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EURO-DOLLAR INTEREST RATES

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

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degree of

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BY

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Baltimore, Maryland

1975

EURO-DOLLAR INTEREST RATES

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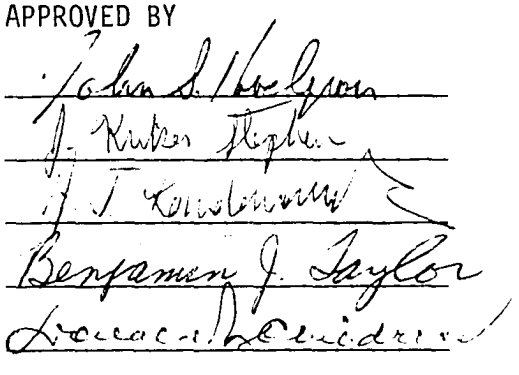

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CHAPTER I

Introduction

The rapid growth and acceptance of Euro-dollars as a new modality for international capital movements has evoked much comment in recent professional and lay journals. Most of these writings, however, presume--as generally accepted knowledge--a faulty concept of the role of the Euro-dollar market in international flows. As this market can affect capital flows with significant impact, the basic role of the Euro-dollar rate must be understood. Exposure and correction of certain erroneous presumptions regarding the fundamental nature of the Euro-dollar rate are the essence of this study.

The question asked here is: What is the role of Euro-dollar interest rates in international capital flows? The answer is important because capital flows represent a significant and potential undermining of economic policy and policy control. Specifically, the flow of capital funds including Euro-dollars can swell or shrink an individual country's balance of payments surplus or deficit on both a liquidity and official measurement basis. Flows can force a country to change interest rates and can force a devaluation or revaluation of one currency relative to another. Because of these potential impacts on any country, the question of whether Euro-dollar rates should be considered as directly linked to U.S. money market rates or as a separate market entity is a question whose answer underlies the very nature of different

policy alternatives.

In general, Euro-dollars and the Euro-dollar market are considered to be an adjunct to the U.S. securities and U.S. money market. Consequently, the Euro-dollar interest rate is considered to reflect U.S. interest rates and control of the Euro-dollar rate is considered to be within the gamut of the normal operations of the Federal Reserve. Evidence developed in this study strongly suggests that this view is incorrect. A new explanation is proposed as an alternative. The Euro-dollar rate can be conceived of as an opportunity cost rate of all interest rates of similar default, market, and liquidity risk. Under this approach, the Euro-dollar rate must be competitive with the highest equivalent interest rate in each country after adjusting for the cost of forward cover to avoid exchange risk. This explanation is substantiated below.

This study concentrates on the question: What is the role of Euro-dollar interest rates in international capital flows? Additionally, it deals with the related question of: What factors are responsible for this role? The format for the subsequent analysis is as follows: The remainder of this chapter describes the basic characteristics of the Euro-dollar market and discusses the significant factors in the sources and uses of Euro-dollars. Chapter Two reviews four particularly relevant contributions--the studies by Hendershott, Kwack, Black, and Branson. A model of the Euro-dollar market and related markets is presented in Chapter Three, along with a discussion of the relevant variables. This chapter also advances hypotheses of inter-relationships between markets and formulates the estimators for the subsequent empirical analysis. Chapter Four describes the data used. Empirical results

and their interpretation are presented in Chapter Five, followed by a comparison between this study's result and others in Chapter Six. Chapter Seven, the conclusion, deals with the implications of the finding that Euro-dollar rates are opportunity cost rates, distinct from U.S. rates.

* * * * *

Euro-dollars are all deposits denominated in U.S. dollars placed with commercial banks outside of the United States including foreign branches of U.S. banks. Most of these bank deposit balances are interest bearing; however, a small number are in "current accounts" maintained by corporations for transaction purposes.[1] A bank which accepts a Euro-dollar deposit receives typically a claim (dollar balance or deposit) on a bank in the United States rather than actual cash. Thus,the Euro-dollar deposit is, in effect, a deposit liability of a U.S. domestic bank due to a foreign bank including foreign branches of U.S. banks.

Close contact among foreign banks which accept and relend the Euro-dollar deposits forms the loose construction of the market. A high degree of interbank activity exists as interest rates among the Euro-banks in various countries are not uniform at any point in time and are constantly being arbitrages both in space (across national boundaries) and in time (among various maturities). The intermediary function of these banks is to amass capital funds, lengthen their term, and channel them via a series of inter-bank depositing and redepositing between the original non-bank depositors and ultimate non-bank lenders.

The wholesale nature of most transactions coupled with the relatively small overhead cost to participating banks allows bankers to operate on a much

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[1]Some writers on this topic define Euro-dollars only as interest bearing deposits, but such specification is unnecessary in describing uses, sources, and implications.

smaller margin in the Euro-dollar market (between Euro-dollar deposit and loan rates) than the margins for overall transactions in the domestic economy. Because it is a wholesale operation and, therefore, not available to all depositors and borrowers, these reduced margins do not compel the Euro-banks to reduce operating margins in their domestic currency transactions.[2]

The immediate depositors of dollars in Euro-banks can be classified as: 1. private individuals, partnerships, and corporations; 2. central banks; and 3. the Bank for International Settlements. However, the underlying source of dollars to these depositors is uncertain. Primary deposits are those deposits which enable the Euro-banking system to increase its holding of cash. The source of primary deposits is generally accepted as ultimately arising from U.S. balance of payments transactions. However, debates continue over the possibility and nature of induced or derivative deposits and on the manner in which U.S. balance of payments transactions give rise to primary Euro-dollar deposits. Arguments over the major sources of Euro-dollar deposit growth follow three general lines.

First is an argument that multiple expansion of Euro-dollars occurs within a Euro-dollar system. The multiple expansion argument is based upon drawing parallels between the U.S. banking system and the Euro-dollar market. Growth of Euro-dollars, accordingly, is based upon the re-depositing of Euro-

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[2]Jane Sneddon Little, "The Euro-Dollar Market, Its Nature and Impact", Federal Reserve Bank of Boston's New England Economic Review, May-June, 1969, p. 3.

dollar loan proceeds with Euro-banks. In a study by Klaus Friedrick[3], a model for both credit and deposit creation is presented. The model shows deposits as an inverse function of 1) reserves held on deposits from non-bank sources, 2) reserves held on inter-bank deposits, 3) the number of intermediaries intervening between the original primary deposit and loan to a non-bank outlet, and 4) leakage in the system. As reserves on both interbank deposits and deposits from non-bank sources are kept at a minimum and the number of intermediaries optimized for profit, the question of multiple creation rests upon the size of leakages. At this point a definitional problem arises. If multiple creation is defined to take place only when Euro-dollar loans are immediately redeposited in the Euro-dollar system, then leakage takes place any time this instantaneous redeposit is absent. Such a definition has lead Kern to list "multiple credit-creation based on fractional banking reserves"[4] and "repeated re-injection into the market of the same dollar held by a non-United States resident"[5] as separate explanations for the source of Euro-dollar deposits. If, instead, multiple creation is defined as a lagged redeposit system with the time for reflow extended in time, the proponents of this source of Euro-dollar deposits would probably increase in number as the specified time period was extended. As Clendenning notes:

> This type of multiple creation is somewhat different from the normal concept of multiple creation in a domestic banking system and is a broader concept that involved a time element arising from the multiple

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[3]Klaus Friedrick, "The Euro-Dollar System and International Liquidity", Journal of Money Credit and Banking, August 1970, p. 342.

[4]David Kern, "International Finance and the Euro-Dollar Market, "National Westminster Bank Review, November 1971, p. 18.

[5]Ibid., p. 19.

rounds of transactions that could occur outside the Euro-dollar system before any deposit reflow takes place.[6]

Given this broader definition of multiple credit creation, proponents feel that while leakages may be great, the multiple creation of deposits and loans has been a significant factor in the expansion of the Euro-dollar market. Manipulation of the Friedrick model illustrates that "The point here is not to deny that leakage is an important constraint but to show that even with considerable leakage, the proposed deposit creation multiple (using inter-bank plus non-bank deposit reserves plus intermediary turnover) yields significant results."[7]

Arguments against multiple creation stress the large leakages, particularly in the years of rapid growth of the market, due to borrowings by United States banks.[8] Increases in United States bank borrowings (such as in 1966, 1967, 1969, and the first half of 1970) amount to a withdrawal of potential secondary deposits from the multiple expansion potential of the Euro-dollar system; a reduction in borrowings is, in effect, an increase in induced deposits.[9]

The second controversial source of induced Euro-dollar deposits, which has been claimed to be the primary momentum for Euro-dollar expandibility

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[6]E. Wayne Clendenning, "Euro-Dollar and Credit Creation", International Currency Review, III, No. 1:18, March, April 1971.

[7]Friedrick, Journal of Money Credit and Banking, p. 346, footnote 13.

[8]E. Wayne Clendenning, The Euro-Dollar Market, (Oxford: Clarendon Press, 1970), p. 57; also Fritz Machlup, "The Euro-Dollar System and Its Control", International Monetary Problems (Washington: American Enterprise Institute, 1972) p. 711.

[9]A. James Meigs, "Managing the World's Money Supply, A Comment", Journal of Money, Credit and Banking:669, August, 1969.

since 1969,[10] is the multiple expansion of foreign official reserves. This case is similar to the deposit expansion described above but with the central banks at the core of deposit expansion instead of the Euro-banks. A central bank places some of its reserves with the Bank for International Settlements (BIS) (or directly into a Euro-bank); the BIS, in turn, deposits these dollars in the Euro-dollar market which are, ultimately, lent to a non-bank borrower who, in turn, converts the dollars into domestic currencies. This conversion leads to an increase in the reserves of the recipient central bank without a decline in the reserves of the original depositing central bank. If the recipient bank deposits the increase in reserves with the BIS or in the Euro-dollar market, a second round of expansion will begin. As Machlup has summarized:

> This four-step sequence clearly shows how one dollar of official reserves can become two dollars in one round. Nothing, of course, prevents a repetition of the process. Indeed, the observed inflow of additional New York dollars may induce managers of the official reserves to increase their placements with the BIS or with London banks directly. In this fashion, dollars may continue to create more dollars, as each round raises the multiplier inherent in the process. It can be stopped only by officials.[11]

This source of Euro-dollar deposit growth has been denied by central banks.

The final source of Euro-dollar deposits is U.S. balance of payments transactions. The uncertainty of this source lies in the question of which balance of payments transactions lead to Euro-dollar deposits and what is the appropriate measure of this source. The liquidity definition of the U.S.

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[10]Kern, National Westminster Bank Review, p. 18.

[11]Fritz Machlup, "The Magicians and Their Rabbits", The Morgan Guaranty Survey, May 1971, p. 12.

balance of payments is considered an unacceptable measure of primary deposits in the Euro-dollar market. Thus, Kern has stated, "The most important point is that the growth of the Euro-dollar market is largely independent of the United States payments deficit."[12] Similarly, Friedman has stated, "Balance of payments deficits do provide foreigners with claims on United States dollar; but there is nothing to assure that such claims will be held in the form of Euro-dollars."[13] The only statement close to an argument for United States balance of payments deficits as a source of Euro-dollar growth comes from the Thirty-fourth Annual Report of the BIS, which states:

> At first the basic deficit in the United States balance of payments contributed to the development of the Euro-dollar market by putting large amounts of dollars directly into foreign hands. At a later stage, however, the market directly or indirectly attracted additional resources from United States firms and their affiliates. This gave rise...to an increase in United States liabilities which...means an increase in the United States balance of payments deficit (liquidity definition).[14]

Notwithstanding the overall validity of the statements of Kern, Friedman, and the Bank for International Settlements, their dogged concentration on balance of payments deficits is inappropriate. The significant variable is the accumulated net dollar flows; i.e., the stock of dollars accumulated by foreigners as a result of any type of international transaction. What is important for the Euro-dollar market is the total stock of dollars which has accumulated in the hands of the foreign public (as reserves) and private

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[12]Kern, National Westminster Bank Review, p. 18.

[13]Milton Friedman, "The Euro-Dollar Market: Some First Principles", The Morgan Guaranty Survey, October 1969, p. 5.

[14]Bank for International Settlements Thirty-fourth Annual Report, (Basle, June 1964), p. 140.

authorities. This aggregate statistic represents the total volume of potential primary deposits in the Euro-dollar market. In contrast, balance of payments deficits net out items which do not necessarily represent a reflux of dollar balances. At the same time, total liquid liabilities of U.S. banks will tend to over-state aggregate net dollar flows because of the impossibility of distinguishing primary from secondary deposits.[15] To the extent that multiple expansion of the Euro-dollar market and/or multiple expansion of official reserves take place, multiple expansion of accumulated net dollar flows occurs; and the entire question of expansion can be viewed in these terms.

Given this definition of accumulated net dollar flows, a remaining question is to what extent do changes in this source of Euro-dollars affect the growth of the Euro-dollar market. First, it is generally accepted that the dollar flows contributed sufficient liquidity to enable the strangling tangle of exchange controls to be relaxed in 1958-59, a prerequisite to the development of the Euro-dollar market. Secondly, without this outflow of dollars, there would not have been any substantial accumulation of dollar deposits held by foreigners on which the creation and development of the market depended.[16] Finally, the rate of growth of dollar flows probably has greater impact than expected for both short and long run growth of the Euro-dollar and

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[15]Machlup, The Morgan Guaranty Survey; Idem, "Euro-Dollar Creation: A Mystery Story", Banco Nazionale del Lavaro Quarterly Review (September 1970). For example, if Euro-dollar deposits are lent to a Frenchman who converts them to Francs, total U.S. liquid liabilities will include the Euro-bank's deposit with a U.S. bank plus the French Bank's claim on dollars during the check clearing process. It should be noted that only changes in the U.S. liquidity liabilities to foreigners are reported in the Balance of Payments.

[16]Clendenning, The Euro-Dollar Market, p. 57 ff.

international interest rates. This last pronouncement contrasts sharply with Clendenning and others who state that the market could still exist even if the outflow from the United States was completely stopped or reversed.[17] The paradox lies in the definitions of flows: most writers on the subject define the outflow in terms of the liquidity definition of balance of payments deficits. In contrast, the net dollar flows in any given year are more closely related to the volume of world trade and capital transactions in which the United States is involved so that the United States balance of payments deficits can be reversed concurrently with increases in net dollar outflows. For example, if all U.S. imports are paid for in dollars and are held by the private foreign sector as short term liquid claims on the U.S., and if all U.S. exports are paid for with foreign securities, total foreign dollar holdings will have increased even if the U.S. exports are greater than imports. Furthermore, the argument that estimates of Euro-dollar deposits have been larger than liabilities of United States banks to non-residents in recent years is not an argument against the claim that changes in accumulated dollar outflows have an effect upon the growth of the Euro-dollar market, but rather is an argument for some type of multiple expansion on the dollar outflows taking place.

