

Initially most Euro-banks simply used their newly acquired dollars for direct investments in the U.S. money markets. By the end of 1957, however, many banks, recognizing an apparent demand for dollar-denominated loans, began granting dollar loans directly. This development marked the birth of the modern Euro-dollar market. From a
relatively small volume of assets and liabilities, the extent and importance of the market has grown rapidly. By 1960, Euro-dollar deposits were in the neighborhood of $1 billion. By 1975, gross Euro-dollar liabilities were more than $150 billion, with net (of inter-bank deposits), liabilities exceeding $23 billion. Annual growth rates for Euro-dollar liabilities have been little short of phenomenal. For example, the market registered a 50% growth of liabilities in 1969, and during 1974, one of the slowest years for the market's growth, the gain in gross liabilities was 14% (net liabilities that year grew by 33%) [6, 1969, 1974]. Thus the Euro-dollar market has grown into a large and important adjunct to the international money markets.

Intrigued by this market, numerous scholars have sought to explain the origin and growth of the market. Many early scholars have emphasized the market's role in providing an escape from various restrictive government regulations. For instance, Einzig [20, p. 6] attributes an important role to the British exchange restrictions adopted in 1957 and "artificially low interest rates . . . on time deposits in the United States." In fact, there once seemed to be a widespread belief that the market existed only because of Regulation Q interest ceilings [2, p. 78]. Of course, neither the 1962 relaxation of Regulation Q ceilings applicable to foreign deposits, nor the later elimination of interest-ceilings on large CDs produced the predicted demise of the market. One must not, however, conclude that these forces played no role in the market's origin and development. Such restrictions probably were important catalysts as economic agents sought to avoid artificial barriers to efficient market functioning.3
A more general view of the market's origin highlights the economic functions of the Euro-dollar market. Viewed in this context, the Euro-dollar market offers various economic agents a means of economizing on transactions with foreign trading partners. For example, suppose an Italian merchant receives dollars in exchange for the sale of his merchandise to the U.S. If he has no need for holding foreign exchange (viz., dollars), because he does not anticipate future expenditures of dollars, he would have no incentive for holding dollars (assuming no significant interest rate differential between U.S. deposits and Italian time deposits). He would then convert the dollars to lira for his transactions balances. On the other hand if he expects an imminent need for dollars (perhaps to purchase raw materials from a U.S. producer or another foreign producer who may require payment in dollars), his actions might differ. In other words, he has a demand for foreign exchange. Using the inventory-theoretic framework of Baumol, Swoboda [53, pp. 39-40] has demonstrated that the existence of fixed conversion costs (brokerage fees), will produce positive foreign currency holdings. Swoboda also suggests that differential transactions costs may generate a preferential demand for a particular currency even though the expected return net of risk for the two currencies is identical. Given these desired foreign currency holdings it is only a short step to the origin of an external deposit market. The Euro-dollar market provides a way of holding foreign exchange balances at a positive yield. Our trader can, by holding a Euro-dollar deposit, avoid the costs of converting dollars to lira and back to dollars again.
Similar forces have been at work throughout history, yet the Euro-dollar (or Euro-currency), market did not really evolve until the late 1950s. Thus, while this general line of reasoning seems valid, something more is required if this approach is to be meaningfully interpreted as a cause for the market's birth. A formal analytic framework examining the market's origin could provide the necessary link. Before offering this framework, however, let us briefly examine some other frequently cited reasons for the market's development.

Thottathil [54, p. 18] noted the absence of suitably developed short-term financial markets in some countries as a factor contributing to the origin of the market. In this view the Euro-currency markets evolved, in part, to offer a short-term medium for holding foreign exchange when domestic markets (e.g., in LDCs), do not or cannot. Others have emphasized the presence of interest-rate differentials (more than large enough to overcome exchange and/or political risk), between national credit markets and the Euro-dollar market. Such differentials may be meaningful explanations for the growth of the market, but not for its origin. Evolution of a profitable market (from the standpoint of lenders, borrowers, and intermediaries) required the existence of either important transactions costs or some barrier (e.g., Regulation Q ceilings and/or effective entry barriers to existing markets) to the efficient economic functioning of domestic markets. Hence, the interest rate differential explanation is offered quite often in conjunction with the "regulatory-response" explanation.

Summarizing, the most frequently cited factors contributing to the birth and development of a Euro-dollar market are:
1) The opportunity to avoid restrictive national banking policies or exchange controls;
2) A means of economizing on foreign currency holdings by avoiding conversion and/or storage costs;
3) The psychological convenience of holding a foreign currency;
4) The absence of suitable domestic money market instruments (especially true for the LDCs);
5) The presence of profitable interest rate differentials.

One should also note the role of the U.S. payments deficit in supplying the dollars that find their way into the market. A theoretical framework encompassing the role of these factors has been missing from the literature. Swoboda [54, p. 10] has attempted to identify some of the factors that determine the choice of the vehicle currency (e.g., the dollar), suggesting that one or more of the following are crucial to this choice. First, a currency may be selected as the vehicle currency through historic accident. Such a serendipitous view, however, has little appeal to the economist who views the world as one composed of rational utility-maximizing "choice-makers." Swoboda does offer more appealing rationale. One is that asset exchange costs may differ due to economies of scale. That is, familiarity with a particular foreign currency because of extensive trading of commodities with that currency may make it preferable to others. This important consideration calls for a more formal treatment in the framework of some model. (The model presented in the following section includes this element specifically.) Also, "thinner" foreign exchange markets are probably riskier. In
other words, a few traders can exert a significant impact on price if little trading is done in that market.

While these elements are important Swoboda fell short of comprehensively linking these factors to the origin of an external deposit market. In the following section a model by Karl Brunner and Allen Meltzer [11] is presented in terms of its applicability to the Euro-dollar market. This theoretical model is shown to explain not only the evolution of a Euro-currency market but the more specific development of the Euro-dollar market. Such an approach represents a more comprehensive view of the market and its origin and one that is consistent with the more ad hoc explanations discussed above.

A Review of the Brunner-Meltzer Model

Brunner and Meltzer [11] present a theoretical model explaining the evolution from a barter exchange system to a monetary system. The following is merely an application of their conceptual framework to the Euro-dollar market. The model builds upon two basic postulates absent from previous exchange theory literature. The postulates focus on the informational characteristics of various assets that prove to be both necessary and sufficient conditions for the use of a medium of exchange. Restating these postulates, we have:

"1) For each transactor in an exchange economy, the marginal cost of acquiring information, measured in units of consumption sacrificed, depends on the goods or services selected [as a medium of exchange].
"2) The marginal cost of acquiring information about the properties of any asset does not vary randomly within a social group and declines as the frequency with which the group uses a particular asset increases" [11, p. 786].

Based on these postulates, Brunner and Meltzer develop a theory that explains the origin and evolution of a medium of exchange. Here this theory is applied to another intermediary asset, viz., the Euro-dollar.

Instead of simply duplicating the Brunner-Meltzer (B & M) model, I verbally summarize their argument specifically applying it to the Euro-dollar market. In the model, a transactor maximizes a utility function subject to his budget constraint. Arguments in the utility function are the mean and variance of some expected bundle of goods and a variable defining the full range of qualities of the goods that ultimately enter his consumption bundle. The transactor allocates resources to acquiring information about goods, to executing transactions, to exchanging directly for goods not in his initial endowment of resources, and to maintaining a reservation demand. This trader faces some uncertainty about market opportunities. This uncertainty depends upon his investment in information from his initial endowment and the various transactions sequences or chains the trader may select. The trader can alter his utility through his allocation of resources to reservation demand, investment in information and execution of trades (transactions costs). The more resources spent on acquiring information or on actual transactions, the less remains for exchange or reservation demand. While conventional trade analysis assumes information and
transactions costs are zero, B & M show that by including them, alternative sequences of transactions (transaction chains), with different resource costs, may exist. "Where information about the qualities and exchange ratios varies with the commodities, there are corresponding differences in the marginal cost of information, so transactors are not indifferent about the commodities they accept for use in subsequent exchanges" [11, p. 792]. That is, some sequences require more information (at the expense of resources) than others. Transactors choose the transactions chain that maximizes utility (minimizes resource expenditures).

Since some goods provide better information and a greater reduction in uncertainty than others, one expects these commodities to enter more frequently in the intermediate steps of the transactions sequence. As more transactors select a particular chain and the assets associated with it, uncertainty about the qualities of that asset declines. The more frequently an asset is used, fewer resources need to be devoted to acquiring information about that asset and the more resources remain for reservation demand or exchange.

B & M [11, p. 793] show that the second postulate assures that the individual trader's optimizing behavior leads "to the social choice of a small number of medium of exchange assets." Repetitive use of similar assets by individual traders lowers information and transactions costs leading to the convergence toward a commonly used asset in the intermediate steps of the transaction chain. Money evolves as a medium of exchange because individuals can use it to economize on the information and transactions costs of trading. B & M anticipated the
extension of such a model to other markets stating that—"the analysis also explains the emergence of specialized trading functions such as brokerage and other market arrangements" [11, p. 787]. The Euro-dollar market is just such a specialized market.\textsuperscript{8} It remains to discuss the Euro-dollar market specifically in this context.

\textbf{Consequences of Brunner and Meltzer's First Postulate}

The B & M model provides both necessary and sufficient conditions for the evolution of a medium of exchange. In a world with finite political, cultural, and geographical boundaries, however, one expects the development of several media of exchange. Trade between these politically defined units necessitates a market for converting one currency into another, i.e., a foreign-exchange market. Traders on each side of the political boundary enter the foreign exchange market to trade their own currency for that of their trading partner.

As trade increases so does the demand for foreign exchange. Further, more frequent foreign exchange transactions increase the incentive to lower the trading costs. Foreign-exchange markets evolve from attempts by economic units to lower some search and information costs. While the resident of Country X has plentiful information acquired over his life about domestic goods and services, he has far less information about goods and services of Country Y. He may wish to acquire commodities from Country Y, but would probably want to hold little if any of that country's currency since he knows little about what he can directly acquire with that currency. In a world of infrequent trades involving foreign exchange, our typical trader would
hold little if any foreign exchange. Both a rising frequency and volume of trades made with foreigners impose costs on our traders. Each foreign transaction necessitates the acquisition of the foreign currency. Ignoring for the moment the risks of changes in foreign-exchange rates, the trader faces brokerage fees each time he enters the foreign market. As Swoboda notes, these costs become higher in absolute amount the more often they are incurred and are an incentive to holding foreign exchange. If the holding period is very long, if the opportunity cost is high, or if the amount of foreign exchange is large, traders would seek profitable outlets for holding these balances. They can deposit these balances in the foreign country, but finding such an outlet in their own country necessitates conversion costs both now and in the future when they again need to acquire foreign exchange. A greater volume of foreign trade induces search for lower cost transactions chains. Similarly, traders who want additional foreign exchange balances (net borrowers), seek the lowest cost avenue for acquiring these assets. That is, both a demand and supply for holding foreign-denominated currency develops. This environment encourages the birth of a market that intermediates between these borrowers and lenders. This intermediary market represents a transactions chain that involves lower costs to traders than transactions that must intermediate through the foreign exchange market. Thus the market for foreign currency deposits evolves from traders' pursuit of a lower cost transactions chain.
Consequences of Brunner and Meltzer's Second Postulate

While this analysis usefully explains the evolution of a Euro-currency market, it remains to explain the more rapid and extensive development of the Euro-dollar market. This explanation involves a straight-forward extension of B & M's second postulate, that the cost of obtaining information about an asset declines as the frequency with which a group uses that asset increases. A quick examination of some institutional features of international trade will, in the context of the B & M model, suggest why the Euro-dollar market developed first and fastest.

Probably the most important single factor contributing to the development of a Euro-dollar market was the emergence of the dollar as a key reserve currency. As the dollar became an important means of international payment, trading agents continued to acquire information about the characteristics of the dollar. International financial statistics were reported in dollar terms, the official gold price was reported in dollars and so on. As compared to other currencies, traders have had to spend fewer resources obtaining information about the characteristics of the dollar. Thus the very fact that the dollar developed into an international means of payment contributed importantly to the origin and growth of a Euro-dollar market. Further, as Brunner and Meltzer suggest, the continued use by economic units of a particular asset has a snowballing effect on lowering the costs (and thereby increasing use) of the asset.
A Formal Analysis

Let us now summarize, in a formal framework, the evolution of a transactions chain incorporating the Euro-dollar market. We can then use Brunner and Meltzer's graphical analysis to show that such a lower-cost chain will generate a higher level of utility for any given expenditures of resources than would alternative chains.

Suppose a trader whose home country (X), has well-developed capital and money markets in domestic currency (x), has now acquired some dollars. Assume also, for simplicity, that there is a fixed and stable exchange rate, e, for converting x to dollars:

2.1) \[ e = \frac{D}{x} \]

where D has the dimension of dollars and x is defined as above.\(^\text{12}\) Our trader now faces a decision regarding his dollar balances.

With No Interest-Rate Differentials or Future Demand for Dollars

Choice 1 involves converting the dollar balances into the domestic currency and then holding the excess money balances in a short-term account paying \( i_x \). The net gain (\( G_1 \)) from exercising this option is (in terms of currency x):

2.2) \[ G_1 = i_x (D/e - S_1) (1 - c) - c (D/e - S_1) \]

Here \( i_x \) is the short-term interest paid in X, c is a fixed conversion cost per unit of foreign exchange, and \( S_1 \) is the fixed, lump-sum search and information costs the trader must incur to find those assets yielding \( i_x \). At the end of the holding period our trader would have a net gain, \( G_1 \), and would possess his own currency which he could use to acquire domestically produced goods and services.
Choice 2 involves using his new found dollar balances to acquire short-term U.S. money market instruments. This choice also involves costs. In order to spend his dollars (assuming no future dollar-denominated transactions are contemplated) he would eventually have to convert his dollars back into the domestic currency. That is, he can delay, but not avoid, the conversion cost (c). Further, he must acquire information about U.S. money market instruments. Here, however, he must devote more resources to acquiring information about assets and about institutions as well, since he is less familiar with any foreign market than he is with his own. The net gain from this choice can be expressed as:

\[ G_3 = i_D (D/e - S_3) - c (1 + i_D) (D/e - S_3) \]

2.3) Here \( i_D \) is the yield on a short-term, dollar-denominated asset, \( c \) is defined as before, and \( S_3 \) is the cost of acquiring information about institutions and markets in the U.S. In general, it is reasonable to assume that \( S_3 > S_1 \).\(^{13}\) If we assume for simplicity the equalization of interest rates across countries, i.e., \( i_D = i_x \), and \( G_1 > G_3 \), and since there is no anticipated future demand for dollar balances for transactions purposes and search costs are higher for a foreigner holding dollar balances in the U.S., little incentive would exist for seeking outlets for these dollars. Thus our typical trader would probably convert to the domestic currency via the foreign exchange market.

With a Potential Future Demand for Dollars

Introducing a potential future transactions demand for dollar balances alters the picture. Suppose that many trades are conducted in
dollars and that the trader frequently engages in transactions requiring the use of dollars. Unlike the first case, our trader may now wish to hold some dollars for his own transactions. (In the earlier case, all future acquisitions of goods and services were expected to require currency x.) Suppose the trader anticipates needing dollars for future transactions with a probability p, such that 0 < p ≤ 1. His net gain, then, from converting the dollars into his domestic currency and holding a domestic asset now becomes:

\[ G_1 = i_x (1-c)(D/e - S_1) - c(D/e - S_1) - p \cdot c (1+i_x)(D/e - S_1). \]

His net gain from converting to his domestic currency (x) and holding a domestic asset is lower than the previous case since now, p > 0. Clearly, the higher p, the lower his net gain from converting and holding x. In general p will be higher the more trade is conducted in dollar terms either directly with the U.S. or with another foreign country. That is, it becomes more costly to convert dollars into the domestic currency the more frequently one trades and requires dollars for those trades. Hence we can expect a greater incentive to hold dollars than before.

Now consider the gain, G_3, from holding dollar balances in the U.S. money markets. This choice involves no conversion to the domestic currency in the present and a less-than-certain conversion cost in the future. Specifically, the probability of not requiring dollar balances for future trade, or what is the same thing, the probability of eventually having to convert the dollars into x is simply 1 - p (instead of 1). Now we can write:

\[ G_3 = i_D (D/e - S_3) - (1 - p) \cdot c (1 + i_D)(D/e - S_3). \]
Here the higher is $p$ (the probability of needing dollar balances for transactions purposes), the greater is the gain from holding dollar balances in the U.S. money markets. This latter transactions chain becomes more attractive the more likely it is that future transactions will require the use of dollars.

**Intermediation Lowers Search Costs**

The high information and search costs to a foreigner entering U.S. money markets, may provide incentive for finding yet another outlet for excess dollar balances. In addition, some transactors may find they have an excess demand for dollar balances and wish to borrow dollars. Both may find domestic banks willing to intermediate in dollars directly. Both thereby avoid the conversion costs normally associated with foreign exchange markets. Further, for very short-term commitments, U.S. monetary regulations forbid the payment of interest (i.e., on demand deposits). Hence, if liquidity is an important consideration to depositors they may be less willing to commit funds for the duration required to get a profitable yield. Euro-banks, not subject to these constraints, may thus find it profitable to intermediate in dollars, offering higher deposit rates and lower loan rates than those offered by U.S. banks. Since these banks normally intermediate in domestic markets as well, potential customers already are familiar with their reputation, structure, etc. For this reason search costs will probably be close to $S_1$ and less than $S_3$. The gains to foreigners from holding excess dollar balances in this market are:

$$G_2 = i_e (D/e - S_2) - c (1 - p)(1 + i_e)(D/e - S_2)$$
Since $S_2 < S_3$ (even if $i_e = i_D$) it is more advantageous to include the Euro-dollar market in the transactions chain than either the domestic market, involving certain conversion costs, or the U.S. money market. The higher is $p$, the more attractive is the Euro-dollar market relative to the domestic market, and the greater the difference in search costs ($S_2 - S_3 < 0$), the more attractive the Euro-dollar market becomes relative to the U.S. money markets. These factors alone would contribute to transactors seeking out the lower-cost transactions chain that a Euro-dollar market may provide.

**Graphical Analysis (Figure 2.1)**

The benefits of a Euro-dollar market can be illustrated using the graphical analysis of Brunner and Meltzer. The vertical axis $E(y_2)$, represents the expected bundle of goods that a transactor can acquire through exchange. The left horizontal axis represents resources devoted to acquiring information about consumption bundles, exchange ratios, etc., up to the maximum of the total resources available, $R$. The right horizontal axis depicts the reservation demand for goods, once again with a maximum $R$.

Following Brunner and Meltzer, it can be shown that the budget constraint depends upon the amount of resources devoted to acquiring information. The functions $V_1$ and $V_2$ show that as more resources are devoted to acquiring information the value of the consumption bundle ($E(y_2)$) increases to a maximum value and then declines. The righthand counterpart of the V-curves shows that allocating resources to information affects the budget constraint in two ways. Investment in
Figure 2.1
information raises the value of the consumption bundle but leaves fewer resources for reservation demand. Thus in Figure 2.1, investment in information $I_1$ moves the budget constraint associated with $V_1$ from line 1 to line 3, allowing the achievement of a higher level of utility. Clearly, one transactor would never acquire more information than $I_m$ (or $I'_m$), since any additional information results in a lower associated value of the consumption bundle and less remaining for reservation demand. Our transactor acquires information until he maximizes his utility, i.e., finds the highest obtainable indifference curve.

The curves $V_1$ and $V_2$ represent the relationship between investment in information and the expected bundle of goods for two different transactions chains. Obviously $V_2$ is to be preferred to $V_1$ for at all points, a given investment in information produces a higher value of $E(y_2)$. $V_2$, in the context of this thesis, represents the transaction chain associated with the Euro-dollar market while $V_1$ is associated with a chain involving no intermediating in the Euro-dollar market (e.g., transactions that circuit through the foreign exchange markets only). Two forces contribute to the preferability of this transactions chain. One is the set of forces, that contribute to the choice of the dollar as the vehicle currency. The second is the search costs with respect to domestic institutions which the trader could previously realize only by converting to the domestic currency. The Euro-dollar market affords international traders the opportunity of holding excess dollar balances in interest-bearing accounts without having to enter the U.S. money market directly. Entering the U.S. markets would necessitate acquisition of information about structure
and institutions generally, and about specific dollar-denominated U.S. assets. In addition, the foreign dollar holder can use the Euro-dollar market to hold his dollar balances instead of undergoing a certain conversion cost now and a probable conversion cost in the future if dollars are once again needed for trade.
Footnotes to Chapter II

1Paul Einzig [20; p. 9] correctly notes the distinction between Euro-dollar loans and dollar-denominated bonds issued in Europe (Euro-bonds).

2See Makin [42].

3In Chapter V of this dissertation, evidence underscoring the importance of Regulation Q in the Euro-dollar market, is presented.

4Swoboda [54; p. 6]. This "psychological convenience" probably derives from the information content of various currencies. For instance, a country that has close cultural and political ties with another country probably prefers the latter's currency to other foreign exchange.

5Other authors have presented similar arguments but in less formal terms. For example, von Mises [50; pp. 30-34].

6Robert Nozick [52] would label both the B & M model and its present extension to the Euro-dollar market as "invisible-hand" explanations. That is they are explanations that "... show some overall pattern or design [but were, in fact, results] produced and maintained by a process that in no way had the overall pattern or design in mind." (p. 19)

7Once again, von Mises and others had recognized this "snowballing" effect in earlier works: "And as soon as those commodities that were relatively most marketable had become common media of exchange, there was an increase in the difference between their marketability and that of all other commodities, and this in its turn further strengthened and broadened their position as media of exchange." Von Mises [50; p. 32].

8Brunner and Meltzer specifically mention the Euro-dollar market as an example of this cost reduction as a market grows [11; fn. p. 787].

9Note the similarity between this analysis and Swoboda's explanation of the development of a vehicle currency. See pages 13-14 above.

10These characteristics include the relative stability of the dollar, its acceptance in trade and so on.
11 The extremely rapid growth of the Euro-dollar market is consistent with this hypothesis.

12 The analysis that follows would have an additional choice dimension with the assumption of flexible exchange rates but the basic conclusions still follow.

13 This assumption \((S_3 > S_1)\) may be reversed if Country X is an LDC with poorly developed or non-existent capital markets.
CHAPTER III

THE LEGITIMACY OF THE EURO-DOLLAR MULTIPLIER

Introduction

Since its inception, the Euro-dollar market's impact on world liquidity has concerned economists. Do Euro-dollars add to the world money stock? If so, how much? Are Euro-dollars an important source of world inflation? If the answers to any or all of these questions are affirmative, can anything be done to control the market? Confronted by the phenomenal growth in Euro-dollars, economists began to analyze the market in terms of conventional money-supply analysis. Much of the work on the Euro-dollar market has focused on the question of the existence and size of the Euro-dollar multiplier. Two basic schools of thought have emerged in this controversy. One, associated with Friedman [23], stresses similarities between a domestic money-supply process and Euro-dollar creation. This view asserts that the multiplier exists and is, at least potentially, quite large since there are no required reserves for the system. Stressing the similarities between a domestic and Euro-dollar expansion process, this school argues that the absence of legal reserves for Euro-banks would, in the absence of leakages, make the Euro-dollar multiplier extremely high. The other view, was initiated by, and generally associated with Klopstock [36]. Its supporters argue that though there are no legal reserves, extensive leakages from the
Euro-dollar market render the Euro-dollar multiplier very small. This approach also emphasizes the distributive function of the market. The differences in the two views, essentially focus on the size of the multiplier. This empirical question has generated a series of studies on the Euro-dollar multiplier.

**Estimates of the Size of the Euro-dollar Multiplier**

Three recent works have examined this question empirically, producing results that are significantly different and difficult to reconcile. Makin develops a multiplier \(1/r\), in which the reserve ratio, \(r\), is determined by the profit-maximizing (cost-minimizing) behavior of Euro-banks. Though his model for determining \(r\) has a certain theoretical appeal, it has faced important criticism from other scholars (see [29]), who contend that Makin's reserve ratio should be considered a maximum. These critics further contend that the structure and nature of the Euro-dollar market is such as to make the level of Euro-dollar reserves negligible. In any case, Makin's work estimated that the multiplier averaged about 18.45 during the 1960s and probably increased as the market grew. Further, he attributed about 40 percent of the growth in Euro-dollar deposits to a multiplier process.

Lee [40] in one sense extended the Makin Euro-dollar model, by trying to estimate the cash drain from the multiplier process. His model incorporates both a "currency-ratio", \(c\), and a reserve ratio, \(r\), in the same manner as textbook U.S. money-multiplier models. However, his treatment of the reserve ratio as an exogenously determined magnitude ignores the actual portfolio considerations of the
Euro-banks that, in fact, determine the reserve ratio. In addition, Lee's failure to identify the appropriate Euro-dollar deposit multiplier has created some confusion. Simply stated, Professor Lee errs in calling any foreign-held dollar liability a "Euro-dollar". He identifies the "cash" leakage from the Euro-dollar market as the sum of short-term dollar holdings of foreign official institutions, foreign commercial banks, foreign non-banks, and international organizations. There is little reason to assume that these components were ever part of the Euro-dollar market. Lee mistakenly identifies these foreign-held dollars as the analogous currency-component of the Euro-dollar system. While Lee's estimates are called "Euro-dollar multipliers", they are not and should be appropriately termed "foreign-held dollar multipliers". Since Euro-dollars are, by definition, deposits at a Euro-bank the true Euro-dollar-multiplier, using Lee's symbols should be $1/c+r$. These comments notwithstanding, Lee's estimates of the "multiplier" $\frac{1+c}{c+r}$ show that the multiplier ranged from only about 1.3 (1963) to about 1.9 (1969) [40, p. 868]. These results suggest that the relevant leakages are, as Klopstock claims, significant. Hewson and Sakakibara [29] in a yet more recent paper develop another Euro-dollar multiplier, in which interest rates are incorporated. However, their most important extension is to include a measure designed to capture the amount of redepositing in the Euro-dollar market attributable to central banks. Their "multiplier" is derived from a general-equilibrium portfolio model and must fall between zero and one in the absence of central bank redepositing but may be somewhat higher if there is some redepositing by central banks. They estimate a "maximum" average multiplier of 1.4
for the 1968-1972 period. These authors, in at least two separate works [30;31], present a strong case against the fixed-coefficient approach, arguing that the "fixed-coefficient" multiplier fails to account for portfolio adjustments by market participants to changes in the rates of return (and risk). These changes may originate with exogenous changes in "primary" Euro-dollar deposits (the Euro-dollar base) or other exogenous factors. However, this criticism alone is not sufficient to refute a multiplier type of analysis if the model directly incorporates interest-rate elasticities. Such a "variable coefficient" approach may still prove to be a less valuable paradigm than Hewson and Sakakibara's, but their criticism of previous multipliers has little validity if applied to a "variable coefficient" multiplier. Though we find that a multiplier model, that effectively answers Hewson and Sakakibara's criticisms, may be constructed, this approach may prove weak.

Questioning the Analogy

Previous work on the Euro-dollar multiplier, with the exception of [29] and [30], implicitly assumes the legitimacy of an analogy between the Euro-dollar and domestic money supply processes. Niehans and Hewson [51] have criticized the multiplier paradigm and instead have supported a general-equilibrium approach. Niehans and Hewson have, in fact, suggested that a multiplier model clouds the most important function of the Euro-dollar market as an efficient distributor of funds in international capital markets. This dissertation offers an alternative analysis of the strengths and weaknesses of the multiplier
analogy.

In many respects, the Euro-dollar multiplier literature is at the rather primitive, "old-view" monetary theory stage. That is, we have seen the development of a fixed-coefficient multiplier for Euro-dollars much like the multipliers of basic money-and-banking textbooks but there has been only limited treatment of the Euro-dollar multiplier in a "new-view" context. While Tobin [55] has indicated that even this approach derives its validity from the special regulatory constraints imposed on commercial banking (viz., interest-rate ceilings, reserve requirements, etc.), we develop a new-view framework for the Euro-dollar process to examine its short-comings explicitly.

A Simple Multiplier Model

To highlight the differences between the Euro-dollar multiplier and a domestic money multiplier, let us initially assume these differences to be sufficiently negligible that a useful analogy can be drawn. We summarize the current state of the literature, examine the effects of endogenizing the reserve and currency ratios, and proceed to focus on the most serious difficulties of such a model.

Let us define the Euro-dollar base (B), as:

3.1) B = C + R. This is directly analogous to a domestic money-supply model in which the base is defined in terms of its uses. Here C is identified as the currency equivalent (e.g., all U.S. liquid liabilities to foreigners, except those of N.Y. banks) to domestic models; and, R is defined as reserves of Euro-banks (e.g., deposits of Euro-banks with N.Y. banks). In domestic models, C consists of
currency held by the public and vault cash of non-member banks. In the Euro-dollar market such clearly identifiable institutional elements are absent. However, the "non-bank public" of the Euro-dollar system could be considered to be all foreigners, i.e., central banks, the non-bank foreign public, international organizations, and foreign commercial banks [40, p. 868]. Foreigners probably consider these highly liquid funds similarly to the way the non-bank public (of domestic models) views cash. Held as liquid claims on the U.S., these funds are readily available to acquire real goods and services.

The reserve component of the base, R, also differs importantly from its domestic money-supply counterpart. In domestic money-supply models, reserves are classified as required and excess reserves. In the Euro-dollar system all reserves are excess reserves since Euro-banks hold only precautionary or "prudential" reserves to meet the uncertain demands for "funds" by their customers. Parameters similar to those determining excess reserves in domestic models, can be expected to determine a Euro-bank's holding of reserves. Interest rates are important to a Euro-bank that tries to optimize its reserve holding and are examined specifically when we endogenize the reserve ratio. Makin identified these reserves as all Euro-bank deposits with any U.S. commercial bank, exclusive of claims of branch banks on their home offices.² Lee, while treating reserves as exogenous, includes only those deposits of Euro-banks with New York banks as reserves for the Euro-dollar system [40, p. 868], arguing that New York deposits are the best proxies for precautionary reserves since they are most readily accessible on short notice. Euro-bank claims on other U.S. commercial
banks are presumably less available and consequently less useful as precautionary reserves. That is, the total marginal cost of obtaining those deposits is higher than for the deposits of N.Y. banks. The role of New York is a money-market center supports this assumption. Niehans has pointed out that even interbank deposits in the Euro-dollar market may be operationally considered as reserves by Euro-banks, since they are readily available to meet the non-bank public's withdrawals. Further one could argue that lines of credit extended to Euro-banks by U.S. should be included as precautionary reserves. These empirical questions are not crucial to the conceptual analysis. We assume only that reserves can somehow be usefully defined. The key distinction, however, between the Euro-dollar and domestic interpretations of reserves is that, for Euro-banks there is no formal central bank that holds reserves.\(^3\), \(^4\)

To continue the development of the simple fixed-coefficient multiplier, we write the behavioral parameters of the model. Let us assume, initially, that the non-bank public holds some fixed ratio of "currency" to Euro-dollar deposits such that:

3.2) \( C = cE \); where \( c \) is a parameter and \( E \) is Euro-dollar deposits. Note that we are assuming that \( E \) is the relevant base for determining the "currency" holdings permitting us to keep the framework directly analogous to U.S. money-supply models. In reality, however, an alternative measure such as world trade volume or a wealth measure would be a more likely candidate.

Further, assume that Euro-banks hold some ratio, \( r \), of their Euro-dollar deposits as reserves. That is,
3.3) \( R = rE \). Finally, the total volume of Euro-dollars depends on the base, \( B \), through some multiplier, \( e \);

3.4) \( E = eB \).

Combining equations 3.1) through 3.4) gives;

3.5) \( B = rE + cE = (r+c)E \), and,

3.6) \( e = 1/(r+c) \). The multiplier depends on the reserve ratio, \( r \), and the cash leakage, \( c \), from the Euro-dollar system. This represents the simplest multiplier model, and one similar in form to a U.S. money-supply model's deposit multiplier.

**Extending the Model**

This rather simple multiplier model can be improved by endogenizing the parameters \( r \) and \( c \) to reflect the impact of various economic variables on the portfolio decisions involved in their determination. Makin's approach represents a first attempt to incorporate in the multiplier the Euro-bank's portfolio decision affecting precautionary reserves. He includes interest-rate variables in a precautionary-demand-for-reserves model to determine a Euro-bank's optimal reserve ratio. This approach is an improvement that, at least conceptually, can be extended to the "currency" ratio. Let us now examine the endogenization of the \( c \) and \( r \) ratios.

**Determinants of "Currency (Leakage)" Ratio**

In domestic money-supply models the currency ratio captures leakages to the non-bank public from the deposit "creating" banking system. For the Euro-dollar market, as Klopstock and others have claimed, the probability is high that large leakages of this type occur.
Tracing the path a new deposit might follow in the Euro-dollar system illustrates this point.

Suppose a Euro-bank receives a new dollar-denominated deposit, paying some rate of interest to the depositor and hoping to profit from this deposit by extending its asset position. The Euro-bank determines its desired reserve ratio and lends the balance. The Euro-dollar borrower, in part, determines the size of the leakage. Suppose the borrower is a U.S. resident or a U.S. commercial bank. In either case, if the borrower spends his loan in the U.S. (or the bank increases its dollar reserves), the leakage from the Euro-dollar market is complete (100 percent). Further, if the borrower were a non-U.S. resident who spent his newly acquired funds to purchase goods and services from a U.S. resident, the leakage is complete and no further expansion of Euro-dollar deposits follows.

Suppose, however, the initial borrower is a non-bank foreigner who spends the proceeds to acquire goods and services from another foreigner. If this latter recipient redeposits all his new dollars in the Euro-dollar market, leakages are zero. If he elects to hold some of the balances in a more liquid form (e.g., as "currency"), there has been only a partial leakage. (In this case the analogy to the textbook example of the multiplier is clearest.) However, this new recipient of dollars may, wish to convert his dollars to the domestic currency via his central bank. Now the original dollar loan rests with the foreign central bank and the "leakage" depends on its actions.

If the central bank increases its Euro-dollar deposits by the amount of the conversion, once again leakages are zero. The extent to
which the central bank either holds its new dollar balances as "liquid" international reserves (for precautionary or transactions motives), or converts its new dollars into gold or its own domestic currency via the U.S. central bank, determine the amount of "leakages". Hewson and Sakakibara [30] stress this central bank redepositing as the most crucial determinant of Euro-dollar leakages. To the extent that the original Euro-dollar borrowers (or subsequent recipients of these funds) convert dollars to the domestic currency via the central bank, central banks probably do play a key role in the determination of ultimate leakages. Further, the series of transactions stages a Euro-dollar enters suggest the likelihood of a very large leakage. Note that even if at this first stage leakages were zero and there was complete redepositing, the second level of transactions includes all the same decision elements as the first. Consequently, the assumption made by many scholars that leakages are indeed large seems valid. That does not, however, represent an argument against the use of a multiplier model but merely an argument that the multiplier is quite small. Further, while one might expect to encounter enormous problems in measuring these leakages, a conceptual Euro-dollar multiplier is certainly not disqualified.

Tracing the Euro-dollar loan through these various stages suggests several key economic variables that one would ideally include in endogenizing the c-ratio. The rate of interest paid on Euro-dollar deposits influences the dollar holder's portfolio decisions as do interest rates paid on other short-term assets in alternative capital markets. Exchange rates, the cost of forward cover, and the value of
an individual's expected transactions denominated in dollars are important. Elements of the central bank's portfolio decisions regarding international reserves deserve to be included. Of these variables, probably the most important are the interest rates on Euro-dollar deposits and other short-term assets. As a first approximation of an endogenized Euro-dollar currency ratio we focus on these elements, though a more thorough model would include a more extensive list of variables. Let:

$$c = c (i_e, i_s); \frac{\partial c}{\partial i_e} < 0 \text{ and } \frac{\partial c}{\partial i_s} > 0.$$  

Here $i_e$ represents the Euro-dollar deposit rate and $i_s$ represents some short-term money market rate. That is, $i_s$ can be considered as the U.S. certificate-of-deposit rate, Treasury-bill rate or some foreign short-term rate. Since $c$ measures leakages from the market, one can assume that the higher is $i_s$ (relative to $i_e$) the greater will be the cash drain from the Euro-dollar market, while higher $i_e$ encourages redepositing in the market.

The Reserve Ratio

Euro-banks, like domestic banks, hold a portion of their liabilities in "reserve" to meet the uncertain future claims on such funds by the public. Important differences, however, exist in the system of constraints imposed on reserves for the two markets. Euro-banks face no legal minimum reserve requirement. Instead, all Euro-bank reserves are, in a sense, excess reserves. Euro-banks do wish to maintain some level of reserves as precautionary balances. "Prudent" banking dictates such caution. However, certain special features of
the Euro-dollar market argue for a negligible reserve ratio.

Recent Euro-dollar literature has stressed some of the features contributing to a very small reserve ratio. Euro-banks function as intermediaries in the international capital market accepting deposits from their customers in large denominations for specified maturities that range from "call" to three years and more. Most Euro-dollars are short-term (less than one year), and most of these are in deposits of three months or less (see Table 2.1). Two facts emerge that have important implications for the Euro-dollar market. First, Euro-dollar deposits are not demand deposits. Though call deposits are similar to demand deposits, most Euro-dollars are of a longer and more certain maturity. Second, because of these "contracted" deposit maturities, Euro-banks have more information about their liabilities than do domestic banks issuing demand deposits. Knowledge of the maturities of its liabilities lowers the probability of excessive or unexpected withdrawals and implies lower reserve ratios. Hence we can expect Euro-banks to maintain a lower reserve ratio than would domestic banks even in the absence of reserve requirements. Makin [44], offered a model, supported by evidence, that predicted a declining reserve ratio for Euro-banks throughout the 1960s. The appendix to this chapter provides a more general treatment of the same question showing that growth and familiarization with the market itself implies declining reserve ratio. In the absence of leakages, this fact argues for a high value for the multiplier.

However, large or small, the reserve ratio, like the currency or "leakage" ratio, can be expected to depend on interest rates. If we
assume that the Euro-dollar deposit and loan rates differ by a constant amount, we can effectively treat them as identical.\(^6\) Competition among Euro-banks should assure that such differentials remain "normal". The Euro-dollar rate is the Euro-bank's opportunity cost of holding reserves. We expect Euro-banks to hold fewer reserves the higher is the Euro-dollar rate.

The effect of other interest rates on reserve holdings is more difficult to predict. Suppose some other short-term rates, such as U.S. CD-rates, increase. To the extent that Euro-banks consider these rates a reserve-borrowing rate, (like the discount rate or federal funds rate for domestic banks), they would wish to hold more reserves, relative to loans. However, the asset side of their balance sheet consists not only of reserves and Euro-dollar loans, but also loans in other currencies and other short-term instruments acquired through other capital markets. Euro-banks would try to increase holdings of these assets, though there may be no measured increase in assets categorized as reserves. The extent to which higher interest rates in other markets induce a switching from Euro-dollar loans to other assets should ideally be reflected in the leakage ratio. We can summarize the endogenization of the reserve ratio as:

\[
3.8) \quad r = r(i_e, i_s), \quad \partial r / \partial i_e < 0, \quad \partial r / \partial i_s > 0: \quad \text{where } r \text{ is the reserve ratio and } i_e \text{ and } i_s \text{ are defined as before.}
\]

We now examine the behavior of the Euro-dollar multiplier when either the Euro-dollar or some other money-market rate changes. Combining 3.6), 3.7) and 3.8) produces:

\[
3.9) \quad e = 1/(r(i_e, i_s) + c(i_e, i_s)) = e(i_e, i_s).
\]
A change in the Euro-dollar rate, \( i_e \), relative to other rates, \( i_s \) has the following effect on \( e \):

\[ 3.10) \frac{\partial e}{\partial i_e} = \frac{3}{2} \left( \frac{1}{(r+c)^2} \right) (r_i^e + c_i^e) > 0. \]

That is, a change in the Euro-dollar rate changes the Euro-dollar multiplier in the same direction. A change in other short-term rates, \( i_s \), has the opposite effect on \( e \):

\[ 3.11) \frac{\partial e}{\partial i_s} = \frac{3}{2} \left( \frac{1}{(c+r)^2} \right) (c_i^s + r_i^s) < 0. \]

This demonstrates two unambiguous effects of interest-rate movements on the Euro-dollar multiplier. Given the elasticities of the \( c \) and \( r \) ratios with respect to the two interest rates, one could presumably predict accurately the effect of changes in various money-market rates on the volume of Euro-dollar deposits. However, a more realistic examination of the market illustrates the shortcomings of such a model.

The above change (\( \frac{\partial e}{\partial i_e} \)) in the multiplier can be termed an "internal effect" of an interest-rate change, since it represents the portfolio adjustments of Euro-banks and the public. More precisely, foreigners now switch some of their dollar holdings (currency) into Euro-dollar deposits that pay a new and higher yield. (Note that in an uncertain world, the theory of portfolio diversification implies only some funds are switched, i.e., there is only partial stock adjustment.) In addition, Euro-banks, now faced with higher holding costs, desire smaller reserves. Both effects increase the value of the multiplier.

This multiplier model, however, does not permit us to examine the entire effect of a change in Euro-dollar or other short-term rates on total Euro-dollar deposits. The reason is that the Euro-dollar "base" is not an exogenous, controllable magnitude as in domestic money models.
Instead, the Euro-dollar "base" responds to such economic variables as interest rates, just as the parameters of the multiplier do. The base, in a broader sense, responds to the whole constellation of interest rates, spot and forward exchange rates that affect international capital flows. In a very real sense, then, the Euro-dollar "base" is determined by the portfolio and trade decisions of U.S. residents. Let us examine this concept in greater detail.

The Euro-dollar "Base"

As we termed the change in the multiplier due to changes in interest rates an "internal effect", we similarly label the effects generating changes in the base as "external." These changes result from portfolio adjustments made by the suppliers of the Euro-dollar base. The stated increase in the Euro-dollar rate induces a flow of funds into the Euro-dollar market from several sources. First, holders of foreign short-term money-market instruments now have a stronger incentive to convert non-dollar-denominated assets into Euro-dollars. This increases dollar claims on the U.S. and, hence, increases the base. Second, some U.S. residents may now wish to increase Euro-dollar holdings at the expense of their holdings of Treasury bills, CD's, time or demand deposits, or other short-term dollar-denominated assets. This, too, increases in the base as previously defined. These "external" effects should influence the size of the Euro-dollar market as measured by deposit volume. (Note that we did not mention the switching to Euro-dollars by foreign dollar holders for that is an "internal" effect captured in $\delta e/\delta \hat{e}$.) Consequently, even this more sophisticated
multiplier model in which the interest-rate effects on the multiplier are included does not adequately explain the impact of fluctuations in interest rates on Euro-dollar deposits. Neglect of these changes simultaneously occurring in the "base" could result in important misinterpretations of the multiplier.

To illustrate this point more clearly, consider an alternative formulation of the multiplier model. Equations 3.1) through 3.8) describe the basic model in which the reserve and currency ratios depend upon interest rates both in the Euro-dollar market and other short-term money markets. (Notice we ignore some of the difficulties that are discussed below in defining the base.) To this system a behavioral equation that demonstrates the impact of interest-rate changes on the base is added. That is, let:

3.8a) \[ B = B(i_e, i_s, \alpha), \text{ and that } \partial B/\partial \alpha = 1, \]
\[ \partial B/\partial i_e \geq 0; \partial B/\partial i_s \leq 0. \]

Here \( \alpha \) represents some autonomous shift parameter. Once again, total Euro-dollar deposits (E) are related to some base (B) by the expression:

3.9a) \[ E = (1/c+r) \cdot B. \]

We now examine the impact of an autonomous increase in the Euro-dollar base on total Euro-dollar deposits. Assume, for simplicity, that \( \partial i_d/\partial \alpha = 0. \) Thus, we have:

3.10a) \[ \frac{dE}{d\alpha} = \left( -1/(c+r)^2 \right) \left( c_i + r_i \right) (\partial i_e/\partial \alpha) + (1/c+r) \]
\[ \left( B_a + B_i e \right) \frac{\partial i_e}{\partial \alpha}. \]

The impact of this shift depends on its effect on Euro-dollar rates \( \partial i_e/\partial \alpha. \) Consider the results under three different assumptions.

Case 1. Suppose that the increase in the supply of Euro-dollars, represented by \( \partial \alpha, \) has no impact on the Euro-dollar rate, i.e.,
\[ \frac{di_e}{d\alpha} = 0, \]  
(the demand for Euro-dollars is perfectly elastic). This is the implicit assumption made in the simple multiplier models. Equation 3.10a) then simply becomes:

3.10b) \[ \frac{\partial E}{\partial \alpha} = \frac{1}{c+r}, \]  
since \( B_\alpha = 1 \). This represents the "normal" result that an autonomous increase in the base increases Euro-dollar deposits by the amount of the multiplier.

Case 2. Now assume the more realistic possibility that \( \frac{di_e}{d\alpha} < 0 \). That is, an autonomous increase in the Euro-dollar base lowers the Euro-dollar rate somewhat. Assuming that the base is not responsive to interest-rate changes, i.e., \( B_{ie} = 0 \), produces:

3.10c) \[ \frac{\partial E}{\partial \alpha} = \frac{-1}{(c+r)^2} \left( c_i + r_{ie} \right) \frac{\partial i_e}{\partial \alpha} + \frac{1}{c+r} B_\alpha. \]

Since the first term is unambiguously negative, the impact of this shift is less than that given by the fixed multiplier approach, i.e., \( \frac{dE}{d\alpha} < \frac{1}{c+r} \).

Case 3. Now suppose that \( B_{ie} > 0 \), and again \( \frac{di_e}{d\alpha} < 0 \). This produces:

3.10d) \[ \frac{\partial E}{\partial \alpha} = \frac{-1}{(c+r)^2} \left( c_i + r_{ie} \right) \frac{\partial i_e}{\partial \alpha} + \frac{1}{c+r} \left( B_\alpha + B_{ie} \frac{\partial i_e}{\partial \alpha} \right). \]

The first bracketed term is negative while the second bracketed term is less than 1. Here both influences reduce the impact of the shift which is clearly less than \( 1/c+r \) and less than that in Case 2. This demonstrates that even a model that incorporates the interest-rate impact on the parameters \( c \) and \( r \) may not predict accurately the structural path of Euro-dollar deposits.

Essentially the empirical difficulties posed by the multiplier model center on the definition and treatment of the Euro-dollar base.
Ideally, the base should include those elements that will generate an expansion, through a multiplier, of Euro-dollars. Most authors have defined the base as the sum of claims on the U.S. by foreigners. However, this approach has some important deficiencies. To highlight these pitfalls consider: What funds represent potential Euro-dollars? Is it only foreign claims on the U.S.? We saw earlier that a U.S. resident (especially corporations) may elect to draw down their own deposits with U.S. banks and channel the proceeds into Euro-dollar deposits. (Limitations on capital flows by the U.S. government probably have limited the extent of these transfers.) This simultaneously produces a dollar claim on the U.S. and a "primary" Euro-dollar deposit. But a U.S. demand deposit had "potential" to become a Euro-dollar deposit before it became a foreign dollar claim. In a very real sense then any U.S. dollar has the potential to become a Euro-dollar and could be included in the base. While this treatment is certainly less than desirable, it illustrates some difficulties in defining the base. In addition, the difficulty in accurately defining the Euro-dollar base raises the issue of what part Euro-dollar deposit growth is due to changes in the base or primary deposits and what part is attributable to a multiple expansion process. Makin [43] attempts to account for this distinction and estimates that about 40 percent of deposit growth is attributable to the "multiplier process" and the remainder due to "new deposits." However, his definition of the base neglects the elements of the potential base as consisting of any U.S. dollar. Further, in adjusting for growth attributable to a Euro-dollar multiplier, Makin considers only the falling reserve ratio over time. As Makin's base is
simply Euro-dollar reserves, it is apparent that he has not dealt specifically with these definitional problems.

Finally, other authors [31, 50], have focused on different problems posed by a multiplier approach. Hewson and Sakakibara 31 stress the absence of institutional constraints that Tobin, for one, claims are requisite for giving a multiplier model validity. Without mandatory reserve requirements, interest-rate ceilings and the like, a multiplier model is inappropriate. Their contention, then, is that an alternative model focusing upon the intermediary functions of the Euro-dollar market is preferable. Niehans and Hewson [50] argue persuasively that little liquidity creation takes place in the Euro-dollar market. Liquidity creation requires a maturity transformation from short-term liabilities to longer-term assets, but the maturity-matching by Eurobanks argues against this kind of transformation. (Refer to Table 2.1.)

This chapter has underscored the kinds of empirical problems associated with any measured Euro-dollar multiplier. If much of the growth of Euro-dollar deposits has come from U.S. deposits or other liabilities that are converted into primary Euro-dollar deposits the measured multiple expansion will have been biased in an upward direction. These portfolio changes do not add to world liquidity. It seems, then, that most existing evidence on the Euro-dollar multiplier contains this upward bias. Conclusions that the calculated multipliers indicate an important independent liquidity creating role for the market are questionable. Since the empirical evidence is rendered inconclusive by the arguments made here and since Niehans and Hewson have provided a theoretical basis for challenging this "creation" of world liquidity,
it would appear that Euro-dollar deposit expansion does not importantly contribute independently to world liquidity.

Summary

The question of whether or not Euro-banks create world liquidity must be faced if one wishes to examine the market's impact on monetary policy actions. Discussion in the academic literature has focused on the extent of Euro-dollar creation, using the framework of a traditional fixed-coefficient multiplier. The logical extension of this framework is to endogenize the reserve and redepositing decisions of market participants. While this chapter has presented such an extension, this "improvement" only highlights the weaknesses of the multiplier approach as it applies to Euro-dollar creation. Specifically, the multiplier model assumes the legitimacy of an analogy to deposit creation by commercial banks. This analogy is unjustified for two important reasons. First, a meaningful and distinctive concept of a controlled Euro-dollar base does not exist. This means that we cannot distinguish empirically Euro-dollars created through the deposit-expansion process from those that are primary deposits (the base). This is true because any meaningful interpretation of the base has to recognize that it too depends on interest rates. Failure to deal with the distinction between primary and created deposits has probably been the most important reason for the wide range of estimates of the size of the "multiplier."