Euro-dollar loans, which play a role complementary to deposits in the growth of the Euro-dollar market, are extended to finance transactions occurring in both dollars and foreign currencies. Historically, the most important dollar users or borrowers have been the U.S. banks. One might conceive of the relationship between U.S. banks and the Euro-dollar market as oligopsonistic or monopsonistic. The larger banks in the United States have been using Euro-dollars

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[17]Clendenning, The Euro-Dollar Market, p. 57.

1) to expand credit, 2) to finance week-end reserve positions, 3) to finance certain loans, and 4) to obtain operating balances for overseas branches. These uses have had a major impact on the structure of the market.

The borrowing of Euro-dollars to extend loans in the U.S. reduces the average ratio of required reserves to both deposits and equivalent liabilities because reserve requirements are lower on borrowings than on demand deposits, and because, until recently, there were no reserve requirements whatever on these borrowings. While this average reserve ratio does not necessarily mean an increase in total reserves, other things held constant, it does enable the banking system to acquire additional earning assets for the same reserve base. Given the amount of required reserves, the increased amount of loanable funds does not have the multiple expansion effect in the sense of a net injection of funds into the commercial banking system[18] because nearly all Euro-dollar deposits held by "Eurobanks" (including foreign branches of United States banks) are in the form of claims on American banks. For example, if Chase Manhattan Bank, N.A. borrows Euro-dollars from its London branch, the New York bank will receive as an asset a claim on another U.S. bank (say, Morgan Guaranty). Consequently, total liabilities of the banking system initially would not show a net change as can be seen below in the simplified balance sheets:

Chase Manhattan - London

	assets	liabilities
before loan	$10 mil. claim on Morgan Guaranty	$10 mil. deposit from foreign source

[18]Friedman, The Morgan Guaranty Survey, p. 4.

Chase Manhattan - London

	assets	liabilities
after loan	-$10 mil. claim on Morgan Guaranty +$10 mil. claim on Chase-New York	$10 mil. deposit from foreign source

Chase Manhattan - New York

after loan	+$10 mil. cash or earning assets (or deposit with Morgan)	+$10 mil. loan from Chase-London

Morgan Guaranty - New York

	assets	liabilities
after loan	-$10 mil. cash or earning assets	-$10 mil. deposit due Chase-London

If the banking system is fully loaned up, Chase will acquire and Morgan Guaranty will liquidate earning assets. If the system is not fully loaned up, Chase may hold cash or deposits with Morgan Guaranty. The former case is shown above.

The only manner in which Euro-dollar borrowing can act as a net injection into the U.S. banking system is if the original source of the Euro-dollars represents either dishording of actual dollars or creation of Euro-dollars by the Federal Reserve System. Nevertheless, Euro-dollars borrowings increases the supply of loanable funds and money in the U.S. banking system.

When the borrowing of Euro-dollars shifts the banking system liabilities from the higher reserve requirements (in New York) for demand deposits liabilities to the lower or nonexistent reserve requirements for borrowed liabilities, there can be limited credit expansion. The multiple contraction initiated in

the above example by Morgan Guaranty's loss of deposits when Chase-New York draws down its claim on Morgan Guaranty will be more than offset by the multiple expansion started by Chase Manhattan-New York Euro-dollar loan because of the lower reserve requirements on the first round of the expansion process.

To reiterate, the increase in loanable funds arising from reserve requirement differentials does not lead to multiple expansion in the sense that the standard textbook reserve multiplier for the system has increased. Instead, reallocation of liabilities has increased expansibility of the system by changing the composition of total reserves. Consequently, the use of a money multiplier (exclusive of borrowings) as an explanation for U.S. monetary expansion is inadequate without the inclusion of reserve requirements against Euro-dollar borrowings.

In addition to credit expansion, head offices of banks in the United States have been able to use their overseas branch balances in a manner analogous to the use of federal funds. Euro-dollars, while not suitable for day-to-day cash and reserve position adjustments because of the distance and the two day clearing time period, are useful for weekend adjustments. Thus, most banks with overseas branches use overnight deposits each Thursday as a partial substitute for federal fund purchases on Friday.[19]

Until Regulation D (see appendix) was amended in July, 1969, effective reserve requirements declined during the clearing of overnight loans from

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[19]Fred Klopstock, "Euro-Dollars in the Liquidity and Reserve Management of U.S. Banks", Federal Reserve Bank of New York Monthly Review (July 1968), p. 133.

branches because the check received from the overseas branch increased the cash items in the process of collection, items which were deductible from deposits in computing reserve requirements. Furthermore, the bills-payable check used to repay the borrowed Euro-dollars was also not included in deposits subject to reserve requirements.[20] As a result, banks in need of funds to meet reserve requirements had been willing to pay more than three times the anticipated federal funds rate on Thursday for Euro-dollar loans for the weekend. This loophole in Federal Reserve regulations was significant. The Federal Reserve of St. Louis has noted that money supply revisions based on the change in Regulation D[21] show significantly faster rates of growth than do the original demand deposit series.[22] While this ability to reduce reserve requirements for the entire weekend no longer exists, the amendment does not hamper the use of Euro-dollars for bolstering weekend reserve positions.

Banks in the U.S. have also actively used the Euro-dollar market to refinance loans to foreigners. From the inception of the voluntary restraint program for balance of payments purposed until the 1968 change in Regulation M,

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[20]Fred Klopstock, "Euro-Dollars in the Liquidity and Reserve Management of U.S. Banks", Federal Reserve Bank of New York Monthly Review (July 1968), p. 132.

[21]The Regulation D change refers to the definition of gross deposits to include certain items issued by overseas branches.

[22]Albert E. Burger, "Revision of the Money Supply Series", Federal Reserve Bank of St. Louis Review, (October 1969), Vol. 51, No. 10, p. 7FF.

[23]Klopstock, Monthly Review, p. 132.

restricting the sale of loans, banks in the United States were able to sell loans normally made to foreign individuals and corporations to their overseas branches, thus enabling the head offices to maintain their outstanding claims below the voluntary quota ceilings while at the same time enabling them to service foreign customers. Many banks without foreign branches made arrangements to sell substantial amounts to Euro-dollar banks under re-purchase agreements--transactions which also increased foreign claims outstanding. The amendments to Regulation M[24] should have reduced the amount of new sales over and above a certain level. However, of greater quantitative importance are loans which are made directly by foreign branches to meet loan demands of head offices. While these loans are also affected by Regulation M to the extent that the loans are made to United States residents, there is considerable leeway for continuation of this type of financing. The substitution of Euro-dollar loans for direct U.S. loans would have the effect of reducing the leakage underlying the U.S. money multiplier.

Finally, foreign branches of United States banks often hold accounts at domestic offices as precautionary reserves which could be used to meet obligations arising from temporary discrepancies between payments and receipts of Euro-dollars or sudden unanticipated demands.[25] These voluntary reserves are actually unnecessary if the head office authorizes the branch to overdraw its domestic deposit account.[26] Notwithstanding, the amount of precautionary

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[24]The amendments place reserve requirements on marginal Euro-dollar borrowings and certain loans made by overseas branches.

[25]Friedman, The Morgan Guaranty Survey, p. 6.

[26]Klopstock, Monthly Review, p. 132.

balances carried by overseas branches both as cash on hand and balances with the head office tends to be minimal because of the smaller interest margins and the resultant need to minimize the amount of unprofitable assets with which the Euro-dollar market banks operate and because there are no regulations except the amendment to Regulation M (see appendix) requiring immobilization of a portion of earning assets at central banks.

In addition to the relationship between U.S. banks and Euro-banks, Euro-dollar loans to foreign users are made for the financing of business transactions, arbitrage and speculation. While the mainstay of Euro-dollar loans to foreigners has been for the direct financing of international trade, the growth of the multi-national corporation has made the financing of less trade-related items (such as seasonal liquidity needs and inventory) a standard part of Euro-bank loan portfolios. Arbitragers are also important users of Euro-dollars. They borrow Euro-dollars and convert them into other currencies to take advantage of deviations from covered interest parity. Finally, speculators borrow Euro-dollars to finance purchases of undervalued currencies and to finance purchases of hard metals, particularly gold.

CHAPTER II

Results of Other Studies

There are no studies which explicitly test the role of the Euro-dollar market in capital flows. The inspiration for a study of this kind derives from a statement by Kindleberger that the Euro-dollar was becoming a world currency but that "...the Euro-dollar market (must) grow still further and become independent of the New York money market rather than an extension of it..."[27] (Parenthesis added.)

An article by Hendershott on the Euro-dollar market[28] is concerned with the length of time required for the Euro-dollar rate to adjust to a change in the U.S. rate. The model is divided into the supply and demand for Euro-dollar deposits and the demand and supply of Euro-dollar loans, the latter (the supply of loans) is derived from the supply of deposits schedule. Thus he derived:

Deposit Demand $D_{ED} = \partial_0 + \partial_1 r^{ED} + \partial_2 r^{US}$ $\partial_1 > 0$ $\partial_2 < 0$

Deposit Supply $S_{ED} = \beta_0 + \beta_1 r^{ED} + \beta_2 r^{EL}$ $\beta_1 < 0$ $\beta_2 > 0$

Loan Demand $DEL = \partial_0 + \partial_1 r^{EL} + \partial_2 r^{a}$ $\partial_1 < 0$ $\partial_2 > 0$

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[27]Kindleberger, p. 7.

[28]Patric H. Hendershott, "The Structure of International Interest Rates: The United States Treasury Bill Rate and The Euro-Dollar Deposit Rate" Journal of Finance (September, 1967) pages 455-465.

r^{ED} = Euro-dollar deposit rate

r^{US} = U.S. deposit rate

r^{a} = alternative cost of funds

r^{EL} = Euro-dollar loan rate

Solving for the deposit rate he gets

$$r_e^{ED} = \frac{1}{\partial_1(\beta_1 - \alpha_1) + \beta_2\alpha_1}\left[\partial_1(\alpha_0 - \beta_0) + \beta_2\partial_2 r^a + \alpha_2(\partial_1 - \beta_2)r^{US}\right]$$

Hendershott's concept of alternative costs only affects borrowers of Euro-dollars in his model. He states: "Alternative costs of funds to borrowers of Euro-dollars include both their domestic cost of borrowing short term funds and the cost of borrowing short term funds in New York."[29] However, Hendershott uses the United States bill rate as a proxy for all alternative costs. Using a discrete form of a Koyak-Nerlove type equation plus the mean values of interest rates during the period of measurement he arrives at:

$$\Delta r^{ED} = k(r_e^{ED} - r^{ED}) \qquad \text{where } r_e^{ED} = \text{equilibrium Euro-dollar rate}$$

By this method, Hendershott tests the Euro-dollar rate against a United States rate with a one and two period lag. His results indicate that the Euro-dollar rate adjusts completely to changes in the United States bill rate, but the process takes about one year. However, using lagged quarterly data, he finds the Euro-dollar deposit rate only adjusts part way to changes in U.S. interest rates.[29]

Kwack, in extending the Hendershott study, is concerned with the impact of foreign interest rates on the time lag for adjustment of the Euro-dollar

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[29]Patric H. Hendershott, "The Structure of International Interest Rates: The United States Treasury Bill Rate and The Euro-Dollar Deposit Rate". Journal of Finance (September, 1967) pp. 455-465.

rate to changes in the U.S. rate. He uses the same model except foreign rates are included in the deposit supply function. He finds:

> "To the extent that foreign rates are affected by the United States rate and other economic factors exogenous to the United States rate, the time required for the Euro-dollar rate to achieve a complete adjustment to changes in the United States rate appears to be longer than that found when only the United States is considered. When foreign rates vary independently of the United States rate, the response of the Euro-dollar rate to changes in the United States rate is found to be partial."[30]

Black[31], in his article, attempts unsuccessfully to establish a forecasting model for Euro-dollar rates. He considers only the demand function for Euro-dollars by United States banks. He equates this function with the supply of Euro-dollars. Thus, he uses borrowings by United States banks from their overseas branches as his quantity figures. On the demand side, he includes Euro-dollar rates, CD rates, Federal fund rates, and Treasury bill rates; on the supply side, he includes the Euro-dollar rate, the Treasury bill rate, the discount on the forward pound, the United Kingdom bank rate, and a measure of the United States Balance of Payments voluntary restriction program. In his estimate of a supply-equal-demand-reduced form equation, he finds that the United Kingdom bank rate and United States Voluntary foreign restriction do not enter significantly into the determination of the Euro-dollar rate and that there is a significant trend term which he explains as the result of increasing awareness of the benefits of bank borrowings from the Euro-dollar market. His

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[30]Sung Y. Kwack, "The Structure of International Interest Rates: An Extension of Hendershott's Tests", Journal of Finance, (Sept., 1971), Vol. XXVI, No. 4, pages 897-900.

[31]Stanley W. Black, "An Econometric Study of Euro-dollar Borrowing by New York Banks and the Rate of Interest on Euro-Dollars", Journal of Finance, (Feb. 1970) pages 83-88.

forecast has large errors which, in part, he claims are the result of a change in market conditions.

Finally, Branson[32], in a study of capital flows in the U.S. balance of payments, tests the sensitivity of U.S.-foreign interest rate differentials and U.S.-Euro-dollar differential to changes in U.S. and foreign rates. He uses the following two equations for estimators:

(1) $^{i}f = a\ ^{i}US + \mu_1$

(2) $^{i}f = b\ ^{i}f + \mu_2$

where ^{i}f represents alternative U.S.-foreign interest rate differentials (including the Euro-dollar rate), ^{i}US represents the U.S. interest rate, ^{i}f represents various foreign and Euro-dollar rates, and μ represents the error.

He finds that with the exception of the Euro-dollar rate, the foreign rate changes explain more of the variance in changes in interest rate differentials than do the changes in the U.S. rate. Additionally, he finds that foreign national rates respond faster to changes in the U.S. rate than to the Euro-dollar rate.

With the exception of the portion of the Branson study reviewed, the literature presumes an alignment between the U.S. and Euro-dollar markets. In the case of Hendershott and Kwack, a relationship between the two market's interest rates obviously underlies the time lag studies undertaken by these authors. In the case of Black's analysis, the stock of Euro-dollars is approximated by the volume of U.S. bank borrowings, implying a close relationship between the U.S. and Euro-dollar markets and biasing the results in this

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[32]Branson

direction as will be subsequently shown.