The second reason for the breakdown in the analogy has been emphasized by Hewson and Niehans [50]. As Chapter II stresses, the Euro-dollar market began, developed, and continues to expand because of
the important intermediary function it serves. Emphasizing this view of the market forces us to focus, as in [50], on the asset and liability structure of the market. Niehans' and Hewson's argument seems persuasive that such a focus would give us little reason to expect significant liquidity creation.

The multiplier analogy seems a weak one for analyzing independent liquidity expansion in the Euro-dollar market. The Euro-dollar market, now viewed perhaps as a non-bank financial intermediary (like a giant savings-and-loan association for wholesale funds), may, however, affect world liquidity indirectly through its impact on the portfolio decisions of economic units within the domestic banking system. Chapter IV considers just such a problem.
FOOTNOTES TO CHAPTER III

1Using Lee's own figures, the true Euro-dollar deposit multiplier, \(1/c+r\), would have been even smaller.

2Makin [43, p. 384], in a footnote correctly indicates that branch bank claims on home offices should not be treated as precautionary reserves but are more appropriately viewed as loans to home offices.

3Lee [40] even argues that in a way the entire U.S. banking system may function as a central bank for the Euro-dollar market.

4While there is no formal link between the Euro-dollar market and any central bank, many Western central banks have taken an active role in trying to assure solvency for the market. Concern over financing problems associated with the Arab oil embargo, led many central banks to provide de facto support for the market, assuring the world that they stood ready to provide short-term credit if necessary. For instance, the U.S. Federal Reserve assured "that means are available for provision of temporary liquidity and will be used if and when necessary." [22, March 1974, p. 148].

5Note that if the central bank bought its own currency from another foreign central bank or the IMF, leakages would depend on the actions of that central bank and may be zero, partial, or complete.

6Hewson and Sakakibara [29, p. 315] cite this constant margin and the assumption that Euro-banks are "pure financial intermediaries" as implying "that the reserve holdings of Euro-banks are negligible." Neither of these assumptions warrants this implication. Other pure financial intermediaries, also earning a constant margin between deposit and loan rates but faced with less certainty about deposit withdrawals, would certainly hold more than negligible reserves.

7"Normal," in this context, simply means a differential large enough to cover all the relevant costs of intermediation.

8Jane Little [41] has cited the narrowing of this differential over time as evidence of increased competition in the market. An alternative explanation exists that rests on the assumption of an initially competitive market. The Appendix to this chapter argues for a declining reserve ratio as the market grows. Empirical evidence (see Makin [44]) supports this view. Holding precautionary reserves is
a cost of intermediation and the need for lower levels of these reserves lowers this cost, which in turn implies a narrower differential.
APPENDIX 3.1

Makin [44] determines the optimal level of precautionary reserves by applying a model first developed by Whalen [58]. Makin's approach leads to the implication that economies of scale in the Euro-dollar market produce a declining reserve ratio over time and, ceteris paribus, an increasing multiplier. While his approach may have greater empirical applicability, our more general model attempts to isolate the underlying source of these scale economies by including many specific features of the Euro-dollar market. Our model draws heavily upon a recent article by Baltensperger [3] in which specific attention is given to the economics of planning and information. His approach, by including the costs of gathering information about expected disbursements, permits a reassessment of the inventory-theoretic models of reserve demand. In previous models elasticities of demand for reserves with respect to a scale variable such as the number of transactions are predicted to be between 1/3 and 1/2. Baltensperger's model, by specifically including information costs, estimates scale elasticities that are greater than one-half and in fact, under special circumstances approach unity, as predicted in a Classical quantity-theory model. This appendix adapts his model to reflect some of the specific features of the Euro-dollar market.

Optimal precautionary reserves held by Euro-banks can be
determined by minimizing a cost function that identifies three types of costs. These costs include: a) the opportunity cost of holding reserves; b) the cost (expected) of acquiring additional reserves should the initial level prove inadequate; and, c) the cost of gathering information. Before specifying this cost function we need to establish some preliminary groundwork.

Let $X$ represent net demand for reserves and $\phi(X)$ the density function of $X$. $\phi(X)$ is normally distributed with mean $E(X) = 0$, and variance $\sigma^2(X)$. Now assume that:

A3.1) $\sigma^2(X) = g(u,T) T$, $\partial g/\partial u < 0$ $\partial g/\partial T < 0$

$\partial^2 g/\partial u^2 > 0$ $\partial^2 g/\partial T^2 > 0$

Here $T$ represents the number of transactions and $u$ reflects the amount of investment in information that is undertaken. This expression permits the possibility that total uncertainty, $\sigma^2(X)$, may not vary in proportion to $T$. This treatment is desirable in the specific case of the Euro-dollar market since Euro-dollar deposits are not demand deposits but are most appropriately viewed as a type of near-money. In addition, an important reason offered for the growth of the market has been the ability of Euro-banks to tailor the maturities of assets and liabilities to specific customer needs. Hence, while more transactions conducted in the Euro-dollar market may increase uncertainty about receipts and disbursements, that uncertainty need not increase in proportion since some information about reserve needs is created as a by-product of Euro-banks' production of assets and liabilities.

The assumptions about the partials of $g(u,T)$ reflect diminishing returns (in reduced uncertainty) from information gathering. Decisions
about u, as this theory suggests, depend on the costs of acquiring information and also on the amount of information already "embodied" in the asset in question. Euro-banks can reduce uncertainty about deposit withdrawals in two ways. First, the deposit maturities are often contractually fixed when the deposit is received. This can be considered a direct acquisition of information. A second means by which uncertainty can be reduced is more indirect. Familiarization with particular depositors and particular liabilities also lowers uncertainty and more transactions increase this familiarization. As Euro-banks experience growth in dollar deposits their familiarization with the new liability grows.

The rest of the model is taken directly from Baltensperger.

The cost function is:

A3.2) \[ C = hR + \int_{R}^{\infty} \phi(X) \, dX + w \, u \, T. \]

The first term on the R.H.S. of A3.2) is the opportunity cost of holding some level of reserves (R), where h is assumed constant. We could approximate h with the Euro-dollar loan rate. The second term represents the expected cost if R proves deficient. The unit replacement cost, p, (approximated by some U.S. money market rate, e.g., the Federal Funds rate or the U.S. CD rate), is assumed constant for simplicity. The third term, w u T, is the cost of gathering information where u is the resources per transaction and w, the price of those resources.

As with Baltensperger, let us standardize for R and X such that b = R/σ(X) and x = X/σ(X). This transformation of variables gives:

A3.3) \[ C = \sigma(x) \left[ hb + \int_{b}^{\infty} p(x-b) \, f(x) \, dx \right] + w \, u \, T \]
Let $\gamma = h_b + \int_b^c p(x-b) f(x) \, dx$

Thus:  \[ A3.4 \]  $C = \sigma(x) \gamma + w u T$

or, \[ A3.5 \]  $C = [g(u,T)T]^{1/2} \gamma + wuT$,  

where $f(x)$ is the standard normal distribution. Optimizing with respect to $b$ and $u$ gives:

\[ A3.6 \]  $\frac{\partial C}{\partial b} = 0 = \frac{[g(u,T)T]^{1/2}}{h - \int_b^\infty f(x) \, dx}$

and:\[ A3.7 \]  $\frac{\partial C}{\partial u} = 0 = \frac{1/2\gamma T^{1/2}}{g(u,T)^{-1/2}} \left( g_u + wT \right)$

where $g_u = \partial g/\partial u$, and $\partial \gamma/\partial u = \partial T/\partial u = 0$.

First order conditions imply that $b$ and $u$ must satisfy $A3.6$ and $A3.7$ such that:

\[ A3.6a \]  $h/p = \int_b^\infty f(x) \, dx$

\[ A3.7a \]  $g_u = -\frac{2w T^{1/2}}{\gamma} g(u,T)^{1/2}$

That is, precautionary reserves will be held such that the amount of reserves results in the equality of the probability density function of a reserve shortage and the ratio of the opportunity cost and restoration cost. The bracketed term on the right side of $A3.6$ represents the marginal benefit of investing in information, while the second is the marginal cost of acquiring information. In Baltensperger's model an increase in $T$ leads to a reduction in the marginal benefit (from increasing $u$), relative to marginal cost. The same is true of $A3.7$ except that the reduction in marginal benefit here is greater than the reduction in marginal benefit in the Baltensperger model. If the $g(u,T)$ function is such that an increase in $T$ results in a less-than-proportional increase in total uncertainty, the increase in precautionary balances of Euro-banks resulting from the scale variable $T$ may
be smaller than in Baltensperger's model. To show this we derive the elasticity of $R$ with respect to $T$. Here $T$ can be thought of as approximating the size of the Euro-dollar market. If Euro-dollar deposits vary directly with $T$, then a unitary elasticity implies a constant $r$-ratio, while an elasticity less than 1 implies a falling $r$-ratio as the market grows. This in turn, suggests that, holding $c$ constant, the Euro-dollar multiplier is increasing with deposits volume. Makin generated this result using a specific form for the density function. Because the present approach specifically includes the influence of information into the model, it represents a more general approach. Still the effect on $R$ is determined by the elasticity of $R$ with respect to $T$ which we yet need to formulate.

From an earlier definition:

$$A3.8) \quad R = b \sigma(X) = b \left[g(u,T)T\right]^{1/2}$$
or in log form:

$$A3.9) \quad \log R = \log b + 1/2 \left[\log g(u,T) + \log T\right].$$

Taking the derivative of $A3.9)$ with respect to $\log T$ gives the elasticity of demand for reserves with respect to $T$:

$$A3.10) \quad \frac{d\log R}{d\log T} = \frac{d\log b}{d\log T} + 1/2 \left[\frac{d\log g}{d\log T} + 1\right]$$

But $\frac{d\log b}{d\log T} = 0$ ($b$ is a parameter depending on $h$ and $p$ but not on $T$). That is $R$ adjusts to changes in $\sigma^2(x)$ so that $b\epsilon$ is satisfied. If the sign of $\frac{d\log g}{d\log T}$ is positive we find the elasticity of $R$ to be greater than $1/2$, while a negative value of $\frac{d\log g}{d\log T}$ would serve to lower the elasticity below $1/2$. Closer examination shows:

$$A3.11) \quad \frac{d\log g(u,T)}{d\log T} = \frac{g_T \cdot T}{g(u,T)} < 0$$
This is a plausible situation if an increase in T increases the information about the asset. If on the other hand \( \frac{du}{dT} \) is negative, the elasticity becomes ambiguous, but is still likely to be less than unity if \( \frac{du}{dT} \) is algebraically small. The sign of \( \frac{du}{dT} \) is determined by the form of \( g(u,T) \) which ought to reflect the special features of the Euro-dollar market and should therefore allow for the probable economies of scale in that market. This demonstrates in a more general framework than Makin's, that a declining r-ratio as the Euro-dollar market grows is a reasonable expectation.
CHAPTER IV

THE EURO-DOLLAR'S IMPACT ON THE
U.S. MONEY SUPPLY

Introduction

In Chapter III it was argued that the Euro-dollar market has probably had little direct impact on total world liquidity. Both theoretical and empirical considerations mitigate against the use of a multiplier analysis to evaluate the direct expansion of world liquidity through the unregulated market. An unresolved question remains. Does the Euro-dollar market have an indirect effect on world liquidity through its impact on domestic money supplies? Activity in the Euro-dollar market may, like activity in domestic savings and loan markets, affect the U.S. money supply. In this chapter we present a multiplier model that attempts to deal with this question. The multiplier model incorporates the potential effect of Euro-dollar activity on the U.S. money supply process. If this activity does affect the U.S. money supply, the Fed may find it more difficult to achieve targeted money supply growth rates. The model that follows serves as the foundation for considering the interaction between the U.S. money supply process (including policy-actions) and activity in the Euro-dollar market.
A Statement of the Problem

The model presented in this chapter is used to analyze the effectiveness of U.S. monetary policy actions under differing sets of initial conditions. One might expect the Euro-dollar market to exert different effects on policy targets under a "tight-money" regime than under an "easy-money" regime. For instance, a number of authors have argued that access to the Euro-dollar market enables some banks to avoid some consequences of contractionary monetary policy. That is, these banks can offset some policy-generated loss of liabilities, thereby avoiding some consequences of contractionary policy. If many banks are able to offset the contractionary policy, the Fed's control over credit-conditions may be seriously hampered. While this possibility has long been recognized, there has been little effort made to examine the specific conditions under which policy may be impaired. Before presenting the model, let us briefly describe the kind of problem to be analyzed.

This chapter examines the question: What, if any, effect does the Euro-dollar market have on the U.S. money supply process? Probably the most extreme effect occurs under tight money conditions. Suppose that the Fed desires to slow the growth of the money stock ($M_1$, $M_2$ or $M_n$), choosing as its target some measure of the growth of the monetary base. Attempting to slow the growth of $M$, the Fed sells securities on the open market. Initially bond prices fall, raising their yields. Private wealth holders and banks, attracted to these lower-priced, higher-yielding assets, reduce their holdings of money (deposits), foreign bonds and money, and Euro-dollar balances. In the absence of
governmentally imposed restrictions, all interest rates rise to establish new equilibrium levels. This process briefly outlines the results of a general-equilibrium model developed by Hewson and Sakakibara [31, 32]. In addition, it indicates a reduction in money balances where money is measured by the deposit liabilities of the three banking sectors in the general-equilibrium model. Permitting substitutable assets for domestic dollar deposits (viz., Euro-dollar deposits), implies that a given U.S. policy action produces a larger contraction of the money supply than if the Euro-dollar market did not exist.

This analysis is more complicated when there are interest-rate ceilings or other price controls. For instance, Regulation Q ceilings, when effective, and the prohibition of explicit interest payments on demand deposits, may prevent an upward adjustment of U.S. deposit rates. As a result, U.S. banks may face larger reductions of liabilities such as CDs than without the controls. Further, the existence of closely substitutable but largely unrestricted dollar assets (Euro-dollars), may intensify this liability attrition. But this is only part of the story. U.S. banks, faced with this loss of liabilities, find it increasingly difficult to grant profitable loans. Some amount of the banks' business, however, is considered "crucial" to the future profitability of the bank. Banks resist, if possible, the accompanying reduction in their loan portfolios, especially those of their favored customers and may try to replace lost deposits with non-deposit liabilities. In recent years, some U.S. banks have been able to offset some of these deposit losses by borrowing Euro-dollars. This Euro-dollar borrowing may offset some of the previous drain to the Euro-
dollar market. The net result is uncertain. However, Euro-dollar borrowing can be viewed as an auxiliary source of base money to the U.S. banking system. Hence, there may be an additional expansion of U.S. money as a result of this borrowing. The upshot is that the initial contraction of the base (by the Fed), may be offset by changes in the multiplier through both domestic interest-rate and Euro-dollar effects. Consequently, if the Fed engages in policy actions aimed at a given growth rate in $M_s$, sets the level for the base accordingly, but ignores possible feedback effects on the multiplier from the Euro-dollar market its actions may be frustrated. The model that follows attempts to assess the influence of Euro-dollar borrowing and depositing on the U.S. money supply process.

The Model

The model presented here draws extensively from earlier work by Karl Brunner and Allen Meltzer, Albert Burger, and others. The model extends Burger's analysis to incorporate influences from the Euro-dollar market. The U.S. monetary base ($B$), defined in terms of its uses, is:

4.1) \[ B = R + C_p \]

(All terms and symbols used throughout this chapter are defined in Table 4.1.) From the sources side of the monetary base we have:

4.2) \[ B = B_a + A + (ED_B - ED_p) \]

Several important facts need to be emphasized at this juncture. The term $B_a$ represents the net sources base exclusive of any Euro-dollar influences. Of course, such a term cannot be measured, since the measured net sources base already contains Euro-dollar effects through
Table 4.1. Definitions of Symbols Used

**Aggregate Variables**

- $B_a$: net sources base of the U.S. money stock including Euro-dollar borrowing
- $R$: total bank reserves
- $R_r$: required reserves of member banks
- $R_e$: excess reserves of member banks
- $A$: discounts and advances from the Fed
- $C_p$: currency held by the public
- $D_p$: total private demand deposits
- $D_m$: demand deposits of member banks
- $D_t$: demand deposits of U.S. Treasury
- $T$: total time deposits at commercial banks
- $T_m$: time deposits at member banks
- $E_{DB}$: Euro-dollar borrowings of U.S. banks
- $E_{DG}$: Euro-dollar deposits held by U.S. residents

**Ratios**

- $r$: aggregate reserve ratio
- $v$: vault cash ratio
- $e$: excess reserve ratio
- $\delta$: ratio of demand deposits at member banks to total demand deposits
- $T$: ratio of time deposits at member banks to total time deposits
- $\beta$: Euro-dollar borrowing ratio
- $b$: ratio of borrowing at Fed to total liabilities
Table 4.1. Definitions of Symbols Used (Cont'd)

Ratios

\( \alpha \) -- ratio of Euro-dollar deposits held by U.S. residents to total demand deposits

\( r_D \) -- required reserve ratio for demand deposits

\( r_t \) -- required reserve ratio for time deposits

\( r_B \) -- required reserve ratio against Euro-dollar borrowing

\( k \) -- ratio of currency held by the public to total demand deposits

\( t \) -- ratio of total time deposits to total demand deposits

the factors affected by the official U.S. balance-of-payments position. The difference \((ED_B - ED_D)\) represents the potential maximum Euro-dollar effect on the base. That is, \((ED_B - ED_D)\) represents the net U.S. balance-of-payments position (on a net liquidity basis) owing to the Euro-dollar market. The U.S. monetary base, however, is only affected by the official settlements deficit (or surplus). Consequently the actual impact of Euro-dollar activity on the base is depends on the extent to which Euro-dollar borrowing and depositing produces official claims (or liabilities) of the central banks.

To illustrate this point, consider the following transactions. Let NYB, EB, FCB and FR designate the U.S. banking system (or equivalently a monopoly U.S. bank); the Euro-dollar bank; the foreign central bank and the U.S. Federal Reserve bank, respectively. The initial T-account for NYB is:

<table>
<thead>
<tr>
<th>NYB</th>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reserves (RUS)</td>
<td>Deposits of U.S. Residents (D-US)</td>
</tr>
<tr>
<td></td>
<td>Loans (LUS)</td>
<td>Deposits of Foreigners (D-F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CDs of U.S. Residents (CD-US)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Euro-dollar borrowing (EDB)</td>
</tr>
</tbody>
</table>

Suppose a U.S. resident now transfers $X from his NYB, CD account to EB. The T-accounts are now changed as follows:
Clearly this transaction affects neither the U.S. base nor total liabilities of NYB. It only results in a change of ownership of U.S. deposit-liabilities. Now suppose EB lends the $X paying the borrower with a check drawn on NYB. Here NYB's deposits have declined. If $X is eventually redeposited in EB (or another Euro-dollar bank), EB will increase its reserves by $DF and NYB's final liability position is unchanged. Likewise, NYB's final position is unaffected if the $X loan is redeposited in NYB. Only if the $X is presented to FCB for conversion to the domestic currency and FCB presents its $X to FR (the Fed) is there a reduction in the U.S. base.

A similar argument holds for Euro-dollar borrowing. Only EDB formerly held as some foreign currency (or gold, SDRs or non-dollar reserve asset) directly affects the U.S. base.

This discussion emphasizes that the model presented here analyzes the maximum possible impact of the Euro-dollar market on the U.S. money supply process. As discussed shortly, the minimum impact of the Euro-dollar market on the U.S. money supply process is embodied in the freeing of member-bank reserves (due to differential reserve ratios) when banks substitute Euro-dollar borrowing for lost deposits.
The Fed is hypothesized to control the net sources base \( (B_a) \) through open market operations. The Fed's holdings of government securities account for the bulk of \( B_a \). Rearranging equations 4.1) and 4.2) produces:

\[
4.3) \quad B_a = R + C_p - A - ED_B + ED_D
\]

The expression for Euro-dollar borrowing \( (ED_B) \) represents a source of monetary base growth that is, for the most part, uncontrolled by the Fed. Of course, the Fed can exert some indirect control over Euro-dollar borrowing through its capital controls and reserve requirements (Regulations D and M), against this liability. Further, the Fed may sterilize changes in \( ED_B \) with sales (or purchases) of government securities. If \( ED_B = ED_D \), the net potential effect of the market on the U.S. base is zero. As discussed shortly, however, even this does not justify the inference that the Euro-dollar market's effect on the U.S. money supply is non-existent.

The U.S. money supply (here represented by \( M_1 \)), is related to the monetary base by some multiplier, \( (m_1) \):

\[
4.4) \quad M_1 = m_1 B_a
\]

\[
M_1 = D_p + C_p
\]

We must now derive the expression for \( m_1 \).

**Member Bank Borrowing:** At the Discount Window and the Euro-dollar Market.

Borrowing from the Fed represents an avenue for member banks to use when confronted by short-term liquidity problems such as a reserve deficiency. It is presumed that banks do not borrow from the Fed in order to increase holdings of earning assets (i.e., profiting from a
favorable spread between market rates and the discount rate). The flow of borrowing from the Fed is described by a ratio to total bank liabilities:

\[ A = b(D_p + D_c + T + ED_B) \]

The ratio, \( b \), depends upon both \( i_s \), the interest rate (on earning assets), and \( \rho \), the cost of borrowing. Note that \( R \) embodies not only the explicit discount rate but also the administrative costs of borrowing imposed on banks. These administrative costs relate to the extent of "surveillance" the Fed imposes on member banks. These relationships are given by:

\[ b = f(i_s, \rho); \ 3b/3i_s > 0 \text{ and } 3b/3\rho < 0. \]

A thorough discussion of the interaction among \( b, i_s, \) and \( \rho \) is deferred to a later section.

U.S. banks borrow Euro-dollars to meet reserve deficiencies or to provide longer term permanent financing. Designate the Euro-dollar borrowing as a ratio to total demand deposits of the public:

\[ ED_B = \beta(D_p). \]

The Euro-dollar borrowing ratio (\( \beta \)), depends on several variables. Increases in the rate banks receive on earning assets (\( i_s \)) are assumed to increase U.S. banks' demand for Euro-dollar borrowings, while increases in the Euro-dollar loan rate (\( i_E \)), discourage borrowings. When banks face deposit losses due to Regulation Q ceilings, the Euro-dollar market may become a more important source of liabilities. These funds enable banks to continue satisfying loan requests of valuable customers. Without these funds, banks may have to reject such requests and damage valuable customer relationships. Euro-dollar borrowing also
varies inversely with the reserve requirements against such borrowing.
Higher reserve requirements raise borrowing costs and require an even larger spread between the rates on earning assets and borrowed funds for banks to profit by such sections. In other words, reserve requirements raise the actual interest cost, by lowering the amount of "usable" funds. Algebraically this effect on the true borrowing cost is given by:

\[ i_a = i_n/(1-r) \]

where \( i_a \), \( i_n \) and \( r \) represent the actual (or realized) rate, the nominal interest rate, and reserve requirement, respectively.

Finally, Euro-dollar borrowing to meet reserve deficiencies is more attractive the higher is the discount rate and/or "surveillance" costs of the Fed. Summarizing the foregoing discussion gives:

\[ \beta = (i_s, i_E, Q, \rho, r_\beta) \]

where

\[ \frac{\partial \beta}{\partial i_s}, \frac{\partial \beta}{\partial \rho}, \frac{\partial \beta}{\partial Q} > 0; \frac{\partial \beta}{\partial r_\beta}, \frac{\partial \beta}{\partial i_e} < 0. \]

(Here \( Q \) designates some measure of the restraint on interest-rates when Regulation Q ceilings are effective.)

The Euro-dollar Deposit Ratio

Euro-dollar deposits by U.S. residents are included in the model through the term \( ED_D \). U.S. wealth holders are assumed to desire some ratio (\( \alpha \)), of Euro-dollar deposits to private demand deposits (\( D_p \)):

\[ ED_D = \alpha D_p. \]

The Euro-dollar deposit ratio (\( \alpha \)), depends on such economic variables as U.S. earning-asset rates, U.S. deposit rates, wealth and Euro-dollar rates. (For expositional convenience Euro-dollar loan and deposit rates
are both represented by \(i_E\). We have then:

4.11) \( \alpha = f(i_s, i_t, i_E, W) \) where

\[
\begin{align*}
\frac{\partial \alpha}{\partial i_s} &\leq 0, \\
\frac{\partial \alpha}{\partial i_t} &< 0, \\
\frac{\partial \alpha}{\partial i_E} &> 0, \\
\frac{\partial \alpha}{\partial W} &> 0
\end{align*}
\]

The ambiguity of \(\frac{\partial \alpha}{\partial i_s}\) occurs because an increase in \(i_s\) serves to reduce both desired \(E_D\) and \(D_p\). Assuming that (for equal U.S. and Euro-dollar rates) U.S. wealth holders prefer holding U.S. assets to Euro-dollar assets and that higher U.S. rates induce a greater reduction in Euro-dollar deposits (by U.S. residents) than in domestic deposits, implies \(\frac{\partial \alpha}{\partial i_s} < 0\). These assumptions are maintained throughout the chapter.

**Currency**

Currency held by the public \((C_p)\) is expressed as some proportion of total demand deposits:

4.12) \( C_p = c D_p \).

This ratio depends upon a number of economic variables including the yield on earning assets, \((i_s)\), deposits, \((i_D)\), the service charge associated with maintaining deposits \((S)\), and nominal wealth \((W)\).