The concept of opportunity costs is considered by Hendershott and Kwack in terms of alternate costs of funds to borrowers of Euro-dollars. However, Hendershott uses the U.S. bill rate to approximate the opportunity costs of borrowing in both the U.S. and foreign domestic market. Kwack extends the opportunity cost approximation by adding foreign interest rates, but neglects the cost of forward cover in his analysis. As a result, the concept of a comparable alternative cost was not developed by these studies.

In the Branson study, the testing of the sensitivity of interest rate differentials to changes in U.S. rates and foreign rates suggests a manner of testing the relative sensitivity of interest differential for comparing the U.S. and Euro-dollar interest rates undertaken later in Chapter V. Additionally, a repetition of Branson's study using more recent data (from identical sources) changes Branson's findings substantially.

CHAPTER III

The Structure of the Euro-Dollar Market

Models of the Euro-dollar market and related markets can be formulated to illustrate the inter-relationships of variables affecting the Euro-dollar rate. To simplify and crystalize these relationships, several assumptions are made. First, the dimensions of the world capital markets are reduced to three spheres: the New York or U.S. market, the foreign market, and the Euro-dollar market. Second, perfect capital markets within each domestic sphere are assumed. Consequently, one interest rate is considered to exist in any market. Next, the reserves held by Euro-banks for liquidity purposes are assumed equal to zero. As a result, the demand for Euro-dollar deposits is equal to the supply of Euro-dollar loans. This particular assumption is not unrealistic; actual reserve balances of Euro-banks are minimal, and the demand for deposits is a function of anticipated loan volume. Finally, Euro-banks are assumed to be profit maximizers. Banks will extend loans and demand deposits up to the point where the marginal revenue from loans equals the marginal cost of deposits. Given these assumptions, three money market models can be formulated based upon the variables affecting the supply and demand for deposits in each market.

The Euro-Dollar Market

The Demand for Euro-Dollars

The demand for Euro-dollar deposits depends on the loan demand for

Euro-dollars, given the assumptions of the model. Loan demand, in turn, depends upon the Euro-dollar rate and the following factors: the state of aggregate economic activity in various countries, the cost of borrowing from other sources, restrictions on borrowing Euro-dollars, and the degree of speculative fervor. These variables will be considered in order.

The State of the Economies - Euro-dollar demand will fluctuate directly with the rate of growth of output in the world. The stronger the ongoing economic processes, the greater the demand for Euro-dollars. The term, "state of the economies", encompasses not only the level of economic activity or gross national product but also the expectations for the future. According to Clendenning:

> "The fundamental factor underlying the demand for Euro-dollarsis the level of economic activity in the countries (including the United States) that participate in the market. If the level of activity is high, the demand for credit for financing both foreign trade and domestic activity will also be high. If this demand cannot be met domestically and, particularly, if anti-inflationary monetary measures are being used, there will be an incentive for the residents of these countries to seek additional financing abroad - of which the Euro-dollar market is one source."[33]

Interest Rates - The assumption of one interest rate in each market means that the demand for Euro-dollar deposits will be derived from the demand for Euro-dollar loans which, in turn, will depend upon the competitiveness of Euro-dollar rates with alternative borrowing opportunities. In this model, the U.S. and foreign ratesare the relevant interest variables.

In the case of the U.S. interest rate, a direct comparison of its rate and the Euro-dollar rate can be made, for there is no need to introduce exchange rates in making such a comparison. In the case of foreign rates,

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[33]E. Warren Clendenning, The Euro-Dollar Market (Oxford: Clarenden Press, 1970), p. 67.

consideration of the cost of forward exchange must be included. Forward exchange is the currently established exchange rate between two currencies for delivery at a definite future date. Unlike the spot exchange rate, the forward rate is not normally pegged within a narrow range, but fluctuates according to the supply and demand for currencies to be delivered in the future.[34] A borrower wishing to hedge against possible adverse changes in the spot rate can borrow dollars, convert them at the spot rate into his domestic currency, and at the same time buy dollars forward for the date on which the loan must be repaid. The relevant cost of this forward cover is the difference between the forward rate and the spot rate, a cost which must be added to the dollar cost of the loan. The cost is positive if the forward foreign currency is below the spot rate (i.e., the cost of the forward dollar is above the current price) and is negative if the forward foreign currency is above the spot price (i.e., the forward dollar price is at a discount). Alternatively, this hedging cost can be stated in percentage form called the forward premium or discount. The premium or discount, calculated by dividing the forward exchange rate minus the spot rate by the spot rate (times 100), can be added to the interest cost of the loan to determine total cost of borrowing abroad. From the vantage point of the Euro-dollar market, foreign interest rates can be converted into comparable dollar rates by adding the premium or subtracting the discount on foreign currencies in dollar terms. This adjusted foreign rate, henceforth,

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[34]Intervention in the forward market has occurred primarily during periods of heavy speculation.

is referred to as the "comparable" foreign rate.

Ceteris paribus, the demand for Euro-dollars varies inversely with the Euro-dollar rate and directly with the U.S. and comparable foreign rate. The higher the Euro-dollar rate is, the more likely alternative sources of funds will be sought by borrowers. Conversely, the higher the U.S. rate or comparable foreign rate is, the greater the demand for Euro-dollars and the higher the Euro-dollar rate.

Restrictions on borrowing Euro-dollars - The demand for Euro-dollars should be adversely affected by the imposition of restrictions on the inflow of Euro-dollars into a country. In the case of the United States, imposition of reserve requirements on marginal Euro-dollar borrowings and imposition of a change in the definition of demand deposits (and, therefore, float) to include drafts on Euro-banks for calculation of reserve requirements should have adversely affected U.S. demand for Euro-dollars. In the case of the foreign country, reserve requirements against increases in domestic liabilities vis-a-vis non-residents such as those imposed in Germany in 1970 should also decrease Euro-dollar demand. Restrictions such as these, by reducing the demand for Euro-dollars, should also reduce Euro-dollar interest rates. On the other hand, restrictions such as Regulation Q, which regulates the maximum interest payable in the U.S., act to increase the demand for Euro-dollars when the ceiling rate is below the U.S. market equilibrium rate. The imposition and removal of Regulation Q thus should increase and decrease the Euro-dollar rate respectively to the extent that the imposition or removal coincide with equilibrium U.S. interest rates above the ceiling.

Speculation - The possibility of an appreciation of a currency relative to the dollar will increase the demand for Euro-dollars whenever speculators feel that it is profitable to borrow Euro-dollars and convert them into the strong currency. The recipient of the dollars may convert them or re-deposit them in the Euro-dollar market. If the ultimate recipient is a Central Bank, the dollars may be held as reserves on deposit in the U.S. or on deposit with the Bank for International Settlements. If the dollars are deposited with the Bank for International Settlements, the dollar may be re-deposited in the Euro-dollar market.

The original demand for Euro-dollars by speculators should tend to cause Euro-dollar rates to increase; however, this effect may be offset by re-deposits of the speculative dollars. This speculation will be referred to as speculation on strong currencies.

The Supply of Euro-Dollars

The supply of Euro-dollars depends upon the Euro-dollar rate and the following variables: alternative interest rates, the potential number of Euro-dollars, restrictions on flows into Euro-banks, and speculation. These factors will be considered in order.

Interest Rates - The quantity of Euro-dollars supplied, ceteris paribus, will vary directly with the Euro-dollar rate and inversely with the U.S. and comparable foreign rate. As in the case of the demand for Euro-dollar deposits, the forward premium or discount on foreign currencies is included in the foreign rate to allow for hedging against changes in exchange rates.

Potential Euro-Dollar Supply - The supply of Euro-dollars, as previously discussed in Chapter I (p. 7), ultimately depends on the accummulated United

States balance of payments gross debits outflows minus dollar returns over a period of time. This figure includes not just net debits or deficits but all dollars sent abroad which do not return. It is a stock figure, not a flow. This stock is consistent with the steady state properties of a supply-demand model in which a set of rates are defined and equilibrated with respect to the volume of funds and their distribution. If the accumulated debits are sub-divided into private foreign accumulations and official reserve holdings, the controversial Euro-dollar system multiplier and central bank multiplier, discussed in Chapter I, could be applied to the respective sub-divisions. However, as the existence and size of these multipliers are controversial, only the aggregated base will be considered in this model. Euro-dollar deposit supply will be greater and the Euro-dollar rate lower the larger the total accumulated balance of payments gross debits minus dollar returns.

Restrictions - The imposition of restrictions on flows into the Euro-dollar market reduces the supply of Euro-dollars and raises the Euro-dollar rate. Two U.S. restrictions, probably, have had the greatest impact on the supply of Euro-dollars. From late 1963 until February, 1974, the Interest Equalization Tax Act, in effect, imposed a tax upon U.S. citizens on the dollar return of any foreign security yielding rates above the U.S. rate, thereby reducing the effective foreign rate. The Voluntary Credit Restraint Act of 1965 limited the volume of loans that U.S. banks could make to foreigners, thereby reducing an indirect supply of Euro-dollars and increasing the Euro-dollar rate.

One additional case of governmental interference in capital flows can be added at this point, although "restrictions" is not a particularly descriptive term. This is the case of a foreign (Germany) central bank

offering preferential rates on dollars. In 1968 dollars were sold spot by Germany to their commercial banks at a special discount, equivalent to an exchange rate below the pegged rate in terms of the price of dollars in foreign currency. Imposition of this negative restriction should have increased the supply of Euro-dollars and decrease Euro-rates.

Speculation on the Possibility of a Depreciation of a Foreign Currency (Weak Currencies) - Speculation increases the supply of Euro-dollars when the dollar is used as a safe-harbor currency. In the process of speculating against currencies which are weak relative to the dollar, speculators will convert the weak currencies into dollars on both the spot and forward market. These dollars then will be placed in Euro-banks or U.S. banks depending upon the relative interest rates offered.

The source of the spot dollar may in part be withdrawals from the Euro-dollar market as Central Banks draw down balances with the Bank for International Settlements or borrow on swap arrangements, both transactions possibly representing withdrawals from the Euro-dollar market.

Based upon the variables discussed above, a supply-demand model can be specified to isolate and crystalize the effects of the above variables on Euro-dollar interest rates. The following symbols will be used:

Qd = quantity demanded of Euro-dollars

Qs = quantity supplied of Euro-dollars

Red = Euro-dollar rate

ELD = world loan demand

Rf = comparable foreign interest rate

Rus = U.S. interest rate

FDRes = foreign restrictions on borrowing

FSRes = foreign restrictions (Negative) on supplying Euro-dollars

USRR = U.S. reserve requirements on borrowings

USD = U.S. redefinition of demand deposits

USRQ = removal of regulation Q ceiling

SS = speculation on strong currencies

BP = accumulated gross balance of payments debits minus dollar returns

V = Voluntary Credit Restraint Act

IET = Interest Equalization Tax Act

SW = speculation on weak currencies

The demand function for Euro-dollars can be stated in linear form as follows:

$$Qd = \alpha_0 + \alpha_1 Red + \alpha_2 Rus + \alpha_3 Rf + \alpha_4 ELD + \alpha_5 FDRes + \alpha_6 USRR + \alpha_7 USD + \alpha_8 USRQ + \alpha_9 SS$$

where

$$\alpha_1<0 \quad \alpha_2>0 \quad \alpha_3>0 \quad \alpha_4>0 \quad \alpha_5<0 \quad \alpha_6<0 \quad \alpha_7<0 \quad \alpha_8>0 \quad \alpha_9>0$$

The supply function is as follows:

$$Qs = \beta_0 + \beta_1 Red + \beta_2 Rus + \beta_3 Rf + \beta_4 BP + \beta_5 V + \beta_6 IET + \beta_7 FSRes + \beta_8 SW$$

where

$$\beta_1>0 \quad \beta_2<0 \quad \beta_3<0 \quad \beta_4>0 \quad \beta_5<0 \quad \beta_6<0 \quad \beta_7>0 \quad \beta_8>0$$

Equating Euro-dollar demand with Euro-dollar supply yields:

$$\alpha_0 + \alpha_1 Red + \alpha_2 Rus + \alpha_3 Rf + \alpha_4 ELD + \alpha_5 FDRes + \alpha_6 USRR + \alpha_7 USD + \alpha_8 USRQ + \alpha_9 SS = \beta_0 + \beta_1 Red + \beta_2 Rus + \beta_3 Rf + \beta_4 BP + \beta_5 V + \beta_6 IET + \beta_7 FSRes + \beta_8 SW$$

Solving for Red, the following manipulation occurs:

$$\partial_1 Red - \beta_1 Red = \beta_0 - \partial_0 + (\beta_2 - \partial_2)Rus + (\beta_3 - \partial_3)Rf - \partial_4 ELD - \partial_5 FDRes - \partial_6 USRR -$$

$$\partial_7 USD - \partial_8 USRQ - \partial_9 SS + \beta_4 BP + \beta_5 V + \beta_6 IET + \beta_7 FSRes + \beta_8 SW$$

yielding the following:

$$Red = \frac{\beta_0 - \partial_0}{\partial_1 - \beta_1} - \frac{\beta_2 - \partial_2}{\alpha_1 - \beta_1} Rus + \frac{\beta_3 - \partial_3}{\partial_1 - \beta_1} Rf - \frac{\partial_4}{\partial_1 - \beta_1} ELD - \frac{\partial_5}{\partial_1 - \beta_1} FDRes -$$

$$- \frac{\partial_6}{\partial_1 - \beta_1} USRR - \frac{\partial_7}{\partial_1 - \beta_1} USD - \frac{\partial_8}{\partial_1 - \beta_1} USRQ - \frac{\partial_9}{\partial_1 - \beta_1} SS + \frac{\beta_4}{\partial_1 - \beta_1} BP +$$

$$\frac{\beta_5}{\partial_1 - \beta_1} V + \frac{\beta_6}{\partial_1 - \beta_1} IET + \frac{\beta_7}{\partial_1 - \beta_1} FSRes + \frac{\beta_8}{\partial_1 - \beta_1} SW$$

Let

$$X_0 = \frac{\beta_0 - \partial_0}{\alpha_1 - \beta_1} \quad X_1 = \frac{\beta_2 - \partial_2}{\alpha_1 - \beta_1} \quad X_2 = \frac{\beta_3 - \partial_3}{\alpha_1 - \beta_1} \quad X_3 = \frac{-\alpha_4}{\alpha_1 - \beta_1} \quad X_4 = \frac{-\alpha_5}{\alpha_1 - \beta_1}$$

$$X = \frac{-\alpha_6}{\alpha_1 - \beta_1} X = \frac{-\alpha_7}{\alpha_1 - \beta_1} X = \frac{-\alpha_8}{\alpha_1 - \beta_1} X = \frac{-\alpha_9}{\alpha_1 - \beta_1} X = \frac{-\beta_4}{\alpha_1 - \beta_1}$$

$$X_{10} = \frac{\beta_5}{\alpha_1 - \beta_1} \quad X_{11} = \frac{\beta_6}{\alpha_1 - \beta_1} \quad X_{12} = \frac{\beta_7}{\alpha_1 - \beta_1} \quad X_{13} = \frac{\beta_8}{\alpha_1 - \beta_1}$$

Then,

$$Red = x_0 + x_1 Rus + x_2 Rf + x_3 ELD + x_4 FDRes + x_5 USRR + x_6 USD + x_7 USRQ + x_8 SS +$$

$$x_9 BP + x_{10} V + x_{11} IET + x_{12} FSRes + x_{13} SW \qquad (I)$$

where

$$x_1 > 0;\ x_2 > 0;\ x_3 > 0;\ x_4 < 0;\ x_5 < 0;\ x_6 < 0;\ x_7 > 0;\ x_8 > 0;\ x_9 < 0;\ x_{10} > 0;\ x_{11} > 0;$$

$$x_{12} < 0;\ x_{13} < 0$$

The United States Money Market

Demand for Funds

The demand for interest paying deposits (or equivalently the supply of money market instruments) in the U.S. market depends upon the U.S. interest rate plus loan demand and the restrictions on lending abroad. As in the Euro-dollar model, the demand for funds in the U.S. market reflects loan demand. Ceteris peribus, loan demand and therefore deposit demand are an inverse function of U.S. interest rates.

Additionally, demand in the U.S. market depends upon aggregate nominal income in the U.S. and its rate of growth. Increases in aggregate income normally cause increases in loan demand while decreases in income, or the rate of growth of income, decrease or slow the growth in loan demand. Generally, U.S. monetary and fiscal policy also affect loan demand but primarily through the policies' effects on income. However, selective controls have been imposed for balance of payment purposes and have affected the demand for funds. The imposition of the Voluntary Credit Restraint Act and the Interest Equalization Tax should have decreased the demand for funds by diminishing the ability and desirability of making loans to foreigners. Because of these two exchange controls, the U.S. market has been relatively insulated from foreign and Euro-dollar interest rate conditions on the demand side.

The Supply of Funds

The supply of interest bearing deposits (or equivalently the demand for money market securities) in the U.S. depends upon U.S. money supply, interest rates, and various restrictions on both inflows into the market and on interest

rates in the market. Money supply, defined as the sum of currency and demand deposits owned by the non-bank public (M_1), represents the limit to the supply of funds in the U.S. market from domestic sources. This monetary aggregate is controlled primarily by Federal Reserve policy. If the stance of policy is defined according to its effect on money supply (as opposed to interest rates), then tight monetary policy restricts the growth of money supply, thereby reducing the supply of deposits and increasing the U.S. interest rate. However, to the extent that market interest rates reflect the rate of price change, tight monetary policy will reduce the rate of increase in prices and therefore reduce the U.S. interest rate.

The quantity of funds supplied to the U.S. market from both domestic non-interest bearing sources[35] and all foreign sources is directly related to the U.S. rate and inversely related to both the comparable foreign interest rate and the Euro-dollar rate. When foreign interest yields, including the cost of forward cover, are high relative to the U.S. rate, the incentive for foreign capital inflow to the U.S. is lessened. Similarly, the quantity supplied in the market decreases whenever the Euro-dollar rate is higher than the U.S. rate. The cost of borrowing Euro-dollars can become prohibitive, and repayments of previous Euro-dollar loans can take place.

The borrowing of Euro-dollars and, therefore, this potential source of supply is also affected by U.S. restrictions. The imposition of reserve

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[35]Domestic non-interest bearing sources include all portfolio holdings which do not base their yields on a fixed coupon. Domestic interest bearing sources are already absorbed in the market.

requirements on borrowings and the redefinition of demand deposits for reserve requirements to include drafts on Euro-banks decrease the supply of funds to the U.S. market. The imposition of Regulation Q ceiling interest rates tends to increase Euro-dollar borrowings and, therefore, supply, particularly when U.S. market rates rise above the ceiling rate. When the ceiling rate is removed, the borrowing of Euro-dollars declines reducing the supply of funds and, ceteris paribus, raising the interest rate. At the same time, Regulation Q may decrease money supply domestically through its effect on average reserve requirement. Consequently, the net effect of this regulation is unknown.

Based on the above variables, a supply-demand model of the U.S. market can be specified. The following symbols will be used:

USQd = quantity demanded for funds (deposits) in the U.S. money market

USQs = quantity supplied of funds in the U.S. money market

Rus = U.S. interest rate

USLD = U.S. loan demand

V = Voluntary Credit Restraint Act

IET = Interest Equalization Tax

USMS = U.S. money supply

Rf = comparable foreign interest rate

Red = Euro-dollar rate

USRR = reserve requirements on borrowings by U.S. banks

USD = U.S. redefinition of demand deposits

USRQ = Regulation Q

α' and β' = coefficients for demand and supply in U.S. Markets[36]

The demand for funds in the U.S. market can be stated in linear form as:

$$USQd = \alpha_0' + \alpha_1' Rus + \alpha_2' USLD + \alpha_3' V + \alpha_4' IET$$

where

$$\alpha_1'<0 \quad \alpha_2'>0 \quad \alpha_3'<0 \quad \alpha_4'<0$$

The supply of funds in the U.S. market can be stated as:

$$USQs = \beta_0' + \beta_1' USMS + \beta_2' Rus + \beta_3' Rf + \beta_4' Red + \beta_5' USRR + \beta_6' USD + \beta_7' USRQ$$

where $\beta_1'>0 \quad \beta_2'>0 \quad \beta_3'<0 \quad \beta_4'<0 \quad \beta_5'<0 \quad \beta_6'<0 \quad \beta_7' = ?$

Equating supply with demand yields:

$$\alpha_0' + \alpha_1' Rus + \alpha_2' USLD + \alpha_3' V + \alpha_4' IET = \beta_0' + \beta_1' USMS + \beta_2' Rus + \beta_3' Rf + \beta_4' Red + \beta_5' USRR + \beta_6' USD + \beta_7' USRQ$$

Solving for Rus:

$$\partial_1' Rus - \beta_2' Rus = \beta_0' - \partial_0' - \partial_2' USLD - \partial_3' V - \partial_4' IET + \beta_1' USMS + \beta_3' Rf + \beta_4' Red + \beta_5' USRR + \beta_6' USD + \beta_7' USRQ$$

The consequent reduced form is:

$$Rus = \frac{\beta_0' - \partial_0'}{\partial_1' - \beta_2'} - \frac{\partial_2'}{\partial_1' - \beta_2'} USLD - \frac{\partial_3'}{\partial_1' - \beta_2'} V - \frac{\partial_4'}{\partial_1' - \beta_2'} IET + \frac{\beta_1'}{\partial_1' - \beta_2'} USMS + \frac{\beta_3'}{\partial_1' - \beta_2'} Rf + \frac{\beta_4'}{\partial_1' - \beta_2'} Red + \frac{\beta_5'}{\partial_1' - \beta_2'} USRR + \frac{\beta_6'}{\partial_1' - \beta_2'} USD + \frac{\beta_7'}{\partial_1' - \beta_2'} USRQ$$

Let

$$y_0 = \frac{\beta_0' - \partial_0'}{\partial_1' - \beta_2'} \quad y_1 = \frac{-\partial_2'}{\partial_1' - \beta_2'} y_2 = \frac{-\partial_3'}{\partial_1' - \beta_2'} \quad y_3 = \frac{-\partial_4'}{\partial_1' - \beta_2'} y_4 = \frac{-\beta_1'}{\partial_1' - \beta_2'}$$

$$y_5 = \frac{\beta_3'}{\partial_1' - \beta_2'} \quad y_6 = \frac{\beta_4'}{\partial_1' - \beta_2'} \quad y_7 = \frac{\beta_5'}{\partial_1' - \beta_2'} y_8 = \frac{\beta_6'}{\partial_1' - \beta_2'} \quad y_9 = \frac{\beta_7'}{\partial_1' - \beta_2'}$$

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[36]The prime symbols will be used to distinguish between the three markets: no prime for coefficients in the Euro-dollar market, a single prime for coefficients in the U.S. market, and a double prime for coefficients in the foreign market.

Then,

$$Rus = y_0 + y_1 USLD + y_2 V + y_3 IET + y_4 USMS + y_5 Rf + y_6 Red + y_7 USRR + y_8 USD + y_9 USRQ$$

where

$$y_1>0 \quad y_2<0 \quad y_3<0 \quad y_4 = ? \quad y_5>0 \quad y_6>0 \quad y_7>0 \quad y_8>0 \quad y_9 = ?$$

The Foreign Market

Demand for Funds

The demand for funds in the foreign market depends upon loan demand, interest rates, forward rates, and speculation. The foreign demand for deposit funds is a direct function of loan demand which in turn depends primarily upon the level and rate of growth of aggregate nominal income. The demand for deposits should increase with increased loan demand and higher foreign interest rates.

Foreign demand is also a function of interest rates and forward rates. The demand for funds from the viewpoint of the foreign market is an inverse function of foreign rates and is a direct function of what can be termed comparable U.S. and Euro-dollar rates. The term comparable U.S. and Euro-dollar rates refers to the foreign market translation of the two dollar rates into the foreign equivalent interest rates by including the cost of forward cover. The inclusion of the cost of forward cover eliminates exchange risk as a factor in comparing the foreign interest rate to other rates.

Finally, the demand for funds is a function of speculation on the possibility of devaluation of the foreign currency. If the foreign currency is considered weak, demand will increase and interest rates will rise as speculators borrow to convert into stronger currencies. If the currency is

strong, speculators will not enter the market on the demand side.

Supply of Funds

The supply of funds to the foreign market depends on foreign money supply, the foreign rate, comparable interest rates, and speculation flows. The supply of funds is a direct function of money supply and the foreign interest rate. Funds supplied are an inverse function of the comparable Euro-dollar rate and the comparable U.S. rate. Foreign interest rates are lower when comparable U.S. and Euro-dollar rates are relatively low.

Speculation on strong foreign currencies, as mentioned above, will increase the supply of funds to foreign markets as speculators convert dollars into the foreign currency in expectation of a revaluation of the currency relative to the dollar. Such speculation will tend to decrease the rate of interest in the foreign market.

Based on the above variables, a supply-demand model can be specified. The following symbols will be used:

FQd = demand for funds in the foreign market

FQs = supply of funds in the foreign market

FLD = foreign loan demand

Rf = foreign comparable interest rate in dollar terms

FX = the premium or discount on forward exchange

Rf - FX = the nominal foreign interest rate

Rus = U.S. interest rate

Rus - FX = the comparable U.S. interest rate from the view point of the foreign market

Red = Euro-dollar interest rate

Red - FX = the comparable Euro-dollar rate from the viewpoint of the foreign market

FMS = foreign money supply

SS = speculation on strong currencies

SW = speculation on weak currencies

The demand for funds in the foreign market can be stated as:

α''_1 and β''_1 = coefficients for demand and supply in the foreign market.

$$FQd = \alpha''_0 + \alpha''_1 FLD + \alpha''_2(Rf - FX) + \alpha''_3(Rus - FX) + \alpha'_4(Red - FX) + \alpha''_5 SW$$

where

$$\alpha''_1\ 0 \quad \alpha''_2\ 0 \quad \alpha''_3\ 0 \quad \alpha''_4\ 0 \quad \alpha''_5\ 0$$

The supply can be stated as

$$FQs = \beta''_0 + \beta''_1(FMS) + \beta''_2(Rf - FX) + \beta''_3(Rus - FX) + \beta''_4(Red - FX) + \beta''_5 SS$$

where

$$\beta''_1\ 0 \quad \beta''_2\ 0 \quad \beta''_3\ 0 \quad \beta''_4\ 0 \quad \beta''_5\ 0$$

Equating supply and demand:

$$\alpha''_0 + \alpha''_1 FLD + \alpha''_2(Rf - FX) + \alpha''_3(Rus - FX) + \alpha''_4(Red + FX) + \alpha''_5 SW =$$

$$\beta''_0 + \beta''_1(FMS) + \beta''_2(Rf - FX) + \beta''_3(Rus - FX) + \beta''_4(Red - FX) + \beta''_5 SS$$

Solving for Rf - FX, the foreign interest rate yields:

$$\beta''_0 - \partial''_0 - \partial''_1 FLD + (\beta''_3 - \partial''_3)(Rus - FX) + (\beta''_4 - \partial''_4)(Red - FX) + \beta''_1 FMS - \partial''_5 SW + \beta''_5 SS$$

and finally

$$(Rf - FX) = \frac{\beta''_0 - \partial''_0}{\alpha''_2 - \beta''_2} - \frac{\alpha''_1}{\alpha'' - \beta''_2} FLD + \frac{\beta''_3 - \partial''_3}{\alpha''_2 - \beta''_2}(Rus - FX) + \frac{\beta''_4 - \partial''_4}{\alpha''_2 - \beta''_2}(Red - FX) +$$

$$\frac{\beta''_1}{\alpha'' - \beta''} FMS - \frac{\alpha''_5}{\alpha'' - \beta''} SW + \frac{\beta''_5}{\alpha'' - \beta''} SS$$

which is the reduced form for the foreign interest rate. This specification can be stated in terms of the comparable foreign rate by adding the forward premium to both sides of the equation. The result shows the determinants of the comparable foreign rate.

$$Rf = \frac{\beta''_0 - \partial''_0}{\alpha''_2 - \beta''_2} - \frac{\alpha''_1}{\alpha''_2 - \beta''_2}FLD + \frac{\beta''_3 - \partial''_3}{\alpha''_2 - \beta''_2}(Rus - FX) + \frac{\beta''_4 - \partial''_4}{\alpha''_2 - \beta''_2}(Red - FX) + \frac{\beta''_1}{\alpha''_2 - \beta''_2}FMS -$$

$$\frac{\alpha''_5}{\alpha''_2 - \beta''_2}SW + \frac{\beta''_5}{\alpha''_2 - \beta''_2}SS + FX$$

or

$$Rf = \frac{\beta''_0 - \partial''_0}{\alpha''_2 - \beta''_2} - \frac{\alpha''_1}{\alpha''_2 - \beta''_2}FLD + \frac{\beta''_3 - \partial''_3}{\alpha''_2 - \beta''_2}(Rus) + \frac{\beta''_4 - \partial''_4}{\alpha''_2 - \beta''_2}(Red) + \frac{\beta''_1}{\alpha''_2 - \beta''_2}FMS -$$

$$\frac{\alpha''_5}{\alpha''_2 - \beta''_2}SW + \frac{\beta''_5}{\alpha''_2 - \beta''_2}SS + \frac{\beta''_3 - \partial''_3 + \beta''_4 - \partial''_4 + \partial''_2 - \beta''_2}{\partial''_2 - \beta''_2}FX$$

Let the following definition hold

$$z_0 = \frac{\alpha''_0 - \beta''_0}{\alpha''_2 - \beta''_2} \quad z_1 = \frac{\alpha''_1}{\alpha''_2 - \beta''_2} \quad z_2 = \frac{\beta''_3 - \partial''_3}{\alpha''_2 - \beta''_2} \quad z_3 = \frac{\beta''_4 - \partial''_4}{\alpha''_2 - \beta''_2} \quad z_4 = \frac{\beta''_1}{\alpha''_2 - \beta''_2}$$

$$z_5 = \frac{-\alpha''_5}{\alpha''_2 - \beta''_2} \quad z_6 = \frac{\beta''_5}{\alpha''_2 - \beta''_2} \quad z_7 = \frac{\beta''_3 - \partial''_3 + \beta''_4 - \partial''_4 + \partial''_2 - \beta''_2}{\alpha''_2 - \beta''_2}$$

Then,

$$Rf = z_0 + z_1FLD + z_2Rus + z_3Red + z_4FMS\ (3) + z_5SW + z_6SS + z_7\ FX$$

where

$z_1>0 \quad z_2>0 \quad z_3>0 \quad z_4?0 \quad z_5>0 \quad z_6<0 \quad z_7<0$

The Estimating Equations

The three markets formulated above are closely related. While there is no identification problem, interest rates are common in all three markets. Other variables are either common to two of the markets or are in a functional relationship to a common variable. While the significance of each individual variable is key to understanding the Euro-dollar market, the question asked in this dissertation is one of the relative significance of the U.S. market and foreign market to the Euro-dollar market.