While Burger includes additional variables such as population mobility and seasonal factors, these variables are not important to the present analysis. The functional dependence of the \(c\)-ratio is expressed as:

4.13) \( c = f(i_D, i_s, W, S) \) and

\[
\begin{align*}
\frac{\partial c}{\partial i_D} &< 0, \\
\frac{\partial c}{\partial S} &> 0, \\
\frac{\partial c}{\partial i_s} &> 0, \\
\frac{\partial c}{\partial W} &\geq 0.
\end{align*}
\]

Changes in yields on earning assets, and wealth have ambiguous effects on the \(c\)-ratio, since the \(c\)-ratio combines the influence of changes in both \(C_p\) and \(D_p\). Increases (decreases) in asset yields reduce (increase)
the public's holdings of both kinds of liquid assets (deposits and currency). The net effect on \(c\) depends on the relative interest rate response of \(C_p\) and \(D_p\). Burger [12, p. 94] assumes currency holdings \((C_p)\) to be independent of interest rates. Under this assumption, \(\partial c/\partial i_s > 0\), since the interest-rate effect on \(D_p\) dominates. The less restrictive assumption that demand deposits respond more quickly (than currency) to changes in rates on earning assets produces a similar result. As Burger notes [12, p. 94], empirical studies support the assumption of a positive relationship between \(c\) and interest rates.

While it seems reasonable to assume, \(\partial c/\partial W < 0\), these wealth effects are ignored in our essentially short-run analysis.

**Reserves**

Reserves for the banking system are defined by the identity:

4.14) \(R = R_R + R_E + V\).

Following Burger, \(V\) is included in an effort to identify reserves for the entire banking system and not only those of member banks. Expressing excess reserves and vault cash of non-member banks as ratios of total bank liabilities, gives:

4.15) \(R_E = e(D_p + D_t + T + ED_B)\) and

4.16) \(V = v(D_p + D_t + T + ED_B)\).

Required reserves \((R_R)\) consist of the reserves required under Federal Reserve Regulations D and M against each separate category of bank liability, including Euro-dollar borrowings. These required reserves are given by:

4.17) \(R_R = r_D \cdot D_m + r_t \cdot T_m + r_B \cdot ED_B\).
Following Burger [12, pp. 25-26], we rewrite 4.17) as:

4.18) \( R_R = r_D \left( \frac{D_m}{D_p+D_t} \right) (D_p+D_t) + r_t (T_M/T) + r_\beta \cdot E_DB \)

Let \( \delta = \frac{D_m}{D_p+D_t} \), \( T = \frac{T_M}{T} \),
define the share of total demand and time deposits, respectively, held
at member banks. Substituting these terms into 4.18) produces:

4.19) \( R_R = r_D \cdot \delta (D_p + D_t) + r_t \cdot T \cdot T + r_\beta \cdot E_DB \).

Define \( r \) as:

4.20) \( r = \frac{R}{D_p + D_t + T + E_DB} \)

Now, combining definitions 4.15), 4.16) with expression 4.19) produces:

4.21) \( r = e + v + r_d \cdot \delta \cdot (D_p + D_t) + r_t \cdot T \cdot T + r_\beta \cdot E_DB \).

Recalling the definitions of the \( t \), \( d \), and \( \beta \)-ratios the following
substitutions are noted:

a) \( \frac{D_p + D_t}{D_p + D_t + T + E_DB} = \frac{1 + d}{1 + d + t + \beta} \)

b) \( \frac{T}{D_p + D_t + T + E_DB} = \frac{t}{1 + d + t + \beta} \)

c) \( \frac{E_DB}{D_p + D_t + T + E_DB} = \frac{\beta}{1 + d + t + \beta} \)

For expositional convenience and to spotlight the role of Euro-
dollar borrowing in our model designate the expression:

4.23) \( r_w \cdot W = r_d \cdot \delta \left( \frac{1 + d}{1 + d + t + \beta} \right) + r_t \cdot T \left( \frac{t}{1 + d + t + \beta} \right) \)

where \( W = \frac{1 + d + t}{1 + d + t + \beta} \)

and \( r_w = r_d \cdot \delta \left( \frac{1 + d}{1 + d + t} \right) + r_t \cdot T \left( \frac{t}{1 + d + t} \right) \).

Here \( r_w \) may be considered a weighted average reserve ratio (across all
classes of deposits and bank size), and \( w \), the share of total domestic
bank deposits. To the extent that switching between time and demand
deposits occurs, \( r_w \) may change, even though \( w \) may not, since time and
demand deposits are subject to different reserve ratios, viz., \( r_t < r_d \).
However, to focus on the role of Euro-dollar borrowing we abstract from
such changes.

From equations 4.22) and the definition of \( w \), it is clear that:
\[
4.24) \quad w + \frac{\beta}{1+d+t+\delta} = 1 \quad \text{and}
\]
letting \( x = \frac{\beta}{1+d+t+\delta} \) gives
\[
w + x = 1.
\]
Rewriting 4.21) produces:
\[
4.25) \quad r = e + v + w \cdot r_w + x \cdot r_\beta
\]
\[
= e + v + (1-x) r_w + x r_\beta
\]
The reserve ratio in 4.25) depends upon a number of factors.
Banks' portfolio decisions about excess reserves and the exact
composition of liabilities influence the effective r-ratio. The
public's desired mix of deposits also affect the r-ratio. The
following discussion, however, concentrates on the responsiveness of
the e- and \( \beta \)-ratios as determined by bankers' portfolio responses to
such economic variables as interest rates.

A bank's demand for excess reserves depends upon the opportu-
tunity cost and any benefits of such holdings. A bank holding more
reserves than law requires foregoes income it could otherwise be
earning. Of course, these excess reserves enable a bank to meet
unanticipated cash demands by depositors. Without this stock of
contingent reserves, banks would have to borrow funds (at the discount
window, the federal-funds market, the Euro-dollar market) or would need
to draw down their legal reserves, thereby incurring a penalty cost.
Summarizing the foregoing discussion gives:

\[ e = f(i_s, \rho, i_e) \]

where

\[ \frac{\partial e}{\partial i_s} < 0, \text{ and } \frac{\partial e}{\partial \rho}, \frac{\partial e}{\partial i_e} > 0 \]

where all interest rate variables are as previously defined. (It should also be noted that the \( r \) and \( e \)-ratios vary directly, i.e., \( \frac{dr}{de} = 1 \).)

As interest rates change, so too does the Euro-dollar borrowing ratio (\( \beta \)). Changes in the \( \beta \)-ratio affect the \( r \)-ratio. In general, an increase (decrease) in the share of a bank's liabilities held as Euro-dollar borrowing lowers (raises) the effective \( r \)-ratio:

\[ 4.27) \frac{\partial r}{\partial \beta} = \frac{\partial}{\partial \beta} \left( \frac{1-x}{\beta} \cdot \delta W + \frac{x}{\beta} \cdot r_B \right) \]

\[ = \frac{\partial}{\partial \beta} (r_B - \delta W); (\frac{\partial}{\partial \beta} > 0). \]

Only since September, 1969, has there been any reserve ratio on Euro-dollar borrowing, and only from January, 1971 to 1973, was \( r_B \) sufficiently high (20 per cent), to be greater than \( \delta W \). Hence, for most of the period under examination \( \frac{\partial r}{\partial \beta} < 0 \), as \( \delta W > r_B \). This effect alone would be sufficient to make Euro-dollar borrowing a potentially expansionary influence on the U.S. money supply. That is, if banks substitute Euro-dollar borrowing for lost time and demand deposits, the effective reserve ratio falls with a consequent increase in the multiplier.

The \( r \)-ratio, then, depends upon the elements on which its components depend. Letting \( i \) represent some index of market interest rates,\(^{12} \) the relation of \( r \) to these factors is expressed as:

\[ 4.28) r = f(i, \rho, Q, R_E) \]

In general, the overall effect on the reserve-ratio of changes in the
independent variables in 4.28) depends on the sign and magnitude of changes in those variables in the elements comprising the r-ratio. Discussion of these important effects is temporarily deferred in order to complete the specification of the basic multiplier.

**Time Deposits**

The public's holding of time deposits (T), is expressed as a ratio (t), to private demand deposits (D_p). The public's portfolio decisions on its holdings of T and D_p respond to various price and interest-rate variables. Consequently the dependence of the t-ratio on these variables is given by:

\[ 4.29) \quad t = f(i_s, i_e, i_t, W/p, y/y_p). \]

Following Burger, increases in the time deposit rate (i_t), real wealth (W/p), and the ratio of transitory to permanent income (y/y_p), raise the t-ratio. Further, we postulate \( \partial t/\partial i_s \) and \( \partial t/\partial i_e \) to be negative. As with the currency-ratio, the actual sign of these effects depends upon the relative responses of the components (D_p and T) to changes in economic conditions. To postulate \( \partial t/\partial i_s < 0 \) assumes that asset-owners reduce their holdings of time deposits relatively more than demand deposits when interest rates change for given values of i_t. This assumption seems warranted since demand deposits provide a service (i.e., as transactions balances), for which there are fewer substitutes than for time deposits.

We also assume that banks respond to higher security yields by offering a higher return on time-deposits, to the extent that the law permits. When the return on banks' earning assets rises, banks offer
higher deposit rates to attract additional liabilities. Regulation Q ceilings, however, may limit their ability to offer higher rates. This "competitive response" (in Burger's terminology) is contained in:

$$i_t = f(i_s, Q)$$

where

$$\frac{\partial i_t}{\partial i_s} > 0 \text{ subject to Q-ceilings.}$$

These Regulation Q effects are shown to be important in evaluating the role of Euro-dollar borrowing in the money-supply process. A complete discussion of these effects is momentarily deferred.

The Full Expression for the Multiplier

The foregoing discussions can be consolidated to yield the reduced-form expression for the money-multiplier ($m_1$), that specifically incorporates the potential effects of the Euro-dollar market. Recalling that the net sources base is given by:

$$B_a = R + C_p - A - ED_B + ED_D$$

From definitions 4.5), 4.7), 4.10), 4.12) and 4.20) rewriting 4.3) produces:

$$B_a = r(D_p + D_t + T + ED_B) + CD_p - b(D_p + D_E + T + ED_B)$$

$$- \beta D_p + \alpha D_p$$

Recalling from 4.4) the relationship of $M_1$ to $B_a$ and the definition of $M_1$ gives:

$$M_1 = m_1 B_a = D_p + C_p = (1+c) D_p$$

or

$$m_1 B_a = (1+c) D_p.$$
defined money multiplier \((m_1)\):

\[
4.34) \quad m_1 = \frac{1+c}{(r-b)(1+d+t+\beta) + c - (\beta-a)}
\]

(It should be noted that the deposit-expansion multiplier is simply the inverse of the denominator in R.H.S. of 4.34).)

Expression 4.34) differs from traditional money multipliers by explicitly incorporating the potential influence of the Euro-dollar market. The effect of Euro-dollar borrowing is captured directly by the \(\beta\)-ratio and indirectly in the \(r\)-ratio, since the share of a bank's liabilities in Euro-dollar borrowings influences the effective reserve ratio. Deposit leakages to the Euro-dollar market are captured by \(\alpha\).

The elements of the multiplier 4.34) respond to such economic variables as interest rates, income, and wealth. That is, the multiplier is not an exogenous constant. Changes in the net monetary base \((B_a)\) generate changes in some or all of the variables in \(m_1\). These feedback effects need to be examined in greater detail. For instance, if changes in \(B_a\) are expansionary but are offset somewhat by opposite changes in \(m_1\), desired changes in \(M_1\) are dampened. On the other hand, if the effect on \(m_1\) is in the same direction as changes in \(B_a\), the expansionary (or contractionary) effect is intensified. Of course, neither of these events necessarily poses a serious problem for the policy-maker, since he may consider the offsetting influence of these feedback effects in his policy decisions. Knowledge of feedback effects from Euro-dollar borrowing may assist the policy-maker in his determination of appropriate policy actions. Attention now focuses specifically on evaluating these feedback effects. An evaluative procedure, based on
The elasticity of the various parameters (especially the β and α ratios), is used.

**Elasticities of the Parameters**

The multiplier parameters, r, c, t, e, β and α, depending upon a number of economic variables. For our analysis, the most important set of these variables are the several interest rates, discount rate and Regulation Q constraints. Elasticities of the parameters with respect to those interest rates is now discussed.

**Elasticities of the Borrowing Ratios: b and β**

Banks' borrowing at the discount window is positively related to the yield on securities (iₜ), and inversely related to the broadly defined cost of borrowing (ρ). The impact of the borrowing ratio (b) on m₁, when interest rates change depends on the elasticities (b) with respect to interest rates and of the multiplier with respect to b. These terms are given by

4.35a) E(b,i)

and

4.35b) E(m₁,b)

(Elasticities, throughout this chapter, are given by the notation E(x,y) which translates as "the elasticity of x with respect to y.")

Rewriting 4.35a) produces:

4.36a) E(b,i) = E(b,iₛ)·E(iₛ,i) + E(b,ρ) E(ρ,i). While E(b,iₛ) and E(b,ρ) are opposite in sign, we can evaluate E(b,i) by making some realistic assumptions about banking behavior. At low market interest rates (at least below Q), the b-ratio approaches zero and E(b,i) is
small in value, but probably positive. Since $\rho$ is an administered rate, $E(\rho, i)$ is likely to be smaller than $E(i_s, i)$. As rates raise and if $\rho$ is not permitted to adjust at the same speed, the first terms in 4.36a) tend to dominate and $E(b, i)$ would be positive and increasing. Continually rising rates induce banks to increase borrowing but the Fed may increase control over the discount window both by raising the discount rate and by tightening its administrative control. Consequently, the second terms in 4.36a) become more important and could conceivably dominate, making $E(b, i)$ negative. Summarizing, we postulate that $E(b, i) > 0$ for interest rates in the low to middle range (higher for the intermediate range), while for interest rates that are high and rising, $E(b, i)$ declines (and may even become negative).

Evaluating $E(m_1, b)$, we have:

$$4.36b) \quad E(m_1, b) = m_1/\theta b \cdot b/m_1 = (1+d+t+\beta)(1+c)/D^2 \cdot (b \cdot D/1+c)$$

$$= b(1+d+t+\beta)/D$$

where $D = (r-b)(1+d+t+\beta) + c - (\beta-\alpha)$

Clearly $E(m_1, b)$ varies directly with $b$ and is always positive. From the previous discussion we expect $b$ to decline when interest rates are high and rising, implying that $E(m_1, b)$ gets smaller.

The elasticity of the $\beta$-ratio is:

$$4.37) \quad E(\beta, i) = E(\beta, i_s) \cdot E(i_s, i) + E(\beta, i_E) \cdot E(i_E, i)$$

Since $E(\beta, i_s)$ and $E(\beta, i_E)$ differ in sign, the sign and magnitude of $E(\beta, i)$ depend upon the relative importance of the first and second terms of 4.37. At relatively low U.S. interest rate levels, Euro-dollar borrowing is a less important source of liabilities. As rates on securities begin rising and deposit rates approach Regulation Q
ceilings, alternative sources of funds become increasingly important and banks may seek to replace lost deposits through the Euro-dollar market. Therefore $E(\beta, i)$ is expected to be larger (and positive), for relatively high interest rates, while for deposit rates well below Regulation Q ceilings $E(\beta, i) \rightarrow 0$. It is, of course, possible that $E(\beta, i) < 0$, (especially at low rates, as U.S. banks may try to reduce their indebtedness to Euro-banks).

Evaluating the elasticity of the multiplier ($m_1$) with respect to $\beta$ produces:

\[ 4.38) \quad E(m_1, \beta) = -\left(\frac{\partial D}{\partial \beta}\right) \cdot \frac{\partial}{\partial D} \]

Partial differentiation of $D$ reveals:

\[ 4.39) \quad \frac{\partial D}{\partial \beta} = (r-b-1) + (\partial \sigma / \partial \beta) \left(1+d+t+\beta\right) \]

Since $r < 1$ and from 4.27), $\partial \sigma / \partial \beta$ is assumed to be negative, it is reasonable to expect that $\partial D / \partial \beta < 0$. Hence, we have $E(m_1, \beta) > 0$ and larger when $\beta$ is larger, i.e., when interest rates are high and rising.

**Elasticities of the $\alpha$-Ratio**

The $\alpha$-ratio captures the leakage of deposits to the Euro-dollar market and depends on a number of interest rates. The elasticity of the $\alpha$-ratio with respect to the index of market rates depends upon the relative importance of the individual interest-rate elasticities:

\[ 4.40) \quad E(\alpha, i) = E(\alpha, \iota)E(\iota, i) + E(\alpha, \iota_s)E(\iota_s, i) + E(\alpha, \iota_E)E(\iota_E, i) \]

The first two products on the R.H.S. of 4.40) are negative while the third is positive, rendering $E(\alpha, i)$ ambiguous. At low interest rates, $E(\iota, i)$ is positive, but as deposit rates approach Regulation Qceilings
E(i_t,i)>0. As U.S. interest rates continue to climb, the third product in 4.40) becomes increasingly important. When Q-ceilings are effective, it is expected that E(α,i) > 0, but for low interest rates we assume that E(α,i)≈0.15

It can easily be shown that:

4.41) \( \frac{E(m_1,α)}{-α/D} < 0 \)

That is, an increase in the ratio of Euro-dollar to U.S. deposits in U.S. wealth-holders' portfolios reduces the U.S. money multiplier. This term captures the potential "leakage-effect" of the Euro-dollar market in the U.S. money supply process.

Elasticities of the t-Ratio

As noted in the previous section, the t-ratio depends on the relevant time deposit rates, the yield on earning assets, income and wealth. The elasticity of the t-ratio with respect to the index of interest rates is:

4.42) \( E(t,i) = E(t,i_s)E(i_s,i) + E(t,i_t)E(i_t,i) + E(t,i_E)E(i_E,i) \)

The value for \( E(t,i) \) depends upon the relative responsiveness of the t-ratio to changes in \( i_s, i_t \), and \( i_E \), and on the responsiveness of banks' offering rate (\( i_t \)) to changes in market rates. Writing the first three of these elasticities gives:

4.43a) \( E(t,i_s) = E(T,i_s) - E(Dp,i_s) \)

4.43b) \( E(t,i_t) = E(T,i_t) - E(Dp,i_t) \)

and 4.43c) \( E(t,i_E) = E(T,i_E) - E(Dp,i_E) \)

Since \( E(T,i_t) > 0 \) and \( E(Dp,i_t) < 0 \) the value for \( E(t,i_t) \) is positive.
However, 4.43a) and 4.43c) depend on the public's behavior toward time and demand deposits, respectively. Burger [12,p. 75] postulates that the substitution between securities and time deposits dominates the substitution between demand deposits and securities (when $i_s$ changes). This assumption seems reasonable since time deposits are viewed by many depositors as a security in a portfolio of assets, while demand deposits are liquid, transactions balances. The presumed domination of $E(T,i_s)$ over $E(Dp,i_s)$ implies that $E(t,i_s) < 0$. It is also reasonable to assume that $E(T,i_E) > E(Dp,i_E)$ implying $E(t,i_E) < 0$. Under these assumptions the sign and numerical value of $E(t,i)$ depend upon the relative sizes of the terms on the R.H.S. of 4.42).

These relationships are summarized as:

4.44a) if $|E(t,i_s)E(i_s,t) + E(t,i_E)E(i_E,i)| > |E(t,i_t)E(i_t,i)|$ then $E(t,i) < 0$

b) if $|E(t,i_s)E(i_s,t) + E(t,i_E)E(i_E,i)| = |E(t,i_t)E(i_t,i)|$ then $E(t,i) = 0$

c) if $|E(t,i_s)E(i_s,i) + E(t,i_E)E(i_E,i)| < |E(t,i_t)E(i_t,i)|$ then $E(t,i) < 0$.

When effective, Regulation Q ceilings exert an important influence on $E(t,i)$, by preventing banks from raising the offer rate on time deposits. When this occurs $E(i_t,i) = 0$, and the first and third pair of terms on the R.H.S. of 4.42) dominate, making $E(t,i)$ negative. When banks experience liability attrition due to Regulation Q ceilings, the
t-ratio may decline when rates continue to rise.

At rates below Regulation Q ceilings, the overall sign and value of $E(t,i)$ depend upon banks' response to changed market rates and on the direct and cross interest-rate elasticities of the t-ratio. Following Burger, at low interest-rate levels banks find it more attractive to reduce holdings of excess reserves and $E(t,i)$ is presumed to be small in value. Burger further argues that as rates continue to climb and excess reserves are exhausted, banks offer higher time-deposit rates as the least-cost avenue of attracting funds. Burger concludes that when market rates are rising Regulation Q restrictions are inoperative, $E(t,i) > 0$. The presence of the Euro-dollar market does not seriously affect this conclusion since, in general, Euro-dollar loan rates are higher than U.S. time deposit rates. If this presumed relationship between Euro-dollar and time deposit rates were reversed however, one would not expect banks to raise the offer rate on time deposits. Banks' expectations of future interest-rate movements may affect Euro-dollar borrowing. If banks expect a reversal of current (say, upward) rates, they may be more willing to borrow short-term funds in the Euro-dollar market even at rates higher than $i_t$, to avoid longer-term contractual deposit commitments. The availability of Euro-dollars as an auxiliary source of liabilities may be expected to lower $E(t,i)$.

Evaluating $E(m_1,t) = \frac{am_1}{\Delta t} \cdot t / m_1 = -(t) \cdot \frac{\partial D/\partial t}{D}$

where $D$ is defined as before. Examining $\partial D/\partial t$ reveals:

4.45) $\partial D/\partial t = (r-b) + (1+d+t+\beta) (\partial r/\partial t)^{17}$

If $\partial r/\partial t \rightarrow 0$ (for small changes in $t$) then $E(m_1,t) < 0$. This is the result normally obtained when one neglects changes in the r-ratio due
to changes in the t-ratio. Models excluding the Euro-dollar market produce the result that \( \dot{r}/\dot{t} < 0 \) since \( r_t < r_d \). In our model, however, the sign for \( \dot{r}/\dot{t} \) may be either positive or negative, since a change in the t-ratio affects \( \beta/1+d+t+\beta \) which has the effect of raising the r-ratio. Hence, with Euro-dollar borrowing it is at least possible that \( \dot{r}/\dot{t} > 0 \). In this case, \( E(m_1, t) \) becomes even more negative (i.e., becomes larger in absolute value). Hence it is assumed that \( E(m_1, t) < 0 \).

**Elasticities of the r-Ratio**

The previous sections examined some interest-rate induced changes in the r-ratio (through changes in \( \alpha \), \( \beta \) and \( t \)). The net effect of \( \beta \) and \( t \) on the r-ratio are embodied in \( E(m_1, \beta) \) and \( E(m_1, t) \). Other forces at work on the elasticity of the r-ratio, viz., the elasticity of the e-ratio also needs to be examined. (Note: While the reserve ratio also includes vault cash, empirical estimates of the v-ratio suggest its accurate approximation by a constant [12, p. 66]. The present analysis maintains this assumption.)

The elasticity of the e-ratio captures the remaining interest-rate induced changes in the r-ratio:

\[
E(e, i) = E(e, i)E(i, i) + E(e, \rho)E(\rho, i)
\]

The sign and value of 4.47) depend upon the relative importance of the terms on the R.H.S. Empirical evidence cited by Burger argues for the presumption that the first pair of terms dominate and \( E(e, i) < 0 \), and that \( (m_1, e) \) declines as interest rates continue to rise. (As rates rise to higher levels, the e-ratio approaches zero, making its impact
on \( r \) and hence \( m_1 \) smaller). Burger [12, p. 62] also noted a \textit{secular} decline in the e-ratio, attributing it in part to such institutional factors as greater confidence in the banking system (through F.D.I.C. insurance, etc.), and the development of the federal-funds market. An additional reason may be due to the Euro-dollar market. Ready access to Euro-dollar loans encourages even further economizing on reserve balances, since the Euro-dollar market represent additional insurance from costly reserve deficiencies. The Euro-dollar market, then, represents another institutional factor arguing for a long-run declining e-ratio.

We may summarize the impact of the e-ratio on \( m_1 \) with:

4.48) \( E(m_1,e) < 0 \) and

\[
E(m_1,e) = 0 \quad \text{as } e \text{ falls.}
\]

**Elasticities of the c-Ratio**

The elasticity of the c-ratio is written as:

4.49) \( E(c,i) = E(c,i_d)E(i_d,i) + E(c,i_s)E(i_s,i) \)

If the public's demand for demand deposits is more sensitive to interest rates than is its demand for cash, both pairs of terms on the R.H.S. of 4.49 are positive, i.e., \( E(c,i) > 0 \). As Burger notes, empirical evidence supports this assumption.

Finally, the responsiveness of the multiplier (\( m_1 \)) to changes in the c-ratio is given by:

4.50) \( E(m_1,c) = \frac{\partial m_1}{\partial c} \frac{c}{m_1} = (1-m_1) \frac{c}{c+1} < 0. \)

(Table 4.2 and Figure 4.1 summarize the behavior of all the elasticities discussed.)
<table>
<thead>
<tr>
<th>Elasticity of:</th>
<th>Low Interest Rates</th>
<th>Intermediate Interest Rates</th>
<th>High Market Rates; Regulation Q Effective</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>b-Ratio</strong></td>
<td>$\epsilon(b,i) &gt; 0$</td>
<td>$\epsilon(b,i) &gt; 0$</td>
<td>$\epsilon(b,i) &gt; 0$ or $&lt; 0$</td>
</tr>
<tr>
<td></td>
<td>$\epsilon(m_1,b) &gt; 0$</td>
<td>$\epsilon(m_1,b) &gt; 0$</td>
<td>$\epsilon(m_1,b)$ declining</td>
</tr>
<tr>
<td><strong>β-Ratio</strong></td>
<td>$\epsilon(\beta,i) &gt; 0$ possible $0$</td>
<td>$\epsilon(\beta,i) &gt; 0$</td>
<td>$\epsilon(\beta,i) &gt; 0$</td>
</tr>
<tr>
<td></td>
<td>$\epsilon(m_1,\beta) &gt; 0$</td>
<td>$\epsilon(m_1,\beta) &gt; 0$</td>
<td>$\epsilon(m_1,\beta) &gt; 0$ and increasing</td>
</tr>
<tr>
<td><strong>α-Ratio</strong></td>
<td>$\epsilon(\alpha,i) &gt; 0$</td>
<td>$\epsilon(\alpha,i) &gt; 0$</td>
<td>$\epsilon(\alpha,i) &gt; 0$</td>
</tr>
<tr>
<td></td>
<td>$\epsilon(m_1,\alpha) &lt; 0$</td>
<td>$\epsilon(m_1,\alpha) &lt; 0$</td>
<td>$\epsilon(m_1,\alpha) &lt; 0$</td>
</tr>
<tr>
<td><strong>t-Ratio</strong></td>
<td>$\epsilon(t,i) &gt; 0$</td>
<td>$\epsilon(t,i) &gt; 0$</td>
<td>$\epsilon(t,i) &lt; 0$</td>
</tr>
<tr>
<td></td>
<td>$\epsilon(m_1,t) &lt; 0$</td>
<td>$\epsilon(m_1,t) &lt; 0$</td>
<td>$\epsilon(m_1,t) &lt; 0$</td>
</tr>
<tr>
<td><strong>e-Ratio</strong></td>
<td>$\epsilon(e,i) &lt; 0$</td>
<td>$\epsilon(e,i) &gt; 0$</td>
<td>$\epsilon(e,i) = 0$</td>
</tr>
<tr>
<td></td>
<td>$\epsilon(m_1,e) &lt; 0$</td>
<td>$\epsilon(m_1,e) &lt; 0$</td>
<td>$\epsilon(m_1,e) &gt; 0$</td>
</tr>
<tr>
<td><strong>c-Ratio</strong></td>
<td>$\epsilon(c,i) &gt; 0$</td>
<td>$\epsilon(c,i) &gt; 0$</td>
<td>$\epsilon(c,i) &gt; 0$</td>
</tr>
<tr>
<td></td>
<td>$\epsilon(m_1,c) &lt; 0$</td>
<td>$\epsilon(m_1,c) &lt; 0$</td>
<td>$\epsilon(m_1,c) &lt; 0$</td>
</tr>
</tbody>
</table>
Figure 4.1. Graphical Presentation of Behavior of Elasticities over Various Interest-Rate Ranges.
Effects of Monetary Policy Actions

This section examines the impact of U.S. monetary policy actions on $M_1$. This short-run analysis focuses on the role of Euro-dollar borrowing and depositing in the determination of $M_1$. Short-run response of the money-supply is affected by changes in the base and changes in the multiplier induced by these changes in the base.

Changes in the monetary base are assumed to induce short-run changes in the market interest rates ($i$), in the opposite direction. That is, in the short-run:

\[ E(i, B_a) < 0. \]

This analysis ignores the possible longer-run Fisherian effects on interest rates that result from changes in inflationary expectations. (As shown in the following section, including Fisherian effects implies \( E(i, B_a) > 0 \), and reverses the implications derived in this section.)

The relationship between narrowly defined money ($M_1$) and the monetary base ($B_a$) is given by \( M_1 = m_1 B_a \). In fixed-coefficient multiplier models of the money-supply process, a one dollar change in the base would produce an $m_1 \times$ $1$ change in the money supply. The present analysis, however, implies that the multiplier itself changes as a result of changes in the base, making changes in $M_1$ more difficult to predict. Differentiating \( M_1 = m_1 B_a \) with respect to $B_a$ produces:

\[ \frac{\partial M_1}{\partial B_a} = m_1 + \left( \frac{\partial m_1}{\partial i} \right) \left( \frac{\partial i}{\partial B_a} \right) \cdot B_a \]

or, in terms of elasticities:

\[ E(M_1, B_a) = 1 + E(m_1, i) E(i, B_a). \]

The responsiveness of $M_1$ to change in the monetary base is determined by the interest-rate responsiveness to changes in the base ($E(i, B_a)$),
and by the portfolio response of banks and the public to changes in interest-rates \(E(m_1, i)\). A negative value for the product \(E(m_1, i) E(i, B_a)\) means that changes in the multiplier offset or dampen the impact on \(M_1\) of changes in the base. To evaluate \(E(m_1, i)\), denote the following expression:

\[
4.54) \quad E(m_1, i) = E(m_1, e)E(e, i) + E(m_1, t)E(t, i) + E(m_1, b)E(b, i) + E(m_1, c)E(c, i) + E(m_1, \beta)E(\beta, i) + E(m_1, \alpha)E(\alpha, i)
\]

From the foregoing discussion, the terms in the R.H.S. of 4.54 depend upon a number of factors including initial interest-rate level and the effectiveness of Regulation Q. This suggests that \(E(m_1, i)\) depends importantly on the initial position. Euro-dollar borrowing, is likely to be an important source of funds when Regulation Q is effective. In evaluating \(E(m_1, i)\) and ultimately \(E(M_1, B_a)\), we must consider these different initial conditions. (Table 4.3 summarizes the following analysis.)

**Case I**

In this case we assume: (1) interest rates are relatively low (historically); (2) deposit rates are well below Regulation Q ceiling rates; and, (3) the Fed exercises little discretionary control of the discounting. From 4.54, \(E(m_1, i)\) depends on the relative importance attached to its components. As argued earlier, the \(E(c, i)\) is small in magnitude and likely to be dominated by other terms in 4.54, while our discussion of the t-ratio suggests that \(E(t, i) = 0\) at the initially specified low interest rates. Under the conditions specified, then,
E(m_1,e) E(e,i) dominates 4.54) and E(m_1,i) > 0 (since both terms are negative).

Dominance of e-ratio under these conditions can be explained by considering a contractionary Federal Reserve action. At initially low interest rates banks hold relatively large excess reserves. As policy forces rates upward, banks predominantly rely on excess reserves as a source of funds. Euro-dollar borrowing exerts little influence under these conditions since other lower-cost sources dominate. Banks "tend to vary i_t in response to (i_s) only enough to maintain their existing stock of time deposits." To the extent banks feel unconstrained in using the discount window, an additional positive force may be exerted on E(m_1,i). Still, since the elasticities of the e-ratio dominate, E(m_1,i) > 0.

Under the conditions specified: E(M_1,B_a) = 1+E(m_1,i) E(i,B) < 1. That is, the Fed's actions are dampened (by banks' portfolio adjustments regarding excess reserves). The Euro-dollar market has very little impact on monetary control, though any borrowing of would intensify the Euro-dollar's dampening effect.

Case II

Case II assumes: (1) interest rates are at an intermediate level; (2) deposit rates approach statutory ceilings; and, (3) the Fed begins exerting "surveillance" of borrowers at the discount window. As rates continue rising, banks deplete their excess reserves, the elasticity of the e-ratio approaches zero, and its effect on E(m_1,i) diminishes. Borrowing and deposits become more important sources of
bank liabilities. When unconstrained by Regulation Q ceilings, banks can offer higher deposit rates, i.e., \( E(i_t, i) > 0 \). Since \( E(m_1, t) \) is negative, the net effect of the t-ratio is to lower the multiplier. In the early phase of Case II the t-ratio is likely to dominate, but as \( i_t \) approaches the ceiling rate, the \( E(t, i) \) approaches 0. Euro-dollar borrowing increases in importance when rates are above the ceilings and rising and reduces the role of the t-ratio elasticity. On the other hand, \( E(\alpha, i) \) act to diminish the size of the multiplier through leakages to the Euro-dollar market. Designate the net effect of the Euro-dollar market on \( m_1 \) as:

\[
4.55) \quad E(m_1, \Gamma) = E(m_1, \beta) E(\beta, i) + E(m_1, \alpha) E(\alpha, i), \quad \text{where } \Gamma \text{ is a parameter summarizing the net influence of borrowing and depositing.}
\]

Conditional values for \( E(m_1, n) \) are given by:

\[
4.56a) \quad E(m_1, \Gamma) > 0 \text{ if } B > A \\
b) \quad E(m_1, \Gamma) = 0 \text{ if } B = A \\
c) \quad E(m_1, \Gamma) < 0 \text{ if } B < A
\]

where \( A = |E(m_1, \alpha) \cdot E(\alpha, i)| \) and \( B = |E(m_1, \beta) \cdot E(\beta, i)| \)

Simplify these conditions by dividing both A and B by \( E(m_1, \alpha) \) and \( E(\beta, i) \). Dividing 4.38 by 4.41 produces

\[
4.57) \quad E(m_1, \beta) = \frac{\beta |(r-b-1) + 3r/3\beta (1+d+t+\beta)|}{E(m_1, \alpha) (1+d+t+\beta)}
\]

\[
= \frac{\beta \cdot n}{\alpha} \quad \text{where } n = |(r-b-1) + 3r/3\beta (1+d+t+\beta)|
\]

Further, note that:

\[
4.58) \quad \frac{E(\alpha, i)}{E(\beta, i)} = \frac{E(\beta, i)}{E(\alpha, i)} = \frac{E(\alpha, i)}{E(\beta, i)} = \frac{(\beta/\alpha) (3\beta/3\beta)}{E(\beta, i)}.
\]
Conditions 4.56) simplify to:

4.59a) $E(m_1, \Gamma) > 0$ if $|n| > \alpha \sigma / \delta i / \delta \beta / \delta i$

b) $E(m_1, \Gamma) = 0$ if $|n| = \alpha \sigma / \delta i / \delta \beta / \delta i$

c) $E(m_1, \Gamma) < 0$ if $|n| < \alpha \sigma / \delta i / \delta \beta / \delta i$

It is reasonable to assume that -1<0 since $\delta r / \delta \beta (1+d+t+\beta)$ is small in value relative to c-b-1. If so, then a necessary (but not sufficient) condition for 4.59) is that $\alpha \beta / \delta i > \alpha \sigma / \delta i$ (i.e., Euro-dollar borrowing is more responsive to increases in interest rates than is U.S. depositors' Euro-dollar holdings). Equality of those relative responses would assure condition 4.59c).

Under Case II assumptions, if conditions 4.59a) hold, the net potential Euro-dollar effects offset the contractionary impact on $m_1$, exerted by the t-ratio. On the other hand, if condition 4.59c) holds, the net potential Euro-dollar effects reinforce the impact of the t-ratio. Only if condition 4.59b) holds is the influence of the Euro-dollar market totally neutral.

Identify as Phase 1 and Phase 2 of Case II, the phases where $\varepsilon(t,i)>0$ and $\varepsilon(t,i)=0$, respectively. Further, for purposes of comparison designate with an asterisk (*) the elasticities of $m_1$ and $M_1$ when potential Euro-dollar effects are omitted. A comparison of multiplier and money-supply elasticities that include the Euro-dollar market with those that omit its impact are summarized in Table 4.3 and in the following discussion.

The net potential effect of the Euro-dollar market depends upon the relationship between U.S. banks' borrowing of Euro-dollars and the U.S. public's transferring of domestic deposits to the Euro-dollar
<table>
<thead>
<tr>
<th>CASE</th>
<th>CONDITIONS 5.58</th>
<th>COMPARISON OF MULTIPLIERS</th>
<th>Comparison of Money Supply Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Under all conditions $E(m_1, i) &gt; 0$</td>
<td>$E(m_1, i) &gt; E(m_1, i)^*$</td>
<td>$E(M_1, i) &gt; E(M_1, i)^*$</td>
</tr>
<tr>
<td>2</td>
<td>Phase 1 $E(t, i) &gt; 0$ and dominates</td>
<td>$E(m_1, i) &lt; E(m_1, i)^* &lt; 0$</td>
<td>$E(M_1, i) &lt; E(M_1, i)^*$</td>
</tr>
<tr>
<td></td>
<td>$E(m_1, i) &gt; 0$</td>
<td>$E(m_1, i) = E(m_1, i)^* &lt; 0$</td>
<td>$E(M_1, i) = E(M_1, i)^*$</td>
</tr>
<tr>
<td></td>
<td>$E(m_1, i) &lt; 0$</td>
<td>$E(m_1, i) &lt; E(m_1, i)^* &lt; 0$</td>
<td>$E(M_1, i) &lt; E(M_1, i)^*$</td>
</tr>
<tr>
<td>3</td>
<td>Phase 2 $E(t, i) &lt; 0$</td>
<td>$E(m_1, i) &gt; E(m_1, i)^* &gt; 0$</td>
<td>$E(M_1, i) &gt; E(M_1, i)^*$</td>
</tr>
<tr>
<td></td>
<td>$E(m_1, i) &gt; 0$</td>
<td>$E(m_1, i) = E(m_1, i)^* &gt; 0$</td>
<td>$E(M_1, i) = E(M_1, i)^*$</td>
</tr>
<tr>
<td></td>
<td>$E(m_1, i) &lt; 0$</td>
<td>$E(m_1, i) &lt; E(m_1, i)^* &gt; 0$</td>
<td>$E(M_1, i) &lt; E(M_1, i)^*$</td>
</tr>
</tbody>
</table>
market. If borrowing responds more to higher interest rates than does depositing, then the Euro-dollar market's net effect on the multiplier \( (m_1) \) is positive. In Phase I of Case II, the potential Euro-dollar effects tend to offset the influences exerted through the t-ratio. While the reduction in \( m_1 \) through the t-ratio enhances the final impact of a contraction in base money, ignoring the potential Euro-dollar effect (when borrowing dominates) leads to overestimating the actual contraction.

In Phase 2 of Case II, the elasticity of the t-ratio approaches zero as Regulation Q ceilings restrict banks from competing for the public's savings. The potential Euro-dollar effect increases in importance and may dominate the other effects. Ignoring the Euro-dollar market, one would expect little change, if any, in the multiplier. However, if the Euro-dollar effect is included one would anticipate some increase in the multiplier. This effect, of course, diminishes the contractionary response of the money supply to a reduction in the base. Banks, unable to attract additional deposits by offering higher deposit-rates, supplement funds with Euro-dollar borrowing, diminishing the final effect of a given policy-generated reduction in the base.

Dominance of the Euro-dollar deposit leakage effect reverses the results of the preceding two paragraphs. Under Phase 1 conditions, the net Euro-dollar effect enhances the influence of the t-ratio. In this case, omission of potential Euro-dollar effects leads to an underestimate of the reduction in the multiplier. Under Phase 2 conditions, the net Euro-dollar effect on the multiplier (here, negative), still generates a reduction in \( M_1 \), apart from that related only to the
reduction in $B_a$.

Case III

We now assume that: (1) interest rates are at relatively high levels; (2) Regulation Q ceilings prevent any further upward movement in deposit-rates; and, (3) the Fed has effectively closed the discount window to all but the most "needy" banks. Under these assumptions, deposit attrition is likely to occur and some deposits drain to the Euro-dollar market. The present model captures this in $a$. On the other hand, U.S. banks may offset some of this leakage by borrowing dollars from Euro-banks, especially their foreign branches. The net potential impact of the Euro-dollar market depends on the relative importance of these two opposing forces.

If Euro-dollar borrowing ($\beta$) dominates, it exerts forces on the money supply process that act to counteract policy-induced changes in base money. Euro-dollar borrowing acts to increase the multiplier (if the base is contracted), dampening the response of money supply. Ignoring these potential Euro-dollar effects leads to an underestimation of dampening by considering only the effect of the t-ratio which declines in response to higher interest rates. Including the net impact of Euro-dollar activity would reinforce the increase in $m_1$ that is associated with a declining t-ratio. Once again, omitting potential Euro-dollar effects leads to the prediction of a larger change in $M_1$ from a change in $B_a$, than if the market is included.

If deposit leakages to Euro-banks dominate the net Euro-dollar effect, the multiplier declines enhancing the contractionary policy
actions. These net Euro-dollar forces may not be large enough to offset the expansion of the multiplier through the t-ratio. Compared to models without the Euro-dollar market, a contractionary policy is found to be more contractionary.

**M₂ as the Measure for Money**

Our analysis has assumed that M₁ represents the operational definition of the money supply with which policy-makers are concerned. This section examines the impact, if any, of incorporating Euro-dollar effects on the behavior of another money-measure, M₂. The definition of M₂ and its relationship to the base is given by:

\[ M₂ = Dp + Cp + T \]

and,

\[ M₂ = m₂Ba \]

It is easily shown that:

\[ m₂ = \frac{1+c+t}{D} \]

where \( D = (r-b)(1+d+t+β) + c - (β-α) \)

It can also be shown that the elasticities of \( m₂ \) with respect to \( c, e, α, β, b \) are of the same sign as those for \( m₁ \). However, \( E(m₂,t) \) differs. Deriving this expression produces:

\[ E(m₂,t) = \frac{ṭm₂}{ṭ} \cdot \frac{t}{m₂} \]

Recall that:

\[ \frac{ṭD}{ṭ} = (ṭr/ṭ)(1+d+t+β) + r-b \]

Assuming, as before that \( ṭr/ṭ \) is small, (in the extreme, zero), then \( \frac{ṭD}{ṭ} = r-b \). Substituting into 4.63 produces:
4.65) \( E(m_2,t) = \frac{D-(r-b)(1+c+t)}{D^2} \left( \frac{t}{1+c+t} \right) \)

The sign of 4.65 depends upon the sign of the numerator. Combining and rearranging terms the numerator of 4.65 may be written as:

4.66) \( |(r-b)d + c(1-r+b) + \alpha \beta (1-r+b)|t \)

All but the last term in the bracket are positive. Since it seems reasonable to expect \( c > \beta \), 4.66 is positive and:

4.67) \( E(m_2,t) > 0 \)

The elasticity of the \( M_2 \) multiplier with respect to \( t \) is opposite in sign to the elasticity of the \( M_1 \) multiplier:

4.68) \( E(M_2,B_d) = 1 + E(m_2,i) E(i,B_d) \)

The value of 4.68 depends upon the initial conditions and the relative importance of Euro-dollar borrowing and depositing. Now reconsider the cases of the last section, maintaining all the assumptions for each case.

Case I

Under Case I assumptions, the elasticities of the e-ratio dominate and determine the overall sign of \( E(m_2,i) \). If the less rigid assumption (that \( E(t,i) > 0 \)) is maintained but that the e-elasticities still dominate), the result is given by:

4.69) \( E(m_2,i)^* > E(m_1,i)^* > 0 \)

(for models without the Euro-dollar market).

In this case the t-ratio elasticities strengthen the expansionary impact of the e-ratio. Again, under these assumptions both Euro-dollar elasticities are small and have little impact.
Case II

Under Case II, Phase 1 assumptions the elasticities of the t-ratio dominate the other elasticities. Unlike the case for $M_1$, however, the elasticities of the t-ratio act to increase the $m_2$ multiplier, dampening the final impact on $M_2$ of a change in the base. In Phase 1, each Euro-dollar elasticity is small and has little effect. To the extent that the net Euro-dollar effect is important $E(m_2, i)$ is even larger than $E(m_2, i)^*$ if $E(m_2, r)$ is positive. (Recall that $E(m_2, r) > 0$ implies dominance of the borrowing effects.) If, on the other hand, $E(m_2, r)$ is negative, $E(m_2, i)$ is smaller than the Euro-dollar market's potential effects are excluded. Including Euro-dollar effects results in a greater dampening of $M_2$ when the borrowing influence dominates and a weaker dampening when depositing dominates.

In Phase 2 potential Euro-dollar effects increase in importance. Since now $E(t, i) \to 0$, the results for the $M_2$ multiplier are similar to those of the $M_1$ multiplier.

It should be noted that:

\[ 4.70 \quad |E(m_2, r)| = |E(m_1, r)| \]

In other words, regardless of which Euro-dollar effect is relatively more important, including the Euro-dollar market has an equal impact on the $M_2$ supply process as the $M_1$ process. This follows from examining the $\alpha$ and $\beta$ elasticities:

\[ 4.71 \quad E(m_2, \beta) = (\partial m_2 / \partial \beta) \cdot \beta / m_2 \]

and

\[ 4.71 \quad E(m_2, \alpha) = (\partial m_2 / \partial \alpha) \cdot \alpha / m_2 \]

Since $E(m_2, \beta) = E(m_1, \beta)$ and $E(m_2, \alpha) = E(m_1, \alpha)$ the stated results must
hold. Excluding Euro-dollar effects from the money-supply process produces similar distortions whether policy-makers gear actions to controlling $M_2$ or $M_1$.

Case III

Under Case III assumptions, deposit leakages become increasingly important and $E(m_2,i) < 0$ if the $t$-ratio elasticities dominate, intensifying the contraction of $M_2 (E(M_2,B_a) > 1)$. If, however, Euro-dollar borrowing is sufficiently large to offset the disintermediation to the Euro-dollar market ($\alpha$), the net potential Euro-dollar effect weakens the contractionary impact. If disintermediation to the Euro-dollar market is not offset by Euro-dollar borrowing ($E(m_2,\Gamma) < 0$) contractionary forces are intensified. The following ordering conditions are given:

$$4.72) \quad E(M_2,B_a) > E(M_2,B_a) > 1 \text{ if } 0 < E(2,\Gamma) < |E(m_2,t) E(t,i)|$$

$$4.73) \quad E(M_2,B_a) > E(M_2,B_a) > 1 \text{ if } E(m_2,\Gamma) < 0.$$

Fisherian Effects Considered

The foregoing analysis focused on short-run responses of the money-supply to changes in the monetary base and the multiplier. While in the short-run, the interest-rate moves in the opposite direction to changes in the base, the long-run impact on interest-rates is different if inflationary expectations are considered. The foundation for this Fisherian effect is the hypothesis that nominal interest-rates incorporate an inflationary premium. An expansionary monetary policy,
while lowering interest rates in the short-run, may actually raise interest-rates in the future as economic agents adapt to the more rapid price inflation that accompanies the money-supply growth. Since inflationary expectations have become a more important consideration to policy makers in the recent past, the longer run implications of monetary policy actions on the behavior of the multiplier need to be considered.

Following Burger, assume that the long-run elasticity of market interest-rates is:

4.74) \( E(i, B_a) > 0 \)

Consider now each of the three cases and the long-run implications of assumption 4.74).

**Case I**

The excess-reserve elasticity dominates the overall \( m_1 \) and \( m_2 \) elasticities so that \( E(m_1, i) \) and \( E(m_2, i) > 0 \) and potential Euro-dollar effects are relatively small at low interest-rate levels. The long-run impact of changes in the base are enhanced by the long-run response of the multipliers to interest rates. Rewriting 4.53) to reflect the long-run assumptions of \( E(i, B_a) \) produces:

4.75) \( E(M_1, B_a) = 1 + E(m_1, i) E(i, B_a) > 1 \)

That is, in the long-run the multiplier response enhances the expansionary (contractionary) change in \( B_a \).

**Case II**

During Phase I of Case II banks can vary deposit interest rates, thereby offsetting the negative influence of rising security yields.
Since $E(t,i)$ and $E(m_1,t)$ dominate the other elasticities and since now the long-run $E(i,B_a)$ is positive, the long-run response of the money supply to changes in the base is somewhat dampened. During this phase potential Euro-dollar effects begin to exert some impact. If Euro-dollar borrowing dominates Euro-dollar depositing, the net effect tends to offset changes in the t-ratio. Of course, the reverse holds if depositing dominates. As deposit interest rates approach $Q$-ceilings, the potential Euro-dollar effects become increasingly important. An important difference exists, however, between the short-run cases discussed earlier and the present long-run cases. It is likely that neither U.S. banks nor U.S. depositors consider the Euro-dollar market an important long-run source of funds for investment. As noted earlier, most Euro-dollar activity is contracted on a very short-term basis. It seems that the Euro-dollar market's potential either to distort or enhance long-run policy objectives is slight. If, however, Euro-dollar activity is important in "long-run" borrowing and depositing decisions the potential for distorting policy objectives would seem to be greatest during a sustained expansionary period. To see this, consider Case III.

**Case III**

Under Case III conditions, U.S. banks are unable to attract new deposits by offering higher explicit rates and alternative sources of funds such as Euro-dollar borrowing become increasingly important. If this borrowing offsets deposit leakages to the Euro-dollar market, the net impact on the multiplier is expansionary. If under these long-run conditions, expansionary policy tends to raise inflationary expectations
and hence interest rates, potential Euro-dollar effects are probably
greatest for an expansionary policy. If Euro-dollar depositing
dominates borrowing, the market's net long-run effect dampens the
monetary expansion. Since the Fed now maintains no interest-rate
ceilings on large CDs and Euro-dollar borrowing and CDs are subject to
the same reserve requirements, Euro-dollar borrowing is a less
important source of liabilities for banks. This is evident from the
drastic reduction in U.S. bank borrowing from the 1969 monthly high of
$14.5 billion to the modest $2.5 billion figure of April 1975. Euro-
dollar depositing since 1969, however, continues to exhibit a modest
upward trend, exceeding Euro-dollar borrowing for all but six months
from January 1973 through April 1975. To the extent that Euro-dollar
activity responds to higher interest-rates caused by a sustained
expansionary policy, it would seem that the market's potential net
impact is a slight dampening of long-run expansionary policy.