This dissertation hypothesizes that the Euro-dollar rate, as an international rate, can be conceived as the opportunity cost rate for all other equivalent interest rates in the world. As such, the Euro-dollar rate can be compared with all other interest rates of similar risks of devault to illiquidity (the latter are referred to as country risks). Consequently, movements in the Euro-dollar rate should reflect movements in the highest comparable interest rate amongst comparable securities in the world.

In contrast to this hypothesis, the Euro-dollar market is usually considered as an extension or adjunct to the United States market. Although this alternative premise has never been tested, it is implicit in many studies of the Euro-dollar market.[37]

A third alternative hypothesis is that the Euro-dollar rate is a function of U.S. rates and a weighted average of foreign interest rates. This is the essence of Kwack's study.

Testing the hypothesis that the Euro-dollar rate is more closely related to the highest comparable rate than to U.S. rates will proceed

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[37]See Hendershott, Kwack and Black as discussed in Chapter II.

employing the following framework: All equations used to estimate the models presented above will be tested by both ordinary and generalized least squares estimation. The Interest Equalization Tax will be excluded because it was in effect for the entire period to be tested. Quarterly seasonal adjustment variables (Qi) will be added to the equation. These seasonal variables should indicate the extent to which the Euro-dollar rate is affected by foreign banks "padding" of their accounts at the end of the year.[38]

The Euro-dollar rate will first be estimated from a modified form of the Euro-dollar model (Equation 1) presented above. Thus, the estimating equation will be:

$$Red = x_0 + x_1 Rus + x_2 Rf + x_4 FDRes + x_5 USRR + x_6 USD + x_7 USQR + x_8 SS + x_9 BP + x_{10} V + x_{12} FSRes + x_{13} SW + x_{14} Q_2 + x_{15} Q_3 + x_{16} Q_4$$

Two series of regressions will be using this Euro-dollar market model to indicate the relative significance of the U.S. and comparable highest interest rates.

The coefficients of the determinants of the Euro-dollar rate will also be estimated in equations derived from the U.S. money market and foreign market models. Thus, if the Euro-dollar rate is hypothesized to be a U.S. money market rate and

$$Rus = y_0 + y_1 USLD + y_2 V + y_3 USMS + y_4 Rf + y_5 Red + y_6 USRR + y_7 USD + y_8 USRQ,$$

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[38]Bank for International Settlements, Annual Report, 1967.

then, by substitution

$$Red = \frac{y_0}{1 - y_5} + \frac{y_1}{1 - y_5}USLD + \frac{y_2}{1 - y_5}USLD + \frac{y_3}{1 - y_5}USMS + \frac{y_4}{1 - y_5}Rf +$$

$$\frac{y_6}{1 - y_5}USRR + \frac{y_7}{1 - y_5}USD + \frac{y_8}{1 - y_5}USRQ$$

Similarly, if the the Euro-dollar rate is hypothesized to be equal to the highest comparable rate and the highest comparable rate,Rf is:

$$Rf = z_0 + z_1FLD + z_2Rus + z_3Red + z_4FMS + z_5SW + z_6SS + z_7FX.$$

then,

$$Red = \frac{z_0}{1 - z_3} + \frac{z_1}{1 - z_3}FLD + \frac{z_2}{1 - z_3}Rus + \frac{z_4}{1 - z_3}FMS + \frac{z_5}{1 - z_3}SW +$$

$$\frac{z_6}{1 - z_3}SS + \frac{z_7}{1 - z_3}FX$$

In testing the Euro-dollar's role in the two markets, the regression coefficients will be composites of the above function. Dummies for quarterly seasonal variation will also be included. Consequently, the estimating equations will be:

$$Red = y_0^1 + y_1^1Rus + y_2^1USLD + y_3^1V + y_4^1USMS + y_5^1Rf + y_6^1USRR + y_7^1USD + y_8^1USRQ +$$

$$y_9^1Q_2 + y_{10}^1Q_3 + y_{11}^1Q_4$$

$$Red = z_0^1 + z_1^1FLD + z_2^1Rus + z_3^1FMS + z_4^1SW + z_5^1SS + z_6^1FX + z_7^1Q_2 + z_8^1Q_3 + z_9^1Q_4$$

An additional test will estimate the coefficients of factors affecting the Euro-dollar - U.S. differential relative to the U.S. - foreign differential.

This test will evaluate factors which affect changes in the alignment of the Euro-dollar rate with U.S. and foreign comparable rates. The results will indicate the direction of alignment caused by the different variables specified. The estimating equation is derived by first substituting the determinants of Rus and Rf into the estimating equation as follows:

$$Red = x_0 + x_1(y_0 + y_1USLD + y_2V + y_3USMS + y_4Rf + y_5Red + y_6USRR + y_7USD + y_8USRQ) + x_2(z_0 + z_1FLD + z_2Rus + z_3Red + z_4FMS + z_5SW + z_6SS + z_7FX) + x_4FDRes + x_5USRR + x_6USD + x_7USQR + x_8SS + x_9BP + x_{10}V + x_{12}FSRes + x_{13}SW + x_{14}Q_2 + x_{15}Q_3 + x_{16}Q_4.$$

Gathering terms, dividing by $(1 - x_1y_5 - x_2z_3)$, and solving for Red yields the following:

$$Red = [x_0 + x_1(y_0 + y_1USLD + y_2V + y_3USMS + y_4Rf + y_6US + y_7USD + y_8USRQ) + x_2(z_0 + z_1FLD + z_2Rus + z_4FMS + z_5SW + z_6SS + z_7FX) + x_4FDRes + x_5USRR + x_6USD + x_7USQR + x_8SS + x_9BP + x_{10}V + x_{12}FSRes + x_{13}SW + x_{14}Q_2 + x_{15}Q_3 + x_{16}Q_4] \quad \frac{1}{(1 - x_1y_5 - x_2z_3)}$$

Subtracting Rus from both sides and dividing both sides by Rf - Rus yields:

$$\frac{Red - Rus}{Rf - Rus} = [x_0 - x_1(y_0 + y_1USLD + y_2V + y_3USMS + y_4Rf + y_6USRR + y_7USD + y_8USRQ) + x_2(z_0 + z_1FLD + z_2Rus + z_4FMS + z_5SW + z_6SS + z_7FX) + x_4FDRes + x_5USRR + x_6USD + x_7USQR + x_8SS + x_9BP + x_{10}V + x_{12}FSRes + x_{13}SW + x_{14}Q + x_{15}Q_3 + x_{16}Q_4 - Rus] \quad \frac{1}{(Rf - Rus)} \quad \frac{1}{(1 - x_1y_5 - x_2z_3)}$$

A linear approximation to this equation can be stated as follows:

$$\frac{Red - Rus}{Rf - Rus} = c_0 + c_1 USLD + c_2 FLD + c_3 USMS + c_4 FMS + c_5 V + c_6 USRR + c_7 USD + c_8 USQR + c_9 SW + c_{10} SS + c_{11} FDRes + c_{12} BP + c_{13} FSRes + c_{14} Q_2 + c_{15} Q_3 + c_{16} Q_4$$

In addition to the above regressions, Chow tests are run on the Euro-dollar-differential-ratio equation (Equation V, page 60) to determine if there has been a shift in the structure of the Euro-dollar market. Finally, the sensitivity of interest rate differentials is tested using the Branson study as the format. The responsiveness of interest rate differentials to changes in the Euro-dollar rate and the U.S. rate are compared on an instantaneous and lagged basis to see first, if there has been any change in results since the Branson data and, second, if there is any difference in responsiveness to changes in Euro-dollar ratesas opposed to changes in U.S. rates.

CHAPTER IV

THE DATA

Data on the Euro-dollar rate are from the Bank of England Quarterly Bulletin. The rates are the end of the month, middle closing rates paid on 90 day deposits. Prior to October, 1965, these rates were the last Thursday closing rates; after this date, they are the Friday closing rates. Data on all other interest rates come from the Federal Reserve Bulletin. The rates selected from this latter source are the monthly average ninety day rates for the U.S. treasury bills, the 90 day rate for United Kingdom Treasury bills, the monthly average day-to-day money rate for France, the end of the month rate on German Treasury bills and the monthly average 90 day treasury bill for the Netherlands. The treasury bill rate and equivalents were choosen to approximate the risk free interest rate in each country. All interest rates cover the period July, 1964 through November, 1970 inclusive. The foreign comparable interest rate is calculated by adding the premium or subtracting the discount on dollar forward exchange from the rate of interest in France, Germany, the United Kingdom, and Netherlands and comparing this rate with the U.S. rate. The highest of the five resulting rates,

for each period of time is employed to obtain the highest comparable rate series. It should be noted that in constructing this series, the U.S. rate appears only once during the period investigated. The comparable rates and their country of origin are found in Appendix II-B.

In two estimations of the Euro-dollar market model, an average comparable foreign interest rate is used. This rate is calculated by weighting the interest rates of France, Germany, the United Kingdom and Netherlands by their quarterly dollar asset claimed against non-residents of the ten major countries in Europe and averaging the results. Appendix II-C shows the dollar assets and weights derived from the assets. To this average interest rate, an average forward exchange rate (explained below) is added. The data source of the weighting factors is the Bank for International Settlements Annual Reports.

Forward exchange premiums and discounts are the annualized ninety day rates reported in the International Monetary Fund Financial Statistics. The series is poor. There are several inconsistencies in going from month to month in the original data which have been resolved by averaging the two different reported rates for the same month. The average forward rate is calculated by weighting the forward premiums of France, Germany, United Kingdom, and Netherlands by each country's quarterly dollar liabilities vis-a-vis non-residents of the ten major European countries as reported by the Bank for International Settlements Annual Reports. These data and the weights derived are found in Appendix II-C.

U.S. and foreign money supply data are from the International Monetary Fund Financial Statistics. Monthly rates of increase in money

supply are used to approximate the U.S. money supply. The rate of increase was used in order to employ consistent data. Only percentage monetary data were available for France. Foreign money supply is calculated by averaging the monthly rates of increase in money supply for France, Germany and the Netherlands, and the quarterly rates of increase for the United Kingdom for each month in the quarter.

Money supply data for the Euro-dollar market are very limited. To avoid double counting all interbank deposits should be netted out. However, estimates of the size of the Euro-dollar market netting out all interbank deposits are only available for the year-end for a limited number of years. While more frequent figures are available for the external positions of European banks vis-a-vis non-residents of the inside area (Belgium, Luxembourg, France, Germany, Italy, Netherlands, Sweden, Switzerland, and the United Kingdom), there is no netting out when funds are lent to outside area banks and redeposited by the latter with banks within the reporting area. Consequently, an approximation of the Euro-dollar money supply base, or accumulated debits minus dollar returns discussed in Chapter I, pages 5 - 8 is made. The liquidity balance of payments position as reported in the Federal Reserve Bulletin has been used as an estimate of the rate of growth of the Euro-dollar money base and, hence, Euro-dollar money supply.

U.S. loan demand is approximated by the monthly U.S. Gross National Product figures reported in the Federal Reserve Bulletin. These data are probably the best indicator of the state of the economic activity upon which U.S. loan demand depends. Foreign loan demand figures are

not quite as clear cut. First, there is a problem of aggregating the GNP's of various countries because of exchange rates and changes in exchange rates. Second, there is insufficient, in one case, and sporatic, in another case, reporting of data in the countries covered in this study. As a result, foreign loan demand is approximated by averaging the quarterly rates of growth in GNP for the United Kingdom, Netherlands, and Germany and constructing from this average an index using the third quarter of 1964 as the base period.

Speculation variables are approximated by dummy variables. Two data series have been generated: one representing devaluation crisis and one representing revaluation crisis. In both series the crisis periods are represented by ones and the non-crisis periods by zero. Speculation against weak currencies includes the Sterling Crises (6/66 - 8/66 inclusive), (4/67 - 6/67 inclusive), and (9/67 - devaluation of 11/67) and the franc crises (5/68 - 10/68) and (7/69 - 10/69). Speculation on strong currencies includes (10/67) and (7/69 - 10/69) both periods representing Deutsch mark crises. It should be stressed that all of these dates are approximations. There is no procedure for measuring crises; however, the dummy variables should give some indication of the importance of speculation.

In a similar manner, most restrictions are represented by dummy variables where ones (1) represent the time when the restriction is in effect and zeros (0) when it is not in effect. There are two restrictions imposed by foreign countries which have been considered-German offering of dollars at preferential rates is included for November and

December, 1967. And German reserve requirements on foreign liabilities are included for April - May, 1970.

The U.S. Voluntary Credit Restraint Program is represented by an index of loans allowable over and above the first quarter, 1964 base period[39]. Dummy variables represent the imposition of reserve requirements on Euro-dollar borrowings and the change in the definition of demand deposits both effective October, 1969 as well as the lifting of the Regulation Q ceiling interest rate in January, 1970.

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[39]Black op. cit. p. 85.

CHAPTER V

THE EMPIRICAL RESULTS

The hypothesis that the Euro-dollar rate is an international opportunity cost rate, derived from the highest comparable interest rate is substantiated in the findings discussed below. In the first two sets of regressions (I and II), the Euro-dollar rate is viewed in relationship to the structure of the Euro-dollar market model. Here the results directly confirm the basic hypothesis. At this point, a comparison is made between the Euro-dollar rate viewed as part of the U.S. market (regressions III) and the Euro-dollar rate viewed as part of the foreign market (regressions IV). Again, the findings are consistent with the highest comparable rate hypothesis.

The variables responsible for the Euro-dollar rate alignment with the highest comparable rate are studied in regressions V. The findings indicate that restrictions have played the most significant role in the alignment of interest rates. At this point, a Chow test is undertaken to confirm that the alignment of Euro-rates with the highest comparable rate represents a significant shift in the structure of the Market. Given affirmation of the shift, two comparisons of the Euro-dollar and the U.S. rate's effect on other interest rates are undertaken.

The general format for discussing each regression is to consider first the overall results, and then to consider the interest rate findings

in relationship to the basic hypothesis. The significance of restrictions is then considered followed by a discussion of other variables in declining of significance.

An ordinary least squares regression was run on the basic Euro-dollar market interest rate equation using the highest comparable foreign interest rate series as a proxy for the foreign interest rate. The results are as follows:

Red = .0616 + .9061 Rf + .2184 Rus + .0001 BP + .0768 SW

standard error .4046 .0906 .09165 .0001 .1733

(t-values) (.1523)(9.9920) (2.3859) (.5514) (.4430)

+ .2019 SS + .2490 FDRes - .0706 FSRes - .0016 V

.3977 .4988 .3202 .0024 (I-A)

(.5077) (.4991) (.2204) (.6732)

- .2278 USRR + .0696 USD - .3737 USRQ - .0948 Q_2

.3751 .4886 .4468 .1603

(.6073) (.1424) (.8366) (.5914)

- .0712 Q_3 + .2686 Q_4

.1568 .1551

(.4540) (1.7317)

n = 76 R^2 = .9522 DW = 2.5107 SE = .4596

Because the Durbin-Watson statistic indicated autocorrelation, a second regression using the generalized least squares procedure was run in order to reduce the effects of autocorrelation and produce estimates

which are unbiased and have smaller variences.[40] The results were as follows:

Red = .02561 + .8424 Rf + .2952 Rus + .0001 BP

standard error .3291 .0872 .0868 .0001

(t-value) (.0776) (9.6589) (3.4003) (1.1456)

+ .0857 SW - .0211 SS + .3850 FDRes + .0455 FSRes

.1559 .3730 .4777 .3097

(.5494) (.0567) (.8060) (.1470)

- .0016 V - .2627 USRR + .5141 USD - .7398 USRQ (I-B)

.0019 .3388 .4541 .4026

(.8163) (1.7753) (1.1322) (1.8378)

- .0460 Q_2 - .0236 Q_3 + .3321 Q_4

.1370 .1298 .1299

(.3360) (.1822) (2.5573)

n = 75 R^2 = .9718 DW = 2.3455 SE = .4386

As can be seen from the t-values, the comparable foreign interest rate, the U.S. rate and the fourth quarter seasonal adjustment variable and definately significant at the 1% level and the signs are as expected. The substantially higher t-statistic for the highest comparable foreign interest rate relative to the U.S. interest rate strongly supports the proposition that the Euro-dollar rate is a world opportunity cost rate, competitive

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[40] Edward Kane, Economic Statistics and Econometrics (New York: Harper and Row, 1968) p. 359.

with the highest effective or comparable interest rates. The coefficient for the highest comparable rate is much higher than for the U.S. rate. Additionally, the coefficient for Rf is not far from 1 which is, in effect, hypothesized.

Of the variables representing restrictions on the supply and demand for Euro-dollars only two are worth noting. The removal of regulation Q ceiling interest rates is marginally significant at the 5% level and is of negative sign as predicted. The sign is indicative that the removal of the interest rate limit decreased U.S. demand for Euro-dollars and, therefore, lowered interest rates. The variable representing the redefinition of U.S. demand deposits to include drafts on Euro-banks is of minimal significance (at the 25% level) and the sign is inconsistent with the prediction. The sign seems to indicate that U.S. borrowings of Euro-dollars to meet reserve requirements depends more on the amount of funds available for reserves than upon the interest rate on borrowing Euro-dollar week-end reserves; thus, the decrease in excess reserves due to the redefinition of demand deposits increased demand for Euro-dollars. A similar explanation can be made for the sign on the reserve requirement coefficients. But, in other regressions, this sign is as predicted so that the large standard error for the reserve requirement variable must be considered to be responsible for the sign.

The significant and positive value for the fourth quarter support indicates that Euro-dollar are borrowed to increase or pad foreign banks liquidity positions for year-end reporting. The balance of payments variable is of significance only at the 25% level probably due to the

inadequacy of these data as a proxy for the Euro-dollar money supply, i.e. accumulated debits minus dollar reflows. However, the sign for this variable is consistent with the hypothesis that increases in the ultimate source of Euro-dollar supply (roughly indicated by deficits in the balance of payments) are consistent with lower Euro-dollar rates and decreases in supply (approximated by balance of payments surpluses) and consistent with higher Euro-dollar rates.

The remaining variables are all insignificant at the 25% level. However, it should be noted that the signs of the two speculative coefficients show that speculation on weak currencies represents a decrease in supply or increase in demand for Euro-dollars and that speculation on strong currencies has the opposite effect. This result may be due to uncovered operations. Borrowing of Euro-dollars could increase in devaluation speculation because the uncovered Euro-dollar rate is lower than the (uncovered) domestic foreign rate. In the same vein, borrowing might decrease and depositing might increase when revaluation is a possibility because of the relatively low uncovered interest rates in the potentially revaluing country. Additionally, as previously mentioned, to the extent that central banks borrow Euro-dollars to supplement their reserve during devaluation crises and deposit with Euro-banks or the Bank for International Settlements (which in turn deposits in the Euro-dollar market) when reserves are excessive, the signs of the coefficients can be justified.

The sign for the voluntary credit restraint program variable is

unexpected. The sign can be explained as the result of large leakages of funds to the Euro-dollar market despite the restraint program. However, the standard error is high; the coefficient could be zero.

A second set of regressions was run on the basic Euro-dollar market equation. This time the average foreign comparable interest rate was used to represent the foreign rate. The results are as follows:

Red = 1.0696 + .7837 Rus + .0734 Rfav + .0001 BP

standard error .6311 .1194 .0363 .0002

(t-value) (1.8949)(6.5623) (2.0240) (.4115)

+ .4022 SW - .4143 SS - .0031 FDRes + .4156 FSRes

.2730 .6189 .7836 .5044

(1.4732) (.6694) (.0040) (.8240)

(II-A)

+ .0033 V + .9531 USRR + 1.9783 USD - 1.4042 USRQ

.3687 .5561 .7062 .6842

(.8927) (1.7138) (2.8013) (2.0523)

+ .1830 Q_2 + .1347 Q_3 + .4915 Q_4

.2484 .2450 .2413

(.7370) (.5497) (2.0367)

n = 76 R_2 = .8819 DW = 2.4519 SE = .7225

As in the previous case, auto-correlation appears. Consequently, the equation was re-estimated using generalized lease squares. The GLS procedure yielded the following:

Red = .8607 + .8738 Rus + .0550 Rfax + .0001 BP + .4144 SW

standard value .5214 .1006 .0343 .0001 .2447

(t-value) (1.6505)(8.6847) (1.6020) (.9863) (1.6934)

- .4825 SS + .1911 FDR + .7072 FSR + .0025 V

.5842 .7511 .4816 .0030

(-.8260) (.2545) (1.4683) (.8360)

+ .6245 USRR + 2.4914 USD - 1.7976 USRQ + .2071 Q_2 (II-B)

.5149 .6383 .6118 .2135

(1.2131) (3.9035) (-2.9381) (.9700)

+ .1626 Q_3 + .5365 Q_4

.2050 .2040

(.7929) (2.6293)

n = 75 R_2 = .9277 DW = 2.3937 SE = .6864

The use of an average comparable foreign interest rate has raised the standard error of the regression and consequently lowered the R-squared relative to the results using the highest comparable rate series. Additionally, the U.S. rate now appears more significant than the average foreign comparable rate. This finding is probably the result of using averages. The average foreign rate is lower than the highest foreign rate and is therefore not truly the opportunity cost rate. Furthermore, the averaging of forward rates reduces the impact of large discounts and premiums which have existed for individual countries. Additionally, the U.S. rate may be more collinear with the highest foreign rate than the average foreign rate.

The significance of other variables is similar to the previous result although it sould be pointed out that in this equation, the sign of the coefficients for the Voluntary Credit Restraint program and the imposition of reserve requirements is as predicted.

The Euro-dollar rate when seen as part of the U.S. market in III below presents some surprising findings, particularly when compared with the Euro-dollar as part of the foreign market in IV. Ordinary Least squares yielded the following results:

Red = 1.4111 + 1.0613 Rf - .0024 USGnp + .0740 USMS

standard error .8178 .0856 .0016 .8426

(t-value) (1.7298)(12.4027) (-1.5327) (1.7383)

+ .0014 V - .1254 USRR + .2888 USD - .0698 USRQ - .1222 Q_2

.0028 .2675 .3949 .3832 .1481 (III-A)

(.5087) (-.4688) (.7314) (-.1823) (-.8251)

- .0736 Q_3 + .2172 Q_4

.1548 .1498

(-.4756) (1.4502)

n = 76 R^2 = .9499 DW = 2.4039 SE = .4593

Again, there is autocorrelation in both equations generalized least squares were used to obtain the following:

Red = 1.3524 + 1.0851 Rf - .0025 USGnp + .0788 USMS

standard error .6797 .0780 .0013 .0387

(t-value) (1.9897)(13.9034) (-1.8561) (2.0375)

$$+ .0013\ V - .1947\ USRR + .3364\ USD - .1086\ USRQ - .1031\ Q_2$$

$$.0024 \quad .2282 \quad .3566 \quad .3427 \quad .1309$$

$$(.5664) \quad (-.8532) \quad (.9435) \quad (-.3168) \quad (-.7872) \qquad \text{(III-B)}$$

$$- .0467\ Q_3 + .2547\ Q_4$$

$$.1341 \quad .1329$$

$$(-.3486) \quad (1.9169)$$

$n = 75 \quad R^2 = .9661 \quad DW = 2.1722 \quad SE = .4501$

The above findings can be compared with the results of the Euro-dollar market when viewed as part of the foreign market. Ordinary Least squares procedures yielded the following results:

$$\text{Red} = -4.6326 + .7649\ \text{Rus} - .1189\ \text{FP} + .0569\ \text{FGNP}$$

$$\text{standard error} \quad 3.6799 \quad .1370 \quad .0575 \quad .0409$$

$$\text{(t-value)} \quad (-1.2589) \quad (5.5854) \quad (2.1330) \quad (1.4346)$$

$$- .0012\ \text{FMS} + .3024\ \text{SW} + .6921\ \text{SS} + .1023\ Q_2 \qquad \text{(IV-A)}$$

$$.0040 \quad .2819 \quad .5054 \quad .2585$$

$$(-.2910) \quad (1.0727) \quad (1.3693) \quad (.3955)$$

$$+ .0341\ Q_3 + .5114\ Q_4$$

$$.2512 \quad .2504$$

$$(.1359) \quad (2.0427)$$

$n = 76 \quad R^2 = .8636 \quad DW = 1.8787 \quad SE = .7534$

Using generalized least squares, the Euro-dollar rate as part of the foreign market yields the following:

Red = -4.1893 + .7361 Rus - .1240 FP + .0550 FGNP

standard error 3.7615 .1377 .0578 .0417

(t-value) (-1.1137)(5.3435) (-2.2638) (1.3185) (IV-B)

-.0006 FMS + .2850 SW + .6260 SS + .0919 Q_2

.0041 .2794 .5027 .2594

(-.1429) (1.0202) (1.2452) (.3543)

.0391 Q_3 + .4940 Q_4

.2547 .2531

(.1534) (1.9523)

n = 75 R^2 = .8541 DW = 1.9827 SER = .7396

First, it should be noted that the Euro-dollar rate fit with the U.S. market is better than the foreign market. The fit may be due to higher correlation between the Euro-dollar rate and the highest comparable rate than between the Euro-dollar rate and the U.S. rate. The U.S. rate is not included in the regression. Also, the relative fits may be the result of the exclusion of U.S. restrictions in the foreign market. These restrictions may affect the foreign market as much as they affect the Euro-dollar market. (Note regressions I.) Supportive of this line of reasoning are the interest rate t-values in the four equations immediately above. The highest effective interest rate is the primary variable in significance in the U.S. market equations, and its regression coefficient

is approximately one (1.0) consistent with the thesis that the Euro-dollar rate equals the opportunity cost rate. In comparison, the U.S. rate while significant in the foreign market is much less so, and its regression coefficient is much less than one.

In the U.S. market equation, U.S. money supply and GNP are both significant variables. In the case of money supply, the finding of higher interest rates with greater money supply may be symtomatic of one of two phenomena: the Gibson (or Fisher) effect or expansion of the money supply via Euro-dollar borrowings. The Gibson effect is the historical coincidence of high interest rates with rising prices. If we accept the theory that rising prices cannot be sustained without increasing money supply, then we can assert that correlation of higher interest rates with increasing money supply is not a surprising finding in data covering primarily the late 1960's. Alternatively, Euro-dollar borrowings can cause an increase in loanable funds concurrent with higher interest rates as explained in Chapter I. Thus, if U.S. banks are fully loaned up, Euro-dollar borrowings can cause an increase in money supply.

The sign of the GNP variable is opposite that which was predicted. The coincidence of negative U.S. GNP and higher Euro-dollar rate can be explained as the result of recognition lags in monetary policy (which was primarily an interest rate policy during the period studied) or the concern for international capital flows during the period.