An Historical Interpretation

Assessing the true impact of Euro-dollar activity on the U.S.
money-supply process is a difficult task. The foregoing analysis was
presented in terms of the maximum potential impact of the market. For
reasons described earlier in the chapter it is highly unlikely that the
actual impact of Euro-dollar activity on the base has ever been very
large and it is not possible to sort out from existing data the actual
effect of this activity. This makes it virtually impossible to
evaluate the contribution of Euro-dollar borrowing and depositing to
changes in the money-multiplier. Nevertheless, an examination of

In Table 4.4, yearly averages of monthly multipliers are given. The first column presents the averages for the "actual" multipliers while the second gives the average multipliers calculated on the assumption that the full-potential impact of Euro-dollar effects are, in fact, realized. In other words these multipliers represent the maximum potential multiplier if Euro-dollar considerations are specifically incorporated. It must be kept in mind of course, that the actual multipliers \( m_t \) have embodied in them the actual impact of all portfolio adjustments including actual Euro-dollar influences. Further examination of Table 4.4 suggests that the biggest impact, if any, of the Euro-dollar market came between 1968 and 1972.

Our analysis suggests that Euro-dollar effects are probably strongest during periods of sustained monetary contraction and when interest rates exceed Regulation Q ceilings. The years 1966, 1968, 1969, and 1973 can be identified as periods during which the Fed was attempting to restrain monetary growth. Table 4.5 reveals that during 1968 and 1969 the \( \beta \)-ratio increased drastically while during 1966 the increase was significant but much smaller in magnitude. By 1973, the imposition of reserve requirement greater than or equal to those of large CDs and the removal of interest ceilings on large CDs had eliminated important advantages of borrowing Euro-dollars. However, the significant increase in the \( \alpha \)-ratio during 1973 suggests that some depositors sought the higher returns available in the Euro-dollar market. Inspection of the \( \alpha \) and \( \beta \)-ratios suggests that if Euro-dollar
Table 4.4

Mean Yearly Multipliers 1964-1974

<table>
<thead>
<tr>
<th>Year</th>
<th>$m_1^*$</th>
<th>$m_1$</th>
<th>$\Delta m_1^*$</th>
<th>$\Delta m_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>2.924</td>
<td>2.892</td>
<td>-.6%</td>
<td>- .7%</td>
</tr>
<tr>
<td>1965</td>
<td>2.904</td>
<td>2.873</td>
<td>-.1%</td>
<td>+ .3%</td>
</tr>
<tr>
<td>1966</td>
<td>2.873</td>
<td>2.883</td>
<td>+.2%</td>
<td>+10.1%</td>
</tr>
<tr>
<td>1967</td>
<td>2.821</td>
<td>2.859</td>
<td>+6.1%</td>
<td>+.2%</td>
</tr>
<tr>
<td>1968</td>
<td>2.827</td>
<td>3.033</td>
<td>+1.2%</td>
<td>-3.2%</td>
</tr>
<tr>
<td>1969</td>
<td>2.851</td>
<td>3.347</td>
<td>-1.6%</td>
<td>-2.0%</td>
</tr>
<tr>
<td>1970</td>
<td>2.816</td>
<td>3.247</td>
<td>-1.5%</td>
<td>+11.9%</td>
</tr>
<tr>
<td>1971</td>
<td>2.793</td>
<td>2.862</td>
<td>+10.4%</td>
<td>+10.4%</td>
</tr>
<tr>
<td>1972</td>
<td>2.837</td>
<td>2.770</td>
<td>+1.6%</td>
<td>+1.6%</td>
</tr>
<tr>
<td>1973</td>
<td>2.744</td>
<td>2.746</td>
<td>+2.3%</td>
<td>-2.5%</td>
</tr>
<tr>
<td>1974</td>
<td>2.744</td>
<td>2.746</td>
<td>-3.3%</td>
<td>-2.5%</td>
</tr>
</tbody>
</table>

Table 4.5

Yearly Averages of Selected Ratios 1964-1974

<table>
<thead>
<tr>
<th>Year</th>
<th>$r^2$</th>
<th>$r$</th>
<th>$t$</th>
<th>$k$</th>
<th>$\beta$</th>
<th>$\alpha$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>.085</td>
<td>.086</td>
<td>.973</td>
<td>.276</td>
<td>.009</td>
<td>.004</td>
</tr>
<tr>
<td>1965</td>
<td>.084</td>
<td>.084</td>
<td>1.081</td>
<td>.277</td>
<td>.012</td>
<td>.005</td>
</tr>
<tr>
<td>1966</td>
<td>.082</td>
<td>.082</td>
<td>1.165</td>
<td>.283</td>
<td>.020</td>
<td>.006</td>
</tr>
<tr>
<td>1967</td>
<td>.079</td>
<td>.080</td>
<td>1.265</td>
<td>.287</td>
<td>.027</td>
<td>.007</td>
</tr>
<tr>
<td>1968</td>
<td>.077</td>
<td>.078</td>
<td>1.264</td>
<td>.275</td>
<td>.039</td>
<td>.009</td>
</tr>
<tr>
<td>1969</td>
<td>.076</td>
<td>.079</td>
<td>1.230</td>
<td>.277</td>
<td>.074</td>
<td>.008</td>
</tr>
<tr>
<td>1970</td>
<td>.076</td>
<td>.078</td>
<td>1.239</td>
<td>.284</td>
<td>.066</td>
<td>.006</td>
</tr>
<tr>
<td>1971</td>
<td>.072</td>
<td>.073</td>
<td>1.415</td>
<td>.285</td>
<td>.017</td>
<td>.005</td>
</tr>
<tr>
<td>1972</td>
<td>.069</td>
<td>.070</td>
<td>1.538</td>
<td>.288</td>
<td>.007</td>
<td>.003</td>
</tr>
<tr>
<td>1973</td>
<td>.063</td>
<td>.063</td>
<td>1.692</td>
<td>.290</td>
<td>.008</td>
<td>.012</td>
</tr>
</tbody>
</table>

*aYears for which two r-ratios differed significantly.*

$^2$r’-ratio calculated to reflect ratio of total bank liabilities including Euro-dollar borrowing.
forces are at all important one would expect to see increases in the multiplier for 1966, 1968, and 1969 and a decrease in 1973. Only for 1968 and 1969 does the multiplier conform to those expectations. Of course, other factors influencing the multiplier were probably more important than Euro-dollar forces.

During 1969 U.S. monetary control would have been affected most by Euro-dollar activity. The ratios in Table 4.5 reveal evidence of the role played by Euro-dollar borrowing. During 1969 the t-ratio (here measured to include CDs) declined from the previous year for the only time in the decade. This alone argues for an increased multiplier. A major reason for this reduction lies in the constraint imposed by Regulation Q. Large CDs declined from $23.8 B in December 1968 to $11.1 B a year later (figures not seasonally adjusted). Other time deposits registered a very slight increase of $1 B. During the same year Euro-dollar borrowing grew from $7.2 B to $14.3 B reaching a peak in November of $14.7 B). It appears, then, that banks were able to replenish some lost CDs with Euro-dollar borrowing and thereby free some reserves. The reserve ratio, measured to include Euro-dollar borrowing ($r'$), reflects this effect showing a slight decline, in opposition to the slight increase if borrowing is neglected ($r$). The impact of Euro-dollar borrowing (EDB) is even more pronounced if one examines only the first eight months of 1969. During this period CDs declined by $10.8, while EDB increased by $7.3 B, implying that loanable funds of commercial banks declined by only about $3.0 B (after reserve requirements against CDs are taken into account). Without access to the Euro-dollar market, banks would have been more
severely constrained. Even so, however, the impact of this borrowing on the money supply was probably quite small. For every $1 B of CDs replaced by EDB between $30 M and $60 M of reserves were freed: Thus, the impact on the money supply process is likely to be small.

In other years, the Euro-dollar's impact on U.S. monetary policy is even smaller, as movements in other ratios are likely to have swamped Euro-dollar effects.

Summary

Our multiplier model specifically incorporates potential Euro-dollar effects. The analysis explicitly recognizes the potential impact of the Euro-dollar market on U.S. monetary policy. Specific conditions for its influence are discussed and examined. While the evidence seems to lead to the conclusion of little impact on U.S. policy, certain periods appear to have been more influenced by Euro-dollar activity. In addition, during those periods, particularly 1969, it is fairly obvious that U.S. banks were able to minimize the distortion created by effective Regulation Q ceilings through Euro-dollar borrowing. However, the impact of this borrowing on the overall money supply was probably quite small.

In at least two studies of the U.S. money supply process, Burger [13, 15] has argued for the improvement in control over monetary aggregates if specific recognition is given to feedback effects through the multiplier. Burger's procedure calls for forecasting the multiplier from historical observed multipliers and lagged percentage changes in the Treasury bill rate. As Burger reports, this procedure usually
results in smaller forecasting errors than merely setting the growth rate of the base equal to the desired growth rate of money. Our analysis points out the potential distortionary effects due to the Euro-dollar market. Hence a procedure that implicitly takes account of all forces affecting the multiplier by forecasting multipliers from past values, may improve monetary control. This would be particularly true of periods when portfolio adjustments by the public and banks alter the $t, r, b, c,$ and potential $\beta$ and $\alpha$-ratios, and ultimately in the multiplier.
FOOTNOTES TO CHAPTER IV

1. Of course, banks have been able to augment funds lost through disintermediation with other sources of funds, such as the issuance of capital notes. CD's, Euro-dollar borrowings and capital note issues are all relatively new sources of funds for banks that many have considered to be "innovations" in banking. For a discussion of this phenomena see [21].

2. See Little [41, pp. 228-42], Clendenning [17, p. 135], and Bell [7, Chapter 6].

3. For an analysis of this behavior by commercial banks see Kane and Malkiel [37], Goldfeld [28, pp. 15-20].


6. This borrowing effect embodies both potential (through the balance-of-payments) and actual effects (through changes in reserves due to liability switching).

7. This assumption is essentially a restatement of the "needs theory" of borrowing. (See Goldfeld [28, p. 43-50]). While it is not necessarily true that banks never borrow from the Fed for profit, the assumption stated in the text permits us to focus on Euro-dollar borrowing for "profit" considerations. Relaxation of this assumption would not significantly alter the conclusions.

8. See Goldfeld and Kane [29, esp. pp. 503-504].

9. Alternatively we could represent as the ratio ED_B/(D_p+T) or ED_B/(D_p+T+D_f). However, the specification in the text greatly simplifies the exposition without altering the implications of the model.

10. Euro-dollar loan rates, in general, exceed nominal U.S. loan rates. This suggests that banks borrow Euro-dollars at a net loss. However, requirements for compensating balances of borrowers, serves to raise U.S. banks' effective lending rates. In addition, as the analysis offered by Kane and Malkiel implies, banks may be willing to lend at a
short-term loss to avert damage to valuable customer relationships (and hence long-run profits).

11State reserve requirements on non-member banks are embodied in the vault-cash ratio which includes that portion of non-member bank reserves, held as cash. Non-member bank reserves held as deposits with either member banks or the Fed itself are incorporated into measured required reserves.

12The index of interest-rates, $i$, can be thought of as a weighted average of all relevant interest rates. The elasticity of the jth interest rate with respect to $i$ represents the weighting factor. In general $E(ij,i) > 0$ for all $ij$.

13For a detailed discussion see Burger [12, p. 68].

14Partial elasticities of the $\beta$-ratio with respect to U.S. Treasury bill yields ($RUS1$) and Euro-dollar loan (RED2) rates were estimated for the period January 1966-April 1975. A Cochrane-Orcutt technique was employed to correct for serial correlation. Results of estimating the elasticities reveal:

$$ F4.1) \log \beta = -4.81317 + .583 \log RUS1 $$
$$ (-5.26) \quad (2.09) $$
$$ -.055 \log RED2 \quad R^2 = .954 $$
$$ (-.25) \quad D-W = 2.0878 $$

While the signs of both elasticities conform to expectations only the U.S. interest elasticity is significant. This, of course, implies that $E(\beta,i) > 0$ for the time period covered by this study.

15Calculation of partial elasticities for the $\alpha$-ratio were also performed in the manner described above. The U.S. certificate of deposit rate ($RUSCD$) was also included since CDs and Euro-dollar deposits are considered substitutes. (The 90-day Euro-dollar deposit rate REDL was used in place of RED2). Estimation reveals:

$$ F4.2) \log \alpha = -4.96021 - .158 \log RUS1 $$
$$ (-15.65) \quad (-.959) $$
$$ -.098 \log RUSCD + .387 \log REDL $$
$$ (-.547) \quad (3.473) $$

Once again these results imply that $E(\alpha,i) > 0$, conforming to the assumption made in the text that $E(\alpha,i) > 0$.

16If $E(D_p,i_s)$ dominates, then $E(t,i)$ is constrained to be always non-negative.

17Burger explicitly ignores any effect a change in $t$ has on $\Gamma$ (p. 37).
Brunner and Meltzer [10] in Appendix III derive this result for the index of interest-rates on bank earning assets. Burger [12] presents a similar derivation. Burger [12, p. 125-130] points out that when inflationary expectations are included (long-run), that the sign of 4.51 may be positive.

Multiplying both sides of 4.52 by $B_a/M_1$ produces:

$$4.52a) \quad E(M_1,B_a) = 1 + \left(\frac{\partial m_1}{\partial i}\right)\left(\frac{\partial i}{\partial B_a}\right) \cdot \beta_a \cdot \left(\frac{B_a}{M_1}\right)$$

Multiplying the second term on the R.H.S. of 4.52a) by $(i/m_1)$ $(m_1/i)$ and rearranging produces 4.53 (in text).

Burger, [12, p. 102]. This assumption implies $E(t,i) \rightarrow 0$.

However, the previous discussion suggests low values for $E(b,i)$.

This interpretation comes from a careful reading and inspection of the monthly reports of the FOMC contained in the Federal Reserve Bulletin (1966-1975).

In fact, as Burger [14, p. 83] notes, it was the only decline since 1951.
APPENDIX 4.1

Some Comments on a General-Equilibrium Model That Incorporates the Euro-Dollar Market

Hewson and Sakakibara (H & S) present a general-equilibrium model of world financial markets that incorporates the Euro-dollar market. Their model extends the analysis of Brainard [9] and Tobin and Brainard [56] to incorporate foreign and Euro-dollar sectors. A close examination of the model, however, reveals that the main implications of the model, viz., the asymmetry of foreign and United States central-bank monetary actions on interest rates, have little to do with the inclusion of the Euro-dollar market. At the same time, the importance of the Euro-dollar market when capital controls prevent direct capital flows between countries goes unnoted.

Consider first the Euro-dollar's role in the model's major implications. In the complete version of the model, H & S conclude that "the integration of world money markets does not reduce the effectiveness of United States monetary policy in dealing with her domestic economy." [31, p. 26]. On the other hand, the directional impact on interest rates of actions by the foreign central bank is ambiguous. H & S correctly attribute these findings to the key assumption that the United States dollar serves as the only international reserve asset. The logical conclusions of this assumption are straightforward. If the
United States monetary authorities can expand (contract) the money supply knowing that any change in the balance-of-payments will not result in an offset in the official monetary base then the policy actions will indeed be unambiguous. However, H & S do not emphasize that including the Euro-dollar market makes no difference to these narrowly-considered conclusions. Retaining all sign conditions of the first four equations of their model and dropping completely the Euro-dollar equations produce the same conclusions about the direction of interest-rate changes. It is therefore not clear what difference the Euro-dollar market makes to their analysis. It is likely that including the Euro-dollar market will affect the magnitude of these interest-rate changes as well as changes in total deposits, since Euro-dollars are a close substitute for United States bank deposits. Thus the partials forming H & S's Jacobian A-matrix are likely to be lower with the addition of these close dollar deposit substitutes. H & S fail to note that the addition of the Euro-dollar market produces different magnitude effects for U.S. policy actions. Of course, as long as the assumption that the dollar is the only international reserve money (i.e., the Federal holdings of United States Treasury bills is the only element of the United States base), the United States policy makers enjoy the advantage of an unambiguous directional impact on interest rates and the money supply (bank deposits only, in their model). However, unlike the multiplier model of Chapter IV, the general-equilibrium model cannot readily analyze differences in lending and depositing interest elasticities under different initial conditions.
H & S also fail to emphasize the implications of including the Euro-dollar market if direct capital movements between countries are prohibited. In [31], H & S construct a simple model assuming autarky and no official-reserve currency. This can be thought of as describing a world in which no capital movements are permitted between countries. Under these circumstances, both countries can unambiguously and independently influence their own domestic interest rates. Including an uncontrolled financial intermediary, such as the Euro-dollar market, alters this conclusion. With capital flows permitted only through the Euro-dollar market, policy actions remain unambiguous but not independent. This suggests, not surprisingly, that if government policy could totally eliminate only direct capital flows between countries, the existence of the unregulated Euro-dollar market would still imply interdependence of policy actions.

The foregoing describes the specific role played by including the Euro-dollar market in the context of H & S's general-equilibrium model. It also suggests the shortcomings of such a model for analyzing the interaction of the Euro-dollar market and United States monetary policy. As noted earlier, the qualitative nature of that analysis does not lend itself to considering the effect of variable interest-rate elasticities under differing initial conditions. Chapter IV specifies more clearly, conditions under which United States policy actions may be impaired.

A few final comments on the "general-equilibrium" approach are offered. It is only in a very narrow sense that H & S's model, like that of Brainard and Tobin and Brainard, is a "general-equilibrium"
model. With income assumed constant in both countries, only the interest-rate effects on portfolio-adjustments are considered. While the single-country model can be fairly easily extended to produce similar conclusions with income as a variable, the same is not true for a two-country model. With two variable incomes in the model, the signs of the H & S's Jacobian matrix no longer conform to the two conditions imposed by two propositions (see H & S [31]) or Tobin and Brainard [56], that are necessary to unambiguously sign the determinant of the matrix. This, in turn, implies that all policy actions are ambiguous. Thus the model is, in fact, not a general equilibrium model but instead a more "complete" partial equilibrium model. This is made even more apparent, when in [33], H & S introduce a number of constraint variables to the model for estimation purposes.

Summary

Summarizing, we have noted a number of "oversights" in the H & S general-equilibrium model. First, the model is not truly a general-equilibrium model but instead a general model of portfolio adjustment in which only prices (interest rates) may vary. The policy implications of the model become ambiguous when income variables are introduced. Second, H & S make little attempt to examine the specific role played by Euro-dollars in their model. The key implications of their model stem from the "key currency" status of the dollar and not from including the Euro-dollar market. We have emphasized that adding the Euro-dollar market does not affect the directional impact of policy actions in their model. Though the model does imply that the magnitude
of effects will differ when the market is included, it does not indicate how much different these effects will be. Third, H & S fail to emphasize the specific intermediary role played by the Euro-dollar market. By beginning from an autarky position and adding the Euro-dollar market, we see that the Euro-dollar market provides an important link between the policy actions of the two countries.

A general-equilibrium model of world financial markets can provide useful insights into the directional impact of policy actions, but the qualitative nature of such analysis makes a quantitative assessment of policy under various conditions quite difficult. The multiplier framework of the preceding chapter, on the other hand, does permit a quantitative evaluation of policy actions under a variety of initial conditions. This latter approach conforms better to the focus of this dissertation.
FOOTNOTES TO APPENDIX 4.1

1For a complete discussion and specification of the model, see Hewson and Sakakibara [31; 32; or 29].

2Their A-matrix is simply a matrix of the partial derivatives of each equation in the system with respect to each interest rate.
CHAPTER V

AN EMPIRICAL INVESTIGATION

Introduction

Chapter IV examined the implications of the Euro-dollar market for U.S. monetary policy in the framework of a domestic money-multiplier. The analysis emphasized the potential nature of Euro-dollar effects while stressing that sorting out such effects empirically in that framework is virtually impossible. One may reasonably ask whether or not an alternative analytic framework exists that produces a more testable model. Hewson and Sakakibara (H & S [31, 32]) have presented a general-equilibrium model to analyze monetary and capital control actions of governments (central banks) as well as the question of multiple Euro-dollar expansion. This approach evaluates policy effectiveness only in terms of the directional impact on interest-rates. Our goal, however, is a more quantifiable implication of the Euro-dollar market's impact on U.S. monetary policy under a variety of conditions. The H & S model is less suited to a quantitative analysis than the model presented in Chapter IV. For instance, the general-equilibrium framework is ill-suited to analyze policy implications when lending and depositing elasticities vary under different initial-conditions. Further, that model generates qualitative conclusions that do not seem to rely importantly on the inclusion of the Euro-dollar market. (See
Appendix 4.1 for a critique of some key features of the general-equilibrium model.)

Chapter IV raised a number of questions concerning the interaction of U.S. monetary policy and Euro-dollar activity. The key empirical issues center on the role of U.S. monetary policy in stimulating both Euro-dollar borrowing and depositing as well as any feedback effects generated by this policy. The analysis suggested that policy actions produce different effects when market rates are high enough that Regulation Q ceilings effectively limit deposit rate adjustments. This implies that policy effects differ during "tight" money regimes as contrasted to more "normal" periods. Additionally, Regulation Q effects, by themselves, may influence the extent of borrowing and depositing. Further, the model raised the question of the effect of applying reserve requirements on Euro-dollar borrowing.

Chapter IV offers a useful framework for considering the interaction of policy and Euro-dollar activity under a variety of initial conditions. However, its emphasis on the conceptual potential feedback effects of Euro-dollar activity creates problems for testing these issues within that framework. The source of these difficulties is the inability to identify the actual impact of this activity on the U.S. monetary base. A further specification that incorporates the important elements outlined in the preceding chapter is required. As argued in Chapter IV, the greatest potential distortion of United States policy stems from the ready access of U.S. banks to alternative sources of funds, especially Euro-dollar borrowings. We begin, then, by specifying the demand and supply equations for these borrowings. Accurate specifi-
cation of the supply of Euro-dollar borrowings necessitates including the demand and supply of total Euro-dollar deposits, since these deposits necessarily place an upper bound on the volume of lending (to all Euro-dollar customers). Accordingly, demand and supply equations for Euro-dollar depositing are also specified and estimated.

Since the model specifies the demand for borrowing by U.S. banks (measured by gross liabilities to their foreign branches), the ideal deposit constraint would be total dollar deposits at these branches. However, only total Euro-dollar deposits by all parties at all Euro-banks in the United Kingdom are available on a continuous monthly basis covering the time period of this study. Nevertheless total Euro-dollar deposits and those only at U.S. branches probably closely parallel each other. Therefore total Euro-dollar deposits at U.K. banks are to proxy the true loan supply constraint. In Chapter IV, some potential and probable actual effects of Euro-dollar activity on the conduct of U.S. monetary policy were considered. While Euro-dollar activity carries the potential for distorting monetary policies, it was argued that the actual impact on the money supply is likely to be quite small. In this chapter, we investigate the role played by U.S. policy in Euro-dollar activity and the extent of any feedback from this activity to the U.S. money supply.

Summarizing, this chapter undertakes the task of: (1) specifying demand and supply relationships for both Euro-dollar borrowing by U.S. banks and total Euro-dollar depositing; (2) empirically estimating those relationships; and, (3) investigating the interaction of United States monetary policy and Euro-dollar activity. In the following
section, the structural demand and supply equations for borrowing by U.S. banks and total Euro-dollar depositing are specified in general terms. In addition, two equations linking Euro-dollar activity to the growth rate of M1 are introduced. Next, two-stage least squares estimates are reported and discussed. A summary of key findings and their implications concludes the chapter.

Structural Equations for the Euro-Dollar Market: The Demand for Euro-Dollar Borrowings

Euro-dollar borrowings by U.S. banks may impair U.S. monetary policy. This borrowing depends upon the Euro-dollar loan rate and other interest rates. Specifically, Euro-dollar borrowing (EDB) by U.S. banks is assumed to vary inversely with the Euro-dollar loan rate (RED2) and positively with the yield on 90-day U.S. Treasury bills (RUS1). This latter assumption is based on the presumed use of these borrowings for both lending and reserve purposes. As argued in Chapter IV, interest-rate elasticities for Euro-dollar borrowing should be different when tight monetary policies make Regulation Q ceilings effective constraints on banks' ability to attract funds. Accordingly, two additional interest-rate variables (RUS1T and RED2T) are introduced to capture the differential effect when Regulation Q ceilings have been identified as effective.\(^1\) The theory implies that the coefficients for RUS1 and RED2 will be higher and lower (in absolute value), respectively, whenever Regulation Q ceilings impair banks' ability to attract funds.

Several other factors influence U.S. banks' demand for Euro-dollar loans. Banks' demand for various types of liabilities (deposits
and borrowings) derives from the public's demand for earning assets (loans). The greater is the public's demand for loans, the more liabilities banks wish to attract. As noted in Chapter IV and in Kane and Malkiel [37], the demand for loans by "preferred" customers is especially important to banks due to both short- and long-run profit considerations. Even when faced with difficulty in attracting liabilities, due to (say) tighter U.S. monetary policy, banks wish to continue meeting the loan requests of these favored customers. Further, even if banks feel compelled to grant fewer new loans, they are likely to remain committed to previously authorized loans and lines of credit. The current volume of commercial and industrial loans (CL) is taken as a proxy for this loan demand constraint. EDB is assumed to vary directly with the CL.

Banks face a domestic loanable funds constraint (BC) that affects their demand for such external sources of funds as Euro-dollars. This constraint is:

5.1) \( BC = DD + TD - RR \), where DD, TD, and RR designate deposits, time deposits (including large-denomination CDs), and required reserves, respectively. Banks' demand for Euro-dollar borrowings is presumed to be greater, the smaller are their domestic sources of funds.

U.S. banks face an additional constraint due to Regulation Q ceilings (RQC). When RQC are effective, banks are less able to attract additional funds from domestic sources by offering higher deposit rates. When effective, such ceilings may force a greater use of non-deposit sources of liabilities, such as Euro-dollar borrowings. Therefore,
EDB varies directly with this constraint \((Q)\). When RQC are effective one expects to observe a greater spread between market interest rates and deposit-rates. The variable \(Q\), measuring the constraint imposed by RQC, is defined as:

\[
5.2) \quad Q = RUS2 - RUSCD \quad \text{(for 1/66 - 6/70)} \quad \text{and} \\
Q = 0 \quad \text{(for 7/70 - 4/75).}^2
\]

Here \(RUS2\) is the federal-funds rate and \(RUSCD\) is the large-denomination CD issue rate.

Since September 1969, Euro-dollar borrowings by U.S. banks from their foreign branches have been subject to legal reserve requirements under Regulations D and M. This imposes an additional constraint on EDB. In the time period covered by the analysis (1/1966-4/1975) this reserve requirement (EDBRR) was changed three times. Higher reserve requirements against this source of funds reduces, ceteris paribus, banks' demand for EDB.\(^3\)

A key issue under investigation in this chapter is the influence of the Fed's monetary policy on Euro-dollar activity. Realistically, it can be argued that the aforementioned variables, especially the interest rate, loanable-funds constraint, and Regulation-Q variable already capture much of the influence of policy actions. Nevertheless, it seems desirable to capture the specific effect of policy actions alone on Euro-dollar activity. To accomplish this objective, two different types of measures are adopted. First, two dummy variables, EMP and TMP, identify months in which statements issued by the FOMC indicate intended easy and tight monetary policy actions, respectively. Second, a specific quantity measure of policy actions is employed. A number of candidates could serve as measures for policy actions.
Monthly or quarterly growth rates of (or more simply, changes in) the money supply (measured by either M1 or M2) could serve as policy indicators. However, measures of this type fail to recognize that under some conditions a six-percent money growth may signal expansionary policy and in other circumstances such a growth rate may indicate a more restrictive policy. A better measure might specifically take account of past growth rates of money as indicating some "normal" growth rate. Monthly or quarterly deviations from this "normal" rate may then signal changes in policy. It must be noted, however, that even measures of this variety are far from ideal, for structural changes or other conditions may alter the perception of a "normal" growth rate of money. After experimenting with various policy measures, QGM, was adopted as a representative measure. (This and the other variables in the model are defined in Table 5.1.)

Finally a trend variable (TREND) is introduced to the demand-for-EDB equation. As discussed in Chapter II increased familiarity (over time) with the attributes and benefits of a market (or asset) argues for increased use of that asset. Hence one expects EDB to vary directly with TREND as United States banks become more familiar with the advantages of borrowing from their foreign branches. Because the TREND-variable may be a source of bias in the equations, the equations were also estimated omitting this variable. These and other results are discussed in a later section.

The following expression summarizes the structural demand for Euro-dollar borrowings (EDB^D):
Table 5.1. Description and Sources of Variables.

<table>
<thead>
<tr>
<th>Endogenous Variables</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDB</td>
<td>Gross liabilities of commercial banks to their foreign branches</td>
<td>FRB</td>
</tr>
<tr>
<td>EDDUS</td>
<td>Dollar value of total Euro-dollar deposits in London</td>
<td>BEQB</td>
</tr>
<tr>
<td>RED2</td>
<td>Euro-dollar loan rate</td>
<td>WFM</td>
</tr>
<tr>
<td>RED3</td>
<td>Euro-dollar call rate</td>
<td>WFM</td>
</tr>
<tr>
<td>RED2T</td>
<td>RED2 when Regulation Q ceilings are in effect</td>
<td></td>
</tr>
<tr>
<td>RED3T</td>
<td>RED3 when Regulation Q ceilings are in effect</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exogenous Variables</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUS1</td>
<td>Yield on U.S. Treasury bills</td>
<td>FRB</td>
</tr>
<tr>
<td>RUSCD</td>
<td>Issue rate on large certificates-of-deposit</td>
<td>WFM</td>
</tr>
<tr>
<td>CL</td>
<td>Total commercial and industrial loans of U.S. banks</td>
<td>FRB</td>
</tr>
<tr>
<td>BC</td>
<td>Loanable funds of U.S. banks defined by: DD+TD-RR, where DD=total demand deposits</td>
<td>FRB</td>
</tr>
<tr>
<td></td>
<td>TD=totaltime deposits (including CDs)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RR=required reserves</td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
<td>Source</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
<td>--------</td>
</tr>
<tr>
<td>WIA</td>
<td>Total dollar volume of world imports</td>
<td>IFS</td>
</tr>
<tr>
<td>YE</td>
<td>Sum of GNP for U.K. and West Germany, expressed in U.S. dollars</td>
<td>IFS</td>
</tr>
<tr>
<td>RG</td>
<td>German call rate</td>
<td>IFS</td>
</tr>
<tr>
<td>RUS1T</td>
<td>RUS1 when Regulation Q ceilings are effective</td>
<td></td>
</tr>
<tr>
<td>RUSCDT</td>
<td>RUSCD when Regulation Q ceilings are effective</td>
<td></td>
</tr>
<tr>
<td>PYUS</td>
<td>U.S. personal income</td>
<td>FRB</td>
</tr>
<tr>
<td>TREND</td>
<td>Variable to capture effect of increasing familiarity with the market over time</td>
<td></td>
</tr>
<tr>
<td>FL</td>
<td>Discount on the forward pound sterling</td>
<td>IFS</td>
</tr>
</tbody>
</table>

**Policy-Related Variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMP</td>
<td>Dummy variable set equal to one when FOMC minutes indicated tight policy; zero otherwise.</td>
<td>FRB</td>
</tr>
<tr>
<td>EMP</td>
<td>Dummy variable set equal to one when FOMC minutes indicated easy policy</td>
<td>FRB</td>
</tr>
<tr>
<td>QM1</td>
<td>Growth rate of seasonally adjusted M1 over the past quarter (as an annual percentage rate)</td>
<td>FRB</td>
</tr>
<tr>
<td>QGM</td>
<td>Ratio of current QM1 to average of QM1 over the past twelve months</td>
<td>FRB</td>
</tr>
<tr>
<td>GBA</td>
<td>Growth rate of monetary base over past quarter in annual percentage terms</td>
<td>FRB</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
<td>Source</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>QFRBC</td>
<td>Growth rate of Federal Reserve Bank Credit over the past quarter as an annual percentage</td>
<td>FRB</td>
</tr>
</tbody>
</table>

**Sources:**
- FRB- Federal Reserve Bulletin
- WFM- World Financial Markets (Morgan Guaranty)
- IFS- International Financial Statistics (IMF)
- BEOB- Bank of England Quarterly Bulletin
The Supply of Euro-Dollar Borrowing

Euro-banks offer loans to various customers to earn a profit, and a number of factors determine their lending decisions with respect to a particular borrower or group of borrowers. As noted earlier, many Euro-banks are branches of parent U.S. banks. In fact, in this study, all measured Euro-dollar borrowing consists of foreign branch loans to the parent bank. While profit-maximizing behavior by Euro-banks is assumed, one must bear in mind that the relevant profit-maximizer may not be the particular branch but the parent institution. If so, the Euro-bank may lend Euro-dollars to the domestic (United States) branches of its parent bank even though more attractive investments are available. In a recent paper, Baltensperger and Chen [4] present a model that describes such behavior. The model demonstrates that decentralized decision-making by a particular branch (e.g., a Euro-bank) may lead to a different loan volume than would centralized decision-making.

Following Baltensperger and Chen, the centralized decision-maker (in this case probably directly associated with the parent-bank) considers the lending opportunities of all branches. Hence, when profits of the overall firm are the relevant objective, transfers from one branch to another are made whenever "there are differences in the loan and demand functions faced by the individual branches." [4, p. 13]. (This decision-
making process would be further complicated if different tax rates apply to the Euro-banks and the parent institution.) When one considers the long-run profits, that incorporate some notion of customer "relationships," these effects may be even more pronounced. Another closely related consideration should be noted. Banks do not feel equally constrained to grant loans to all customers. As Goldfeld notes, banks "will be less willing to meet the needs of dealers, brokers, or sales finance companies if it is short of funds." [27, p. 19, fn. 12]. If domestic and Euro-banks are part of a common centralized decision-making unit, Goldfeld's observation has particular relevance here. To a large extent the Euro-dollar market is a "wholesale" funds market. Thus the loan opportunities of Euro-banks probably have quite different characteristics than those of the parent banks. This provides additional support for the view that the supply of borrowing by Euro-banks may not conform to more narrowly conceived interest-rate assumptions. The U.S. Treasury-bill rate reflects market conditions in the United States and we expect a positive relationship between EDB and RUS1 under a centralized-decision making structure. The supply of EDB is also likely to be a positive function of Euro-dollar loan rates. If the "accommodative" relationship to its parent bank dominates, EDB may be supplied perfectly elastically to the domestic bank. As with the demand equation, the supply of borrowing to United States banks is likely to be less sensitive to the borrowing rate and more sensitive to the U.S. rate when Regulation Q is effective. We include RED2T and RUS1T to capture the possible effect of this greater willingness of Euro-banks to supply their home offices during tight-money periods.
Underlying these assumptions on RED2T and RUS1T is the additional implicit assumption that the parent bank always faces the more desirable (from the standpoint of long-run, overall profit maximization) demand for loans. If the Euro-bank itself confronts the "better" loan market one would expect its behavior vis-à-vis the parent bank to conform more closely to that implied by strictly internal profit-maximization.

As an alternative to providing Euro-dollar loans to the parent bank, Euro-banks could, after conversion to the relevant currency, invest funds in foreign money-markets. EDB-supply, then, is expected to vary inversely with foreign short-term interest rates (here, measured by the German call-money rate).

Euro-banks may also use the liabilities they have acquired for speculative activity in world money markets. For instance, an anticipated appreciation (or depreciation) of a European currency vis-à-vis the dollar raises (lowers) the cost of lending dollars. A Euro-bank would find it more profitable to borrow dollars, using these funds to acquire the currency expected to be revalued. We include the discount on the forward pound sterling (FL) to capture the effect of this speculative activity on the supply of Euro-dollar loans. Following Black [8, p.85] the discount on the forward pound "...will rise as the pound weakens in sympathy with a revaluation crisis or speculation in gold." Euro-banks are assumed to reduce Euro-dollar lending to U.S. banks when FL increases, and instead sell Euro-dollars for gold or currencies that are expected to be revalued.

Euro-banks, like their domestic counterparts, confront a number of constraints. Euro-banks may only grant loans to the extent that the
the availability of loanable funds permits. This loanable-funds constraint for Euro-banks is their volume of deposits less any precautionary reserves that they hold. As argued in Chapter III Euro-banks probably hold a very small volume of such funds. Niehans and Hewson claim that "... the reserve ratios of (Euro-banks) are very low, certainly much below five percent and possibly as low as 1-2 percent." [5, p. 4]. Hence there seems to be little loss of accuracy in treating the volume of Euro-dollar deposits (EDDUS) as the relevant loanable-funds constraint. Further, this treatment obviates potential specification problems associated with identifying the relevant measure of these precautionary reserves. EDBS, then, varies directly with the volume of loanable funds.6

Euro-banks also face a loan demand by the non-bank public. For U.S. banks, CL proxies this loan demand. Since comparable measures of loan demand for Euro-banks do not exist, the non-bank demand for Euro-dollar loans is approximated by foreign income (YE), with the underlying assumption of a positive relationship between income and loan demand.

The Fed's monetary policy (measured by the two dummy variables EMP, TMP) and the quantity measure (QCM) should affect the supply of EDB. Conventional analysis of policy effects (for instance, that offered by Hewson and Sakakibara [31]) implies that restrictive policy reduces banks' willingness to lend. However, tight policy may divert funds from U.S. banks and toward Euro-banks. Coupled with the "accommodative" relationship between Euro-banks to be more willing to lend to the parent bank during periods of slow money growth (tight money) than otherwise.
Finally for reasons similar to those described in the previous section, \( EDB^S \) is expected to increase over time (TREND) as information, search and other transactions costs fall.

The following expression summarizes the behavioral assumptions of the structural supply equation:

\[
5.4) \quad EDB^S = S(RED2, REDST, RUS1, RUS1T, FL, RG, EDDUS, YE, TREND, TMP, EMP, QGM)
\]

\[
S_{RUS1} < S_{RUS1T}
\]

\[
S_{RED2} > S_{RED2T}
\]

**The Demand for Euro-Dollar Deposits**

The volume of deposits available for lending by Euro-banks limits the Euro-dollar loan-supply. Like the quantity of loans, the volume of deposits is market-determined, making it necessary to specify demand and supply equations for deposits.

The public is assumed to view Euro-dollar deposits as reasonably close substitutes for domestic deposits, particularly large-denomination CDs. This assumption means that EDDUS varies directly with the Euro-dollar deposit-rate (RED3) and inversely with the United States rate on large CDs (RUSCD). Further, the analysis offered in Chapter IV implies that Euro-dollar depositing would be more sensitive to both RUSCD and RED3 when Regulation Q ceilings limit the upward adjustment in CD rates.

Euro-dollars cannot serve directly as a medium of exchange but they can be converted to U.S. monetary assets at maturity or, with an interest-penalty, prior to maturity. Euro-dollars, then, are high-yield,
near-money assets for depositors wishing to hold short-term, liquid assets in a profitable vehicle between transactions. This suggests that Euro-dollar deposits vary directly with some measure of international transactions. For purposes of this study, the dollar value of world imports (WTA) measures the volume of international transactions.

A higher discount on forward pounds (FL) is expected to reduce the public's demand for Euro-dollar deposits, as speculators try to reduce dollar holdings and acquire currencies that are expected to be revalued.

Actions of the FOMC may also affect the demand for Euro-dollar deposits. Tighter monetary policy stimulates the non-bank public's demand for high-yielding assets. It is expected that the demand for Euro-dollars is greater during periods of contractionary policy and smaller during periods of expansionary policy. Hence, EDDUS should vary directly with TMP and inversely with EMP and QGM. Once again, the influence of declining transactions costs over time (TREND) is to increase Euro-dollar depositing.

The demand for Euro-dollar deposits is summarized by:

$$5.5) \text{EDDUS}^D = d(RED3, RED3T, RUSCD, RUSCDT, FL, WTA, + + - - + + + + TRENDS, TMP, EMP, QGM).$$

$$d_{RED3} < d_{RED3T}$$

$$|d_{RUSCD}| < |d_{RUSCDT}|$$

Included in total Euro-dollar deposits are those of the U.S. non-bank public. Euro-dollar depositing decision of this sector may affect the U.S. money-supply (see Chapter IV). Consequently the non-bank public's demand for Euro-dollar deposits is also specified. The U.S. public's
demand for Euro-dollar deposits parallels that of total EDDUS, but some modifications are desirable. Most importantly the transaction variable (WTA) is modified and expressed as U.S. personal income (PYUS). Otherwise the specification remains the same as for EDDUS.

The Supply of Euro-Dollar Deposits

Euro-banks' willingness to provide dollar deposits derives from their demand for dollar-denominated earning assets such as loans and U.S. Treasury bills. Therefore, Euro-banks' supply of deposits to the public is similar in structure and directly related to their supply of borrowings.

It was argued that Euro-banks' profit-maximizing decision making may be most appropriately described in terms of their intimate tie to the parent bank. This "accommodative" link between the two "branches" implies the same kind of analysis for their supply of deposits. However, in this study, EDDUS measures all Euro-dollar deposits at all Euro-banks in the United Kingdom. Thus we are examining the deposit-supply behavior of all U.K. Euro-banks and not only those that are branches of U.S. banks, suggesting that the deposit-supply behavior is most appropriately modelled in terms of the more traditional internal profit-maximizing behavior.

Euro-banks are assumed, ceteris paribus, to provide fewer deposits at high Euro-dollar deposit rates (RED3) than at low deposit rates. At the same time, higher yields on dollar-denominated assets such as Treasury bills (RUS1) induce a greater supply of such deposits, while higher foreign money-market rates (RG) reduce their willingness to supply dollar deposits.
As in the previous three structural equations, interest-rate measures accounting for differential behavior when Regulation Q serves as a constraint, are also included. Higher coefficients (in absolute value) for RUS1T and RED3T would indicate an increased willingness to serve as a deposit intermediary when Regulation Q acts as an effective constraint.

Since Euro-banks' deposit supply derives from the overall demand for loans, one expects to find a direct and positive relationship between the demand for loans and the supply of deposits. Loans to U.S. banks are measured by EDB while loans to the non-bank foreign public are measured by YE.

As argued earlier, Euro-banks may engage in speculative activity by borrowing dollars (increase their willingness to supply dollar deposits) and acquiring the currency expected to be revalued. The supply of Euro-dollar deposits by Euro-banks then is expected to vary directly with the forward discount on the British pound (FL).

Monetary policy may affect the supply of Euro-dollars. If Euro-banks use tighter policy actions to attract additional deposits from U.S. depositors, one would expect a greater supply of deposits when tight-policy prevails and a smaller supply in periods of monetary "expansion." That is, EDDUS\(^S\) varies directly with TMP and inversely with QGM and EMP.

The deposit supply equation is given by:

\[
5.6) \quad \text{EDDUS}^S = S(RED3, RED3T, RUS1, RUS1T, RG, FL, EDB, + + + - - - \\
+ + + YE, TREND, TMP, EMP, QGM)
\]
The foregoing equations include measures of Euro-dollar response to U.S. monetary policy. Chapter IV developed a multiplier analysis to examine, in a theoretical framework, the potential influence of Euro-dollar activity on the money supply. Testing the implications of the model in that particular framework is virtually impossible since we cannot observe the actual effect of Euro-dollar behavior on the monetary base. However, the analysis does suggest ways to link Euro-dollar activity to the domestic money-supply process. This link is provided by the addition of two equations to the above subsystem. The influence of monetary policy actions on Euro-dollar activity is proxied by some monetary growth rate. Feedback from the Euro-dollar market to money growth is provided in two steps. First, the money growth rate \( Q_{M1} \) is linked simply to the growth rate of the base \( G_{BA} \). Second, the measured growth rate of the base, viewed from the sources side (Equation 4.2) depends upon the direct policy actions of the Fed and Euro-dollar activity. The growth of Federal Reserve bank credit \( G_{FRBC} \) is taken as a measure of the exogenous policy component contributing to the growth rate of the base. In addition, growth rates of Euro-dollar borrowing and depositing are included to capture the impact of Euro-dollar activity on the United States monetary base. Finally the declared policy intentions of the Fed \( (T_{MP} \text{ and } E_{MP}) \) are presumed to influence the growth rate of the monetary base. The two additional equations linking Euro-dollar activity and monetary policy are given by:
\[ 5.7) \quad QMI = (GBA) \]

and

\[ 5.8) \quad GBA = (GFRBC, GEDB, GEDDU, TMP, EMP). \]

**Empirical Results**

The structural subsystem of equations described above was estimated by two-stage least squares (2SLS) to reduce simultaneous-equation bias. The estimation procedure employed 112 monthly observations from January 1966 through April 1975. Two variables, WTA and YE are reported only on a quarterly basis. Approximate values for between-quarter months were interpolated by assuming a constant growth (positive or negative) rate within each quarter. Estimated coefficients for the equations are given in Table 5.2. While we experimented with several variations of the monetary policy variable, only the results using the ratio of the current quarterly growth rate of M1 (not seasonally adjusted) to the past 12 months' growth rate are reported. Similar results were obtained by using simple quarterly growth rates of M1 or quarterly changes in M1. However, none of the other various measures (expressed as monthly growth rates of M1 or M2) proved significant in any of the equations.

Before discussing the equations in detail, some general comments are noted. The Durbin-Watson statistics in the equations suggest the presence of positive auto-correlation. To correct for this bias, a Cochrane-Orcutt interative method was used. Estimates of the coefficient of correlation \( \rho \) between current and lagged error terms were estimated and used to transform the variables of the structural equations. The equations were re-estimated as
5.9) \[ Y_t - \rho Y_{t-1} = (1-\rho)\beta_0 + \beta_1 (X_t - \rho X_{t-1}) + e \]

where \( Y_t \) and \( X_t \) are the current (lagged) variables of the L.H.S. and R.H.S., respectively, of the structural equations. Results of this procedure are reported in Table 5.3.7

Reported d-statistics for the final iteration of the two supply equations still indicate positive autocorrelation, leading us to conclude that important variables are omitted from the specification. This conclusion is not entirely surprising since the constraint variables used in both equations are at best rough proxies for the true constraints. In addition, the inability to measure the influence of the institutional link between lender and borrower is consistent with the omitted variables interpretation. For these reasons, one must cautiously interpret the results of the two supply equations.

An additional potential source of bias in the equations is the high degree of collinearity between TREND and several variables (especially the constraint variables BC, CL, WTA, and YE) in the system. Omission of the TREND variable in preliminary estimates of the equations had its most serious impact on the EDBRR variable. Without TREND included, the coefficient for EDBRR in the EDB demand equation was consistently positive and significant. For the most part, other variables were unaffected. Standard errors for all equations and for the variables most highly correlated with TREND are considerably lower when TREND is included. Nevertheless, TREND is included in the final estimation of each equation and is interpreted as a proximate indicator of increased familiarization with the market.
Table 5.2. Two-Stage Least Squares Estimates.

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<td>d=.9899</td>
<td>S.E.=1284.77</td>
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</table>

| EDB-Supply | C | RED2 | RED2T* | RUS1 | RUS1T* | RG | YE | EDDUS | FL | TREND | EMP |
| 4751.03 | (-483.93) | 2940.93 | 2341.18 | -3873.44 | -5.61 | -59.40 | .12 | -473.94 | 112.86 | -1148.19 |
| (1.93) | (-1.23) | (4.25) | (4.36) | (-3.81) | (-.06) | (-6.49) | (2.02) | (-3.73) | (.86) | (-2.32) |
| (-) | (-) | (+) | (+) | (-) | (-) | (+) | (-) | (+) | (-) | (-) |
| EMP | QGM |
| 1415.38 | -303.29 |
| (2.64) | (-1.69) |
| d=.7886 | S.E.=1798.85 |

| EDDUS-Demand | C | RED3 | RED3T | RUSCD | RUSCDT | WTA | FL | TREND | TMP | EMP | QGM |
| -20510.0 | -280.32 | 1245.28 | 375.13 | -1434.46 | .09 | 117.16 | 269.20 | -272.5 | 253.57 | -251.7 |
| (-26.70) | (-.80) | (2.84) | (.99) | (-2.95) | (36.74) | (1.41) | (24.31) | (-.67) | (.53) | (-1.78) |
| d=.7566 | S.E.=1588.39 |
## EQUATION:

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\[ d = 1.2553 \quad S.E. = 4728.26 \]

## EDDU-Demand

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\[ d = 1.1497 \quad S.E. = 309.664 \]

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## GBA

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\[ d = .8030 \quad S.E. = 4.48 \]
Table 5.3. Two Stage Estimates After Correcting For Auto-Correlation.

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|             | d=1.7136 | S.E.=1217.52 |     |     |     |     |     |     |     |     |     |

S.E.= 919.08 d=1.7154
**EQUATION:**

**COEFFICIENTS FOR:**

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#Results of the Third Iteration of Rho, using the Cochrane-Orcutt Method

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**G11**

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| (-) | (7.88) | d=1.9426 | S.E.=4.71 |

**GBA**

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d=1.5856 | S.E.=3.74 |
The Demand for Borrowings

Estimation of the demand for Euro-dollar borrowings by U.S. banks produced coefficients that, for the most part, conformed to prior expectations. Correction for serial correlation left most coefficients significant at the .10 confidence level or better. All interest-rate coefficients conformed to predictions, although the U.S. Treasury-bill rate was significant (in the corrected version) only at a .20 level. Both the Euro-dollar loan rate (RED2) and the Treasury bill rate (RUS1) had a significantly greater impact on borrowing when Regulation Q-ceilings were in effect. This result supports our hypothesis (see Chapter IV) that Q-ceilings increase interest-sensitivity of U.S. banks' borrowing. While the evidence also implies that the deterrent effect of RED2 is significantly greater when Q-ceilings are in effect, the positive influence through the Treasury-bill rate appears to dominate. The significant positive coefficient for the Q-variable itself underscores the importance of these ceilings to the development of Euro-dollar borrowing as an alternative liability source. The results suggest that eliminating ceilings on large denomination CDs (beginning in July 1970) was perhaps the dominant factor lowering borrowing levels during the 1970's.

The coefficient for the reserve requirement against Euro-dollar borrowing (EDBRR) indicates that this constraint was important in reducing borrowing during the seventies. The evidence presented here suggests that even when these reserve-requirements were subsequently lowered, Euro-dollar borrowing did not once again spurt upward because Regulation Q ceilings no longer impaired banks' ability to attract
large CDs.