While the other variables in the U.S. market model are insignificant, it should be noted that their signs (except for the redefinition of

demand deposits) are as predicted. Increased restrictiveness of the Voluntary Credit Exchange Program is positively associated with Euro-dollar rates whereas both the imposition of reserve requirements and the removal of certain U.S. interest rate ceilings (Regulation Q) decrease U.S. demand and, consequently, are associated with lower Euro-dollar rates. The redefinition of demand deposits for reserve requirement calculation, as previously mentioned probably affects the interest inelastic portion of U.S. demand for Euro-dollars.

In the foreign market, the discount on forward exchange is significant at the 5% level. The sign of the forward premium is negative as the forward percentage rate was subtracted from the foreign rate when calculating the highest opportunity cost rate. As previously mentioned, foreign GNP and foreign money supply have the predicted signs although the latter variable, money supply, has virtually no significance. The speculative variables are marginally significant and both have positive signs. The positive signs of both may reflect the simultaneity of speculation on weak and strong currencies.

Ordinary and generalized least squares regressions on the ratio of the Euro-dollar - U.S. rate differential to the foreign - U.S. rate differential hereafter referred to as the composite yielded the following results:

Ordinary Least Squares

$$\frac{Red - Rus}{Rf - Rus} = .3198 - .5237\ (D\text{-}1) - 1.8700\ USMS$$

$$121.3612 \qquad .1084 \qquad .8070$$

$$(.2632) \qquad (.4829) \qquad (2.3171)$$

$$
\begin{array}{lll}
-\ .3027\ FGNP & +\ .1139\ \ USGNP & +\ 5780\ SW \\
\ \ 1.5018 & \ \ .1674 & \ \ 3.3491 \qquad (V\text{-}A) \\
\ \ (.2016) & \ \ (.6804) & \ \ (.1726)
\end{array}
$$

$$
\begin{array}{lll}
+\ 1378\ (D\text{-}01)\ SS & -\ 55.8297\ FDR & -\ 1.8622\ FSR \\
\ \ .4983\ (D\text{-}01) & \ \ 8.6633 & \ \ 8.7820 \\
\ \ (.2764) & \ \ (6.4443) & \ \ (.2120)
\end{array}
$$

$$
\begin{array}{lll}
+\ 19.4231\ V & -\ 23.0955\ USRR & +\ 55.2190\ USD \\
\ \ 5.8133 & \ \ 8.0505 & \ \ 10.4326 \\
\ \ (3.3411) & \ \ (2.8688) & \ \ (5.2929)
\end{array}
$$

$$
\begin{array}{lll}
-\ 35.4505\ USRQ & -\ .1726\ BP & -\ 1.3236\ Q_2 \\
\ \ 9.4914 & \ \ 2.8895 & \ \ 2.8149 \\
\ \ (3.7350) & \ \ (.5975) & \ \ (.4702)
\end{array}
$$

$$
\begin{array}{ll}
-\ \ 2.7275\ \ (D\text{-}30)\ Q_3 & -\ .3585\ (D\text{-}27)\ Q_4 \\
\ \ 2.6859 & \ \ .2042\ (D\text{-}02) \\
\ \ (1.0155) & \ \ (1.7555)
\end{array}
$$

$n = 76 \quad R^2 = .6888 \quad DW = 2.1235 \quad SER = 8.1152$

generalized least squares were also run although unnecessary. The following results occurred:

$$
\begin{array}{lll}
\dfrac{Red - Rus}{Rf - Rus} = -\ 29.6621 & -\ 4.173\ (D\text{-}01)\ FMS & -\ 1.8044\ USMS \\
\ \ 121.6608 & \ \ .1083 & \ \ .7928 \\
\ \ .2438 & \ \ .4540 & \ \ (2.2761)
\end{array}
$$

$$
\begin{array}{l}
-\ .1942\ FGNP + .9307\ (D\text{-}01)\ USGNP + .5595\ SW \\
\quad 1.4955 \qquad\qquad 1635 \qquad\qquad\qquad 3.3767 \\
\quad (.1299) \qquad (.5694) \qquad\qquad (.1659) \\
+\ .1352\ SS - 55.4032\ FDR - 1.6612\ FSR \qquad\qquad\qquad\qquad (V\text{-}B) \\
\quad 4812\ (D\text{-}01) \quad 8.6662 \qquad 8.8970 \\
(.2890) \qquad -6.3929 \qquad -.1867 \\
+\ 19.8709\ V - 23.0911\ USRR + 55.9418\ USD \\
\quad 5.8606 \qquad 8.0557 \qquad\quad 10.3605 \\
\quad (3.3906) \qquad (2.8664) \qquad (5.3995) \\
-\ 36.3817\ USRQ - .2195\ BP - 1.3079\ Q_2 \\
\quad 9.4037 \qquad\quad 2.8418 \qquad 2.7429 \\
\quad (3.8689) \qquad (.7723\ D\text{-}01) \quad (.4768) \\
-\ 2.8485\ Q_3 - .3312\ (D\text{-}02)\ Q_4 \\
\quad 2.6211 \qquad 2.001\ (D\text{-}02) \\
\quad (1.0867) \qquad (1.6551)
\end{array}
$$

$n = 75 \qquad R^2 = .6923 \qquad DW = 2.063 \qquad SER = 8.1615$

The R^2's for the two composite regressions are substantially lower than the R^2's on the regressions run on interest rate levels. These lower R^2's are expected; the pattern of variation in interest rate differentials are more apt to be affected by unspecified and unquantifiable variables than the level of Euro-dollar rates. Nothwithstanding, the R^2's are sufficiently high to indicate that the Euro-dollar rate has gravitated toward alignment with the highest comparable rate and away from the U.S. rate.

Of the variables regressed against the composite ratio, restrictions on capital flows are the most significant category probably indicating that the Euro-dollar market has acted as a loophole for capital flows when other markets have been unable to accomodate them. If the origin of the Euro-dollar market can be attributed to the reduction of exchange controls in the United Kingdom (in 1957) and other major countries (in 1958), the imposition of other controls can be said to be responsible for the market's significant and relatively independent growth. Theoretically, the necessary conditions for the creation of any banking system based on foreign currency deposits are: 1) the existence of interest rate differentials between national credit markets, 2) a sufficient degree of freedom from exchange controls to permit investors to take advantage of rate differences, and 3) sufficient confidence in the vehicle currency to permit the potential for profit to outweigh the risk. To the above requirements one additional qualification must be appended. Theoretically, short term money capital will flow to the country having the highest short-term deposit rate given the risk of default and illiquidity. If one accepts the three requirements listed above, no reason exists for the development of a separate foreign currency banking market unless there is some disincentive to depositing or borrowing directly in the country yielding the highest or lowest comparable rate. Restrictions affecting direct investment can be postulated as the incentive for increased use of the Euro-dollar market and for the movrment toward relative independence of Euro-dollar rates.

As can be seen above all U.S. restrictions except the Voluntary Credit Restraint Program variable are significant. The imposition of reserve requirements on Euro-dollar borrowings by U.S. banks in October, 1969, increased the effective cost of U.S. bank borrowing of Euro-dollars. While regressions IIIA and IIIB show the effect of the requirement was to decrease U.S. demand for Euro-dollars, and therefore Euro-dollar rates, the positive sign in the interest rate differential composite reveals that the reserve requirements tended to widen the relative Euro-dollar - U.S. rate differential. The apparent conflict in signs can be resolved if increased independence of Euro-dollar rates is accepted as the result of the imposition of reserves. Thus, as a result of the imposition of reserve requirements, Euro-dollar rates increased their sensitivity to the highest comparable rate. The monopsonistic control of Euro-dollar by U.S. bank rates was no longer a determinant factor in the Euro-dollar rate. This increased sensitivity can be substantiated by Euro-dollar activity in 1970 when, despite large repayments of funds to the market by U.S. banks, the Euro-dollar market continued to expand. The market, in 1970, not only found other outlets for the money returned to it by U.S. banks, but also experienced an increase in total lending.

The removal of the Regulation Q ceiling on ninety day U.S. bank certificates of deposit in June, 1970, increased the relative Euro-dollar - U.S. rate differential. The positive sign for the removal of ceiling rates may reflect decreased supply of direct U.S. dollars to the Euro-dollar market although, theoretically, this type of capital outflow had been restricted by the Voluntary Credit Restraint Act of 1965.

It can be hypothesized that either the Voluntary Credit Restraint Program was ineffective or that an alternative combination of events is responsible for the increased Euro-dollar - U.S. differential. The alternative occurence which could be responsible for the increased differential is the relative expansion of Euro-dollar loans in 1970 for extensive credit in the United Kingdom and for speculation on the mark. If, in 1970 - a year of generally declining interest rates - Euro-dollar rates declined relatively less than U.S. and foreign rates as the result of proportionately greater relative demand, then the ineffectiveness of the Voluntary Credit Restraint Program need not be held responsible for this finding.

The negative variable for the redefinition of demand deposits (which increased required reserves) reflects a higher U.S. rate, thereby decreasing the composite ratio. This explanation is compatible with the discussion of regressions IA and IB whereby U.S. banks appear to borrow Euro-dollars irrespective of the rate in order to meet reserve requirements. Such borrowings could take place simultaneously with rising domestic rates as a result of the squeeze on reserves.

In addition to U.S. restrictions, foreign supply restrictions are significant in regressions VA and VB. The specific restriction (see page 29) was the imposition of a thirty percent reserve requirement on increases in capital inflows into Germany in April, 1970. The negative sign reflects a decrease in the composite probably as a result concurrent with higher foreign rates resulting from decreased supply into the foreign market and decreased Euro-dollar borrowings and, consequently,

Euro-dollar rates. Foreign market demand restrictions although insignificant at the 40% level have a positive sign which coincides with decreased foreign rates and increased Euro-rates.

One of the most significant variables in the composites is speculation on strong currencies. The sign of the coefficient is positive reflecting increased demand for Euro-dollars and higher Euro-dollar rates. The significance of this variable suggests that the Euro-dollar market acts to intensify speculative capital flows despite the lack of significance of the variable representing speculation on weak currencies. The absence of a clear-cut finding for speculation on weak currencies may be the result of the frequent coincidence of speculation on weak and strong currencies plus the motive of minimizing losses (as opposed to motive of obtaining profits from the dollar view point) in the case of devaluation speculation. During a devaluation, losses can be minimized by moving cash balances out of weak currencies whereas profits are made by borrowing weak currencies and converting into stronger ones. Corporations and individuals can borrow more easily during revaluation crises than during devaluation. The restriction and moral suasion applied against borrowing weak currencies during a devaluation crisis may tend to limit some profit motivated speculation using borrowed balances. There are no similar restrictions on borrowing to speculate on strong currencies.

The other variables in V worthy of mention are the U.S. money supply, the fourth quarter seasonal adjustment, and the balance of payments.

The U.S. money supply variable is positively related to the composite and is slightly significant. This finding may reflect an increase in money supply in the U.S. as a result of Euro-dollar borrowings. The positive sign of the fourth quarter is also slightly significant and appears to reflect year-end borrowing by foreign banks. The balance of payments variable, while of questionable significance is worth noting since the sign reflects an increase in the relative Euro-dollar - U.S. differential coinciding with a predicted decrease in the balance of payments deficit (the proxy for Euro-dollar money supply).

The R^2 in the composite regression is high enough as previously mentioned to support the possibility of a shift in the structure of the Euro-dollar market. A shift means that the Euro-dollar - U.S. alignment had changes relative to the foreign - U.S. differential. To confirm the existence of this shift, a Chow test was performed on the generalized least square composite regression of set V above. The data were divided at the month of the imposition of reserve requirements on Euro-dollar borrowings (October 1969). The Chow test was calculated from Regression VB plus the following sub-periods:

BEFORE RESERVE REQUIREMENTS

$$\frac{Red - Rus}{Rf - Rus} = -.801.9165 + .1833\ FMS - 2.6346\ USMS$$

334.5847 .1996 1.1601

(2.3968) (.9182) (2.2710)

3.0515 FGNP + .1122 USGNP + 1.4805 SW

1.960 .2740 3.9163

(1.5566) (.4093) (.3780)

- 63.4397 SS - .3581 FDR + 18.1765 FSR

10.7265 9.1499 6.3202

5.9143 (- 3913) 2.8759

- 5.1704 V - 38.6075 USRR - 63.5764 USD

2.1450 12.0778 11.6526

(2.4104) (.31966) (5.4560)

- 30.2268 USRQ - .3713 (D-02) - 1.9940 Q_2

11.0845 3.8657 38219

(2.7269) (.9605 D-03) (.5217)

- 1.9940 Q_3 - .3540 Q_4

3822 3.5248

(.5217) (.1004)

n = 51 R^2 = .7930 DW = 2.0643 SE = 8.1443

AFTER RESERVE REQUIREMENTS

$$\frac{Red - Rus}{Rf - Rus} = -366.4689 - .2712\ FMS - 2.3993\ USMS$$

243.1865 .2110 1.6793

(1.5069) (1.2856) (1.4288)

$$+ 5.5979\ FGNP - .2942\ USGNP - 5.5727\ SW$$

3.7922 (D-13) .4582 (D-12) 11.0902 (D-12)

1.4762 (D-6) .6422 (D-6) .5025 (D-5)

.6574 (.1094) + 5.2696 - 1.3864

5.4469 6.5704 (9.675) (.2110)

$- 6.0960\ Q_4$ 5.8019 (1.0507)

$n = 25$ $R^2 = .4703$ $DW = 2.4254$ $SE = 7.3585$

Chow Test $F = 2.06$ $n = 75$ $k = 16$

Since the critical value of F (75) is 1.74, the hypothesis that there is no shift in the structure of the relative Euro-dollar - U.S. differential can be rejected. This finding confirms that the structure of the Euro-dollar market has changed over time and that relative separation of the Euro-dollar market from the U.S. market must be considered as a distinct possibility.

This shift in structure is also found in the Branson study and is repeated using more recent data. Branson's study of the sensitivity of interest rate differentials to changes in the U.S. rate "suggested that changes in the U.S. rate will explain changes in the U.S. - Euro-dollar differential better than any of the U.S. foreign national differentials." His results were as follows:

Differential	Coefficient of regression on ΔUS	R^2
Δ(US-Can)	.83941	.24134
(t-value)	(.16238)	
Δ(US-UK)	1.0426	.33549
(t-value)	(.1599)	
Δ(US-Ger)	1.2617	.09129
(t-value)	(.4342)	
Δ(US-E)	.8274	.50602
(t-value)	(.0925)	

n = 85 (February, 1956 - February, 1966)

Where

US = U.S. rate

Can = Canadian rate

UK = United Kingdom rate

Ger = German rate

ED = Euro-dollar rate

Using similar data (except omitting Switzerland and adding Neitherlands) for a more recent sample period, the results were substantially different as can be seen in Table I (page 74). Unlike the Branson data, the regressions of changes of U.S. - foreign differentials, with the exception of Canada are higher for U.S. - foreign differentials than for the Euro-dollar rate, explain most of the variance in changes in the differential i.e., the R^2's are greater than .5. This test is repeated using day to day interest rates shown in Table II (page 75).