The other coefficients, except those relating to the policy measures, conformed to à priori predictions. The positive coefficient for \( CL \) supports the view that Euro-dollar borrowings have helped banks maintain loans to "preferred" customers. The negative coefficient for the loanable-funds constraint (BC) supports the assumption that EDB was importantly affected by banks' ability to attract funds through more traditional avenues. While the TRENDS variable may capture several effects and may also produce bias in the estimation (as noted earlier), its significant positive coefficient tends to confirm the importance of increased familiarization to the growth of Euro-dollar borrowing.

The monetary policy variables, taken by themselves, lead us to reject the hypothesis that policy actions importantly affected Euro-dollar borrowing. While IMP carries a significant coefficient of the anticipated sign in the initial estimation, the coefficient is insignificant after adjusting for autocorrelation. Though this evidence does not support the hypothesis of an important policy response, coefficients for the other variables in the EDB-demand equation suggest the opposite. Our "direct" policy measures may be poor indicators of the true policy stringency (or ease). First, the dummy variables themselves are based on an interpretation of FOMC statements of the policy being sought during that month. Until 1970, the main emphasis of these policy directives was on credit-market conditions (interest-rates), though proviso-clauses usually contained some reference to an alternative indicator (e.g., bank credit). The equations were estimated with these dummy-variables re-defined to account for these
differences in policy emphasis, but the results were not appreciably altered. Another problem associated with the "quantity" policy measures is discussed in footnote 4 of this chapter. The coefficient for QQM, while opposite in sign to expectations (given our interpretation of that variable), was not significantly different from zero. When the equations were estimated using interactive measures of QQM and TMP or EMP, the results were essentially the same as those reported.

Other variables in this equation probably capture a large part of the policy effects. Strong negative coefficients for BC and the coefficients for the various Regulation Q effects (Q and RUSIIT) support the importance policy actions, especially when Q-ceilings are operative.

Taken together the results of estimating this equation suggest two conclusions. First, "tight" or "easy" monetary policy actions alone were not significant in affecting Euro-dollar borrowing by U.S. banks, but when tight policy actions forced market interest rates to levels that rendered Q-ceilings effective, U.S. banks borrowed more extensively from their foreign branches.

Second, the effect of applying reserve requirements to borrowing in 1969, while contributing to an initial sharp reduction in this borrowing, was enhanced if not dominated by removing Regulation Q-ceilings for large CDs.

The Supply of Euro-Dollar Borrowings

Estimation of the EDB-supply equation produced ambiguous results. At first glance it appears that the behavior of Euro-banks is not accurately described by an accommodative relationship to the parent
bank. The interest-rate incentive to lend (RED2) is significantly higher (not lower, as the theory suggests) when Q-ceilings are effective (RED2T). In fact, the reported results imply that the Euro-dollar loan rate carries a significant positive coefficient only when these ceilings are an effective constraint.\textsuperscript{11} (Under more "normal" conditions, the coefficient is not significantly different from zero.) Further, the negative coefficient for RUS1T suggests that Euro-banks are less accommodative when Q-ceilings operate than otherwise. The results actually imply that when Q-ceilings are effective, Euro-banks operate in a manner consistent with traditional internal-profit-maximizing theory.

Though multicollinearity of the rates or an inappropriate specification of the equation could produce these apparently perverse coefficients, an alternative explanation exists that is consistent with the centralized decision-making view of U.S. and Euro-banks. The Baltensperger-Chen analysis implies that some branches may "subsidize" other branches that have more "profitable" lending opportunities. Coefficients for RED2 and RUS1 support this accommodative relationship for banks during "normal" periods. However, when Q-ceilings become effective, it may well be the case that the Euro-bank branches face equally or more attractive lending opportunities than the parent bank. Parent bank loan customers, possibly aware of lending difficulties within the United States, may go directly (or be referred) to the foreign branch. Further, tight money conditions elsewhere may generate a greater than "normal" demand for Euro-bank loans. In other words, the Euro-banks may become less passive accommodators of parent-bank loan
requests under these conditions simply because they now face the more "profitable" lending conditions.

Other coefficients carried the anticipated sign in the "uncorrected" version, though RG was not significant. In the transformed equation, the loanable funds constraint variable (EDDUS) proved insignificant, suggesting that total Euro-dollar deposits are not an effective constraint on lending to the parent bank. This result is not surprising, since loans to U.S. banks are but a small fraction of total Euro-dollar deposits and, as noted, EDDUS itself is only a proxy for the true constraint. The significant negative coefficient for YE suggests that greater loan demand by the non-bank public diminishes Euro-banks' lending to the parent bank. The significant negative coefficient for the speculative variable (FL) indicates that foreign exchange market activity has an important effect on lending to U.S. banks.

The three policy measures yield ambiguous results and must be interpreted cautiously. On the one hand, the negative coefficient for QGM conforms to expectations based on an accommodative relationship and the interpretation that higher QGM signals monetary ease. (This coefficient, however, is not significant in the transformed version of the equation.) While only TMP is significant in the transformed version, coefficients for both TMP and EMP indicate the traditional response of intermediaries to policy actions; i.e., they are more (less) willing to lend when easy (tight) conditions are pursued. If one interprets higher QGM as signalling an impending move toward tightness, these results would appear consistent with each other. They would,
however, argue against a strictly accommodative relationship to the parent bank.

Transforming the variables to account for apparent auto-correlation failed to raise the Durbin-Watson statistics to a level permitting rejection of positive serial correlation. Additional iterations, based on additional estimates of $\rho$, did not improve the $d$-statistic, leading us to conclude that one or more important variables have been omitted. This conclusion may be especially warranted for this equation since at least two variables include (YE and EDDUS) are at best only rough proxies for the true constraint variables. In addition, it is probably impossible to measure the special relationship between lender and borrower in this market. If this kind of relationship is important, it could account for the systematic bias in the error terms implied by the low $d$-statistics.

The Demand for Euro-Dollar Deposits

Estimation of the total demand for Euro-dollar deposits produced some surprising results. Most notably, when "normal" monetary conditions prevailed neither the Euro-dollar deposit rate (RED3) nor the U.S. CD-rate (RUSCD) proved significant. (When TREND is omitted, the rates are significant, but the standard error of the equation is much higher.) When Regulation Q ceilings are in effect, the coefficients for RED3 and RUSCD are significantly higher (in absolute value). While this is not true for the transformed equation, the implied coefficient for RED3T and RUSCDT are significant at the .10 and .20 level respectively. (These coefficients and their $t$-statistics are:
for REDST 701.40 (1.86) and for RUSCDT, -622.67 (-1.54).

These results support the view that restrictive regulatory practices of governments were an important cause of growth of the market (see pp. 12-13). The strong positive coefficient for WTA indicates that Euro-dollar deposits have been an important short-term near-money asset for international traders. The highly significant coefficient for the TREND variable suggests an important role played by familiarization with the market. Of course, TREND probably captures a number of other effects as well, including general economic growth and greater sophistication of international markets. As noted it also biases the interest-rate coefficients. Coefficients for the two dummy policy variables were not significant. The coefficient for the quantity measure of monetary policy reveals that tight money conditions contributed to total Euro-dollar deposit growth. Speculation in foreign-exchange markets, as measured by FL, does not appear to influence Euro-dollar depositing importantly.

Estimation of the United States public component of total Euro-dollar depositing (EDDU) proved disappointing on several counts. In the transformed equation both interest-rate coefficients carried the wrong sign. The Q variable was included directly since presumably U.S. depositors are importantly affected by that constraint. However, the coefficient did not prove significant.

In addition, only the transactions demand variable, PYUS carried a significant coefficient of the expected sign. The policy coefficients were similarly disappointing as only TMP was significant (at the .20 level). Perhaps the real source of difficulty in this
estimation is a deficiency in the data measuring EDDU. Since EDDU (defined as dollar-deposits claims of the non-bank U.S. public) was available only at quarterly observations until April 1968, twenty-one of the first thirty observations were interpolated. However, quarterly estimation of the equation proved even more disappointing which may suggest that the equation is mis-specified. Experimentation with alternative measures of the independent variables failed to improve the estimates. An additional problem may be that an important part of actual deposits are not reported to the Fed. Deposits of U.S. foreign-subordinates would not be included in this total yet such deposits are probably the most sensitive to U.S. and Euro-dollar interest rates. Because this variable is probably the least reliable of any in the study and because the results seem to be much more sensitive to specification error, any interpretation of these results is, at best, suggestive.

To the extent any conclusions can be drawn, the available evidence suggests that Euro-dollar depositing is not particularly sensitive to U.S. or Euro-dollar interest rates on U.S. monetary policy actions.

The Supply of Euro-Dollar Deposits

The equation describing Euro-banks' supply of Euro-dollar deposits reveals that loan demand (EDB and YE) from both U.S. banks and the non-bank public are significant and of the expected sign. The apparently greater importance of foreign or non-bank demand for loans is not surprising in view of the fact that EDDUS measures Euro-dollar deposits at all Euro-banks in the United Kingdom.
The significant coefficients for the German call-rate (RG) supports the presumption that higher yields in other money markets discourages Euro-dollar intermediation. The positive coefficient for the discount on the forward point (FL) is consistent with the implications of a negative coefficient for the same variable in the EDB-supply equation. That is, it appears that Euro-banks actively borrow dollars (supply deposits) to acquire currency (or gold) which they expect to be revalued.

Coefficients for the Euro-dollar (RED3) and U.S. interest rates (RUSI) are more difficult to interpret. Both are opposite in sign to our expectations. It may be that RED3 captures the effect of a higher loan rate which is closely related to the deposit rate and we cannot rule out the possibility that the estimated equation is actually a deposit-demand equation. Implied coefficients for RED3T and RUS2T, while significantly lower and higher respectively than the coefficients under "normal" conditions, are themselves not significantly different from zero.

In addition, the low d-statistics, even after three iterations of \( \rho \) suggest that important variables have been omitted and may be an important source of bias in the estimated rate coefficients. The insignificant policy coefficients suggest that the Fed's actions do not importantly influence Euro-banks' supply of deposits.

**The Money-Growth Equations**

The two equations linking the Euro-dollar market to the United States money-supply process reveal some rather interesting results. Not
surprisingly, nearly 99 percent of the growth rate of M1 is accounted for by the growth of the monetary base. The negative, though insignificant, constant term suggests that other factors (e.g., changes in the multiplier) tend to offset changes in the base. Euro-dollar effects had a small but significant impact on the quarterly growth rate of the monetary base. The growth rate of Euro-dollar borrowing by U.S. banks appears to have had a significant impact on the growth of the base, while the growth of depositing has not. During 1969, monthly Euro-dollar borrowing increased at an average annual rate of about 67-68 percent, suggesting that, by itself, Euro-dollar borrowing resulted in a money supply in 1969 about $2 billion greater than it would have been otherwise. The reduction and stabilization of the growth rate of EDB since the imposition of reserve requirements and the removal of Regulation Q-ceilings for large CDs suggests that EDB probably has had little or no impact on the U.S. money supply since the late 1960's. Further, even the $2 billion bulge in M1 attributable to EDB in 1969 probably does not represent a "serious" impact on overall monetary policy. However, a potentially serious effect of Euro-dollar activity arises from the uneven access banks have to this source of funds. That is, large banks may be more able to avoid the consequences on a monetary contraction than small banks.14

Coefficients for TMP and EMP lead to an interesting interpretation. The coefficient for TMP suggests that the quarterly annual growth rate of the base is nearly 34 percentage points lower when the Fed has stated it is pursuing a tighter credit condition. On the other hand, when the FOMC has stated an intended easing of credit conditions
the growth rate of the base does not differ significantly from more "normal" times.

Summary

A number of propositions about the interaction of Euro-dollar activity and United States monetary policy were tested. Structural demand and supply equations for Euro-dollar borrowing by U.S. banks and total Euro-dollar depositing were specified. The equations tried to account for differential interest-rate effects when Regulation Q ceilings were effective. In addition, the borrowing supply equation was modelled in terms of the special relationship between borrower and lender. All equations included both dummy variables and "quantity" variables to measure the monetary policy effect on Euro-dollar activity. Additionally, interest rates contained in the equations may also reflect policy actions. Specific measures of the direct effect of Regulation Q and the reserve requirements against Euro-dollar borrowing were included to gauge their impact on U.S. banks' demand Euro-dollar loans. A dummy (TREND) variable was included to capture the influence of growing familiarization with the market over time. Finally, two additional equations provided the link between Euro-dollar activity and the United States money supply process.

Estimation of the equations produced some rather interesting results. While the conclusions these estimates suggest are not entirely novel, the model underscores more than previous studies, the role of Regulation Q ceilings on Euro-dollar borrowing.

As suggested in Chapter IV, Euro-dollar borrowing sensi-
tivity to U.S. interest rates proved greater when Q-ceilings were operative. Similar results held for total Euro-dollar depositing, supporting the widely circulated notion that the Euro-dollar market owes much of its growth to government interference in market adjustments.

The reported evidence further suggests that borrowing induced by these Q-ceilings had a small but significant impact on the U.S. monetary base and ultimately on the money supply, contributing roughly an additional $2 billion to M1 during the peak borrowing year (1969). The Fed has been effective in reducing this potentially distortionary offset to policy actions by imposing reserve requirements against such borrowing and more importantly by eliminating interest ceilings on large CDs.

The evidence then supports the view that restrictive U.S. monetary policy actions, when coupled with the constraint of Regulation Q, contributed importantly to Euro-dollar borrowing. Evidence implied by the coefficients for the several "direct" policy measures do not support the view that policy actions exerted an important influence on Euro-dollar activity. To the extent that the ratio of quarterly growth rate of M1 to some "normal" growth rate is a meaningful measure of monetary policy, the evidence does not strongly support its influence on Euro-dollar activity. Interpretation of evidence based on this variable needs to be very cautious, in any event. From the supply side, Euro-banks appeared to be affected by "tight" or "easy" money conditions in a way consistent with the traditional transmission of policy actions through intermediaries. Support for the view that Euro-banks' lending
to its "parent" United States bank is dictated by overall profit-
maximization of the firm was inconclusive. However, behavioral
implications of such a view were, at least in part, supported by the
evidence.
FOOTNOTES TO CHAPTER V

1 Regulation Q ceilings were considered effective (dummy variable set equal to one) whenever the difference between the statutory ceiling rate (RQCO and the certificate-of-deposit rate was zero (or negative). Thirty-seven months were so identified.

2 The removal of these ceilings initially applied to only short-term CDs. Euro-dollar borrowings are probably considered a close substitute for these liabilities in particular.

3 Hewson and Sakakibara [33] also use two additional dummy variables to capture the marginal effect of these reserve requirements. Only one of these dummies carried a statistically significant coefficient in preliminary regressions by this writer. However, the coefficient appeared to be sensitive to the specification of the equations. For this reason and to limit the analysis as far as possible to measurable data, these as well as other dummy variables used by Hewson and Sakakibara were omitted. It should be noted that the strong correspondence between their various dummy variables and the disturbance terms could account for their much higher Durbin-Watson statistics.

4 An additional problem of such measures relates to how banks expect the Fed to behave in coming months. For instance, The Wall Street Journal recently reported that the rapid increase in the money stock over the previous week led many observers to abandon hope for a further relaxation of credit conditions since the Fed would now need to pursue a slower growth rate in order to achieve its long-run desired rate. For additional discussion of this view see Kane (AER, Sept. 1974, p. 840).

5 Use of this variable to measure speculative activity is not without precedent. (See [Black, 8] .) Alternative measures, e.g., the premium of forward marks, were not available as a consistent, monthly average over the time period under investigation.

6 As noted in the introduction to this chapter, the ideal constraint would measure only those deposits at U.S. branches. However, this degree of disaggregation does not exist.

7 For a more thorough discussion of this procedure, see [Kmenta 39, pp. 287-89].
8The effect of TREND on the EDBRR coefficient probably cannot be attributed to multicollinearity since TREND and EDBRR are not highly correlated. The positive coefficient for EDBRR when TREND is omitted may also reflect some simultaneity, since the Fed raised the reserve requirements precisely when EDB was increasing rapidly.

9See the following discussion of the EDDUS-demand equation for an additional exception.

10Stanley Black [8, p. 86] argued that the TREND-variable be excluded from borrowing equations after September 1969 when U.S. banks began to reduce borrowing significantly in response to the imposition of reserve requirements. If the TREND-variable is used to capture the increased familiarization with the market, this exclusion does not seem justified. U.S. banks are not likely to "forget" the advantages of Euro-dollar borrowing merely because additional Regulation makes that borrowing more expensive.

11The results for the transformed equation (Table 5.3) imply a coefficient of 1894.16 ($t = 3.51$) for RED2 when ceilings are in effect.

12The initially low d-statistics for the other equations may also be due to mis-specification.

13Mikesell and Furth [49, p. 90] argue that "... there are simply no satisfactory data on holdings of Euro-dollar deposits by U.S. residents to test this relationship the substitutability of Euro-dollars for domestic deposit." This argument suggests that EDDU is indeed a very poor proxy for Euro-dollar depositing by U.S. residents. It further makes the interpretation of the estimated $\alpha$-ratios in Chapter IV more suspect.

14Little [41] argues that the evidence on this uneven access is inconclusive.
CHAPTER VI

SUMMARY AND CONCLUSIONS

This dissertation examined the origins of the Euro-dollar market and several aspects of its implication for world liquidity for monetary policy. The main focus of the dissertation has been the role and influence of Euro-dollar activity on the U.S. money supply. We now summarize the content of each chapter.

Chapter II examined the factors contributing to the origin and growth of the Euro-dollar market in the context of a theoretical model. The chapter considered the market's development in a framework that emphasized the market's function as an efficient intermediary. This approach highlighted information and transactions cost elements that can be used to explain both the development of a Euro-currency market in general and the faster growth of the Euro-dollar market in specific. This emphasis on the market's function provided a basis for the consideration of the market's impact on world and domestic money supplies.

Chapter III considered the propriety of a multiplier analogy of Euro-dollar expansion, to a domestic money-supply process. It was shown that while such analysis is conceptually feasible, the analogy breaks down when one focuses on empirical definitions. The main deficiency of such models even those that appropriately endogenize the public's and bank's behavior, was shown to be the difficulty of distinguishing "base"
from "created" Euro-dollars. This flaw makes interpreting empirically-derived multipliers more difficult and less certain. Theoretical work by other scholars [51] was cited as additional reason to suspect only a minimal independent impact of Euro-dollars on the world money supply. The analysis of Chapter III should be viewed as a complementary argument to the theoretical attack on multiple Euro-dollar creation. Even if Niehans' and Hewson's critique of the multiplier paradigm is rejected, one must successfully resolve the empirical and definitional problems noted in Chapter III, if one is to give a meaningful interpretation to empirically estimated "multipliers."

Appendix 3.1 presented a formal model that drew upon earlier work by Baltensperger and considered the impact of increased familiarization with depositors on optimal precautionary reserves. While the model has general applicability, special features of the Euro-dollar market were noted that argue for its specific application to Euro-bank precautionary reserves. The model predicted that Euro-dollar precautionary reserves would decline as total deposits increased. To the extent that he has appropriately measured these reserves, Makin has produced evidence that supports this view. This analysis implies an increasing Euro-dollar multiplier over time. Failure to observe what would be dramatic consequences of such an expansion further argues that the market does not have the independent effect on world liquidity that many analysts once feared. Consequently, theoretical considerations, available empirical evidence and the legitimacy of that evidence support the rejection of a multiplier paradigm for analyzing independent money-creation from the Euro-dollar market.
While a multiplier framework to analyze independent Euro-dollar creation has several weaknesses, a multiplier analysis of the U.S. money supply that incorporates Euro-dollar effects may prove promising. The conceptual framework of Chapter IV stressed the potential impact of the market on the U.S. money supply process. The model took account of portfolio adjustments due to policy-induced interest rate changes and demonstrated their potential effect on the money multiplier under a variety of conditions. It was argued that these adjustments exert their greatest influence on the money stock when market interest rates are above Regulation Q ceilings. This analysis implies that when the Fed undertakes restrictive policy measures under these conditions, achieving its policy targets may be frustrated. Conventional multiplier models have emphasized this phenomenon through effects on the t- and r-ratios. The analysis suggested that the distortionary impact may be heightened when Euro-dollar effects are considered.

In Appendix 4.1 some criticisms of a general-equilibrium analysis of the Euro-dollar market were offered. While the general equilibrium model is useful in demonstrating policy interdependence and general qualitative implications of policy actions, it is less useful in generating quantitative predictions of policy effects under different initial conditions. The multiplier model underscored the effect on Euro-dollar activity when artificial barriers (e.g., Regulation Q-ceilings) prevent competitive rate adjustments.

It was argued that the multiplier model is useful in deriving policy implications under a variety of conditions but that testing them in such a framework is virtually impossible. Chapter V, then, specified
structural demand and supply equations for Euro-dollar borrowing and depositing that took account of the key implication suggested in Chapter IV. Two additional equations provided the link between Euro-dollar activity and the U.S. money supply. Major attention was given to differential interest-rate effects when Regulation ceilings were in effect. Several measures of policy action were included to capture its influence on Euro-dollar activity. In modelling loan and deposit supply behavior of Euro-banks particular attention was given to the special relationship between lender and borrower. Since measured U.S. bank borrowing from foreign branches was our dependent variable, consideration of implications of this institutional linkage was necessary. Work by Baltensperger and Chen [4] provided the theoretical foundation for the effects of this connection. The emphasis on this institutional link between borrower and lender differentiates this model from previous work. The specification of independent loan and deposit supply equations (by the intermediary) required this consideration. When this "accommodative" relationship is considered, supply responses to changes in interest-rates may differ from those assumed under a more conventional analysis that ignores this relationship.

Chapter V also reported and discussed the two-stage least squares estimation of the model. The evidence tends to support a number of conclusions about the interaction between the Euro-dollar market and U.S. monetary policy. First the Euro-dollar borrowing by U.S. banks seemed to be strongly influenced by the presence of effective Regulation Q ceilings against large denomination CDs. When Regulation Q ceilings combined with high market interest rates there was a significant
increase in Euro-dollar borrowing by U.S. banks. This evidence under-
scores and highlights the singular effect of the Q ceilings themselves.
That is, when policy actions forced interest rates above the Q-ceilings
some important counter-action to the policy came through the Euro-dollar
market. The evidence further emphasized that eliminating Regulation Q-
ceilings for large CDs played a major role in the diminished use by
U.S. banks of the Euro-dollar borrowing facility. Evidence from the
deposit equations also revealed the important impact of these ceilings
in encouraging Euro-dollar depositing. Denied the opportunity to
receive a competitive CD-rate in the U.S. banks, depositors (U.S. and
foreign) seem to have shifted some funds into Euro-dollars. Together
evidence based on Q-related variables supports one argument frequently
mentioned as important in encouraging Euro-dollar activity, viz.,
government interference in market adjustments (see Chapter II).

The evidence cited in Chapter V also supported earlier
conclusions (see [33]) that the imposition (by the Fed) of reserve
requirements against Euro-dollar borrowing played an important role in
reducing U.S. banks' use of this source of funds. However, our
estimates suggested that the elimination of Q-ceilings was probably
more important.

While several coefficients can be taken to indicate an important
Euro-dollar borrowing (and depositing) response to monetary policy
(especially when Q-ceilings were effective) evidence based only on the
policy measures themselves did not support this conclusion. However,
the "direct" policy measures are subject to serious interpretative
problems. First, the monetary growth rate measure was taken to
indicate an expansionary policy if the current growth rate exceeded that of the previous twelve months. It may, however, be taken to indicate that policy will soon be tightening. Second, the dummy policy variables are based on an *ex post* interpretation of F.O.M.C. policy statements. It is certainly possible that banks believed the Fed to be pursuing a policy different from that intended by the F.O.M.C. In conclusion, evidence based on these policy measures should probably not be taken to indicate that Euro-dollar activity did not importantly respond to U.S. policy. In fact, as noted, most of the evidence supports the opposite conclusion. The available empirical evidence also supports the conclusion that Euro-dollar borrowing by U.S. banks did serve to offset somewhat tight policy actions. Our estimates revealed that the growth of Euro-dollar borrowing did have a small but significant impact on the growth of the U.S. monetary base. However, since Euro-dollar borrowing growth declined from 1970 through 1973 before levelling off, it does not appear that the Euro-dollar market poses any serious threat to the conduct of U.S. monetary policy. Even at its peak (1969) the impact on the U.S. money supply of this borrowing was relatively small (about $2 billion).

Estimation of the two supply equations proved somewhat disappointing. The assumed "accommodative" relationship between U.S. and Euro-banks was not conclusively supported or refuted. Even adjusting for presumed serial correlation, however, low Durbin-Watson statistics were taken as indicating omitted variables. Conclusions based on this evidence are therefore suggestive at best.
Finally, evidence based on a dummy variable to capture the effect of increased familiarization with the market proved highly significant. Though this measure may be capturing other effects, it tends to indicate that the market has grown as traders have familiarized themselves with the market's advantages. Further the significance of the transactions measure (volume of world trade) suggests that the market will continue to be an important adjunct to international financial markets. This continued importance will probably contribute to the increasing interdependence among nation's economies.
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[28] Goldfeld, Stephen and Kane, Edward J. "Determinants of Member-Bank