Finally, a scaled down version of the Hendershott study has been attempted to discern if there is any difference in the timing of reactions of foreign rates to U.S. rates versus Euro-dollar rates. The results are shown in Tables III and IV (pages 76 & 77). The data are for three month interest rates in Table III and day to day rates in Table IV.

As can be seen, Tables III and IV show the results of regressing changes in various foreign interest rates with a one, two and three period lag on changes in U.S. and Euro-dollar rates. The R^2's for time lagged responses to changes in both U.S. and Euro-dollar rates are similar, thereby reflecting the close correlation of all interest rates. However, it should be noted that with the exception of the Canadian three month interest rate data, there is no apparent one to one relationship between either the U.S. or Euro-dollar market. Consequently, the findings do not support Branson's so-called reservoir hypothesis - that the U.S. interest rate sets the general level of world interest rates. This finding lends credence to the importance of a concept of

comparable opportunity costs in the determination of interest rates. The multi-collinearity of all interest rates can be better explained in terms of opportunity costs than a U.S. reservoir hypothesis. Finally, it should be noted that while the regression coefficients are generally significant for changes in U.S. and Euro-dollar rates in the first period, the picture is very mixed as to the timing of significant secondary impacts of U.S. and Euro-dollar rate changes. This mixed timing picture may reflect the forward exchange market's role in adjusting comparable interest rate differentials.

TABLE I

Interest Rate Differential Changes Using 3 Month Interest Rates

	Constant	Coefficient of Regression on Δ US	R^2	SE	F
Δ (US - Can) (t value)	.00511	-.55034 (-4.46098)	.2751	.24157	19.970
Δ (US - UK)	.02203	-1.30662 (4.46165)	.6922	.26762	71.5595
Δ (US - Ger)	.01432	-.88421 (7.56295)	.5640	.26207	57.1866
Δ (US - Neth)	.02302	-.98298 (-8.40671)	.6630	.22560	86.1716
Δ (ED - US)	.05095	-.60645 (-4.59720)	.3842	.34091	21.1243

	Constant	Coefficient of Regression on Δ ED	R^2	SE	F
Δ (ED - Can) (t value)	.01030	-.74622 (-11.13712)	.7100	.20060	124.0354
Δ (ED - UK)	.02257	-.92184 (-14.17935)	.7480	.26761	201.0538
Δ (ED - Ger)	.01479	-.84404 (13.72301)	.7790	.26343	188.3208
Δ (ED - N)	.02264	-.85265 (-14.83237)	.8021	.21985	220.1476

US = U.S. treasury bill rate

Can = Canadian treasury bill rate

UK = United Kingdom treasury bill rate

Ger = German treasury bill rate

Neth = Netherlands treasury bill rate

ED = Euro-dollar rate

TABLE II

INTEREST RATE DIFFERENTIAL CHANGES USING DAY INTEREST RATES

	Constant	Coefficient of Regression on Δ US	R^2	SE	F
Δ (US - Can)	.03070	-.67751	.4559	.35395	16.5307
(t values)		(-4.06580)			
Δ (US - UK)	.01710	-.81123	.5839	.30181	32.953
(t values)		(-5.70923)			
Δ (US - Germ)	.00848	-.92610	.3208	.73175	7.2265
(t values)		(2.68821)			
Δ (US - Nether)	.09561	-.81962	.3593	.56975	9.3366
(t values)		(.35926)			

	Constant	Coefficient of Regression on Δ ED	R^2	SE	F
Δ (ED - Can)	.04438	-.83362	.7033	.35741	61.6671
(t values)		(-7.85284)			
Δ (ED - UK)	.02871	-.95358	.7481	.30538	110.5372
(t values)		(-10.51367)			
Δ (ED - Ger)	.02852	-1.20081	.5738	.72704	30.9240
(t values)		(-5.56093)			
Δ (ED - Nether)	.41238	-1.03585	.6095	.57159	37.2292
(t values)		(6.10157			

US = federal fund rate

Can = Canadian day to day rate

UK = United Kingdom call rate

Ger = German day to day rate

Nether = Netherlands day to day rate

ED = Euro-dollar rate

TABLE III

INTEREST RATE DIFFERENTIAL CHANGES OVER TIME

		US Coefficient	R^2		US Coefficient	R^2
Δ US - Can				US - UK		
March-Dec.	64	-.59983	.4190		-.16631	.0957
	65	-1.36440	.7715		.03397	.0125
	66	-1.07410	.5813		.06290	.6637
	67	.21429	.1588		.00367	.0225
Jan.-July 68 - 69		-1.11456	.7570		1.25154	.8602
Δ US - Ger				US - N		
March-Dec.	64	-1.3350	.6320		-4.20113	.7032
	65	-5.38614	.6220		3.16513	.4296
	66	-2.03226	.7225		1.2444	.6020
	67	.29864	.1992		.62317	.3559
Jan.-July 68 - 69		2.63129	.6990		-1.40272	.2754
Δ r_{ED}- Can		Δ r_{ED} Coefficient	R^2	r_{ED}-r_{UK}	Δ r_{ED} Coefficient	R^2
March-Dec.	64	.86795	.6522		-1.20293	.6177
	65	1.09546	.2937		-.97945	.5180
	66	-.74622	.4132		-.97064	.4043
	67	-.60164	.4112		.85036	.6690
Jan.-July 68 - 69		-1.13537	.9206		.95641	.9334
ED - Ger				ED - N		
March-Dec.	64	1.46064	.2055		2.21262	.5671
	65	.91044	.1392		2.50013	.6350
	66	.88845	.3312		.36323	.0925
	67	.59442	.4145		-1.07210	.7254
Jan.-July 68 - 69		-1.98231	.8397		-1.13254	.8808
ED - US						
March-Dec.	64	.13916	.1235			
	65	.13659	.0714			
	66	.66263	.7145			
	67	.20016	.1523			
Jan.-July 68 - 69		.54606	.4211			

TABLE IV

THE RESPONSIVENESS OF INTEREST RATES TO CHANGES IN THE U.S. AND EURO-DOLLAR RATE

3 Month Rates

	U S		E D	
r Canada	regr. coef.	(t value)	regr. coef.	(t value)
Constant	.0025	(4.5877)	1.2252	(5.4080)
t	1.1075	(6.1402	.6256	(4.6542)
t-1	.0623	(.2265)	.1356	(.6646)
t-2	-.2477	(1.5023)	-.2000	(1.3585)
R^2	.7410		.6280	
r United Kingdon				
Constant	2.0420	(2.6026)	.7491	(6.6653)
t	.4123	(1.5859)	.2720	(1.7146)
t-1	-.1421	(.3637)	.0411	(.1609)
t-2	.5754	(2.1002)	.3015	(2.3723)
R^2	.5312		.6138	
r Germany				
Constant	2.0209	(2.8986)	1.7403	(6.7454)
t	-.1620	(-.7169)	-.0339	(-.2521)
t-1	-.0220	(-.0932)	.0406	(.3021)
t-2	.4064	(2.1439)	.2378	(1.5136)
R^2	.1880		.2227	
r Netherlands				
Constant	-1.0352	(-4.2450)	-.8404	(-3.4381)
t	.7091	(3.7146)	.4803	(3.1912)
t-1	-.1010	(-.3599)	-.1092	(.0052)
t-2	.4971	(2.6228)	.3225	(2.1043)
R^2	.2810		.7023	

CHAPTER VI

Comparative Findings

The findings of this paper differ substantially with the findings of other studies of the Euro-dollar market. The hypothesis of the Euro-dollar rate's parity with the highest comparable interest rate, substantiated in the previous chapter, implies that other studies have erred in their assumptions about the Euro-dollar market. In the case of the Hendershott, the Kwack, and the Branson studies, there is a presumption that the U.S. interest rate establishes the level of world interest rates. In the Hendershott and Kwack cases, as discussed in Chapter II, the central question is one of the speed of adjustment of the Euro-dollar rate to changes in the U.S. rate. Findings of Chapter V (Table IV) show that most foreign interest rates tend to adjust to changes in the U.S. rate or the Euro-dollar rate in a manner similar to Hendershott and Kwack's findings for the Euro-dollar rate with the most significant adjustments made in the first three periods. However, the findings here show additionally that, with the exception of the Canadian interest rate, the foreign interest rate's adjustment to the U.S. rate is virtually indistinguishable from the foreign rate's adjustment to the Euro-dollar rate. Consequently, a presumption of U.S. rate causality in interest rate changes is not justifiable.

The inability to distinguish the source of adjustments of interest rates contrasts sharply with the reservoir hypothesis discussed in the Branson

study. According to the reservoir hypothesis as stated by Branson, the U.S. money market establishes the level of interest rates in the world whereas the foreign money markets establish interest rate differentials. Thus, the world capital market is likened to a main reservoir with connecting pools. A change in the level of water in one of the smaller pools has little affect on U.S. interest rates whereas a change in the level of U.S. market rates would affect all foreign rates. In contrast, the highest comparable rate hypothesis suggests that the large reservoir should represent the highest opportunity cost rate in the world given non-exchange risk, not the U.S. rate. All interest rates should adjust to this opportunity cost rate in the absence of government interference. Because the comparable Euro-dollar rate, as seen in each country, acts as the proxy for the highest rate, the Euro-rate will compete as a substitute with other market securities in each country. Consequently, the Euro-rate should represent the main reservoir rate in dollar terms thereby "determining" the level of interest rates. While it can be argued that the U.S. market should still be considered the main reservoir based upon the magnitude of funds in the U.S. market, these funds have heretofore been restricted from participation in foreign markets. The recent reduction of these restrictions (Jan.,1974) should reduce the insulation of U.S. capital flows to changes in the highest comparable rate and should result in increased supplies of funds to the country or countries with the highest comparable interest rate. A direct consequence of the reduction of restrictions should be increased competition between the Euro-dollar market and the highest comparable interest rate markets. The new U.S. source of potential funds to the Euro-dollar market has probably been a major factor in reducing interest rate margins between Euro-dollar loans and deposits during 1974.

Branson, in his studies, has also suggested that foreign interest rates react faster to changes in U.S. rates than Euro-dollar rates. In Tables I, II, and III of Chapter V, the opposite results are generally found. The findings of this paper also show that changes in the U.S. rate affect the U.S. - foreign interest rate differential more frequently than do changes in the foreign rate. This result confirms the weakness of the U.S. central rate reservoir hypothesis as interest rate differential changes can and frequently are caused by changes in the U.S. rate.

The foreign interest rate variables used in the estimating equations of the Euro-dollar market have been adjusted to include the forward premium or discount on foreign exchange. This adjustment has not been used by the other studies of the Euro-dollar market. Kwack used unadjusted interest rates and found that their inclusion only affected the speed of adjustment of Euro-dollar rates to U.S. rates. According to the findings of this dissertation, Kwack's results (showing a slower speed of adjustment for Euro-rates) reflect themisspecification of the primary independent variable. The chain of causality implied in the results of the previous Chapter imply that all interest rates react to changes in the highest comparable rate. Kwack, by using actual foreign rates, ignores covered interest arbitrage and presumes a direct relationship between U.S. and foreign rates. Consequently, when Kwack interjects foreign interest rates in the U.S. - Euro-dollar rate equations used by Hendershott, the resultant decreased speed of adjustment may well represent the Euro-dollar's reacting to a partial specification of their primary determinant.

Mispecification of variables may also exist in the Black study. Black uses a trend term to eliminate serial correlation. The procedure is justified

as reflecting U.S. banks' increasing sophistication in the use of Euro-dollars gained by experience. Alternatively, the serial correlation may reflect the shifting of the Euro-dollar market structure away from close correlation with U.S. rates, a shift demonstrated in the preceding chapter and, in effect, a trend.

The role of restrictions in the development of the Euro-dollar market has been considered in the model presented here and in the Black model. Black includes the Voluntary Credit Restraint Act and the Interest Equalization Tax which are the only restriction relevant for the time period covered by his study. Both restrictions are insignificant in the Black study. In this study the Voluntary Credit Restraint Act is also found to be insignificant, but, more recent restrictions appear to have caused a shift in the Euro-dollar market away from control by U.S. banks toward increased competition in the world capital markets. The possibility of such a shift has not been considered by other studies although it is suggested by Kindleberger as a trend that may occur in the future.

Variables representing speculation have not been considered in the other studies. The significance of the revaluation variable used in the model above suggests that Euro-dollar market is a major source of financing for speculative activity. Whether currency speculation has a stabilizing or destabilizing effect on international trade is a controversial point; currency speculation has a destabilizing effect on domestic economic policy in the short run. Consequently, the finding of significant speculative variables tends to support the reasoning behind those who support intervention in the Euro-market by central banks and/or the Bank for International Settlements.

The finding that the highest comparable interest rate data series

explains the Euro-rate better than the average foreign comparable interest rate (Chapter V, Regressions I & II) suggests imperfect arbitrage among interest rates. Officer and Willett have noted that deviations from covered interest parity may result from the increasing marginal cost of borrowing and from government interference in the amount of funds borrowed domestically[41]. Euro-dollars, as an additional source of funds unregulated by any authority, reduces the marginal cost of borrowing for arbitrage transactions by shifting outward the supply of loanable funds. Consequently, growth of the Euro-dollar market in the future should continually reduce the variance from parity.

Additionally, the ease and convenience in depositing and borrowing in the Euro-dollar market and the relative depth and breath of funds in the Euro-dollar market should attract new arbitragers to enter the market either to take advantage of interest rate differentials between the domestic market and the Euro-dollar market or domestic and other market differences. Again, the Euro-dollar market should act to narrow covered differentials between all capital markets.

Finally, it should be noted that while the question of a Euro-dollar multiplier has not been tested herein, the insignificance of the balance of payments proxy for Euro-dollar money supply reflects the need for a better measure of primary deposits into the Euro-dollar market and does not negate the possibility of a multiplier process.

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[41]Lawrence M. Officer and Thomas D. Willett, "The Covered Arbitrage Schedule: A Critical Survey of Recent Developments", Journal of Money Credit and Banking, May, 1970, p. 248 and p. 251.

CHAPTER VII

Conclusion

In summary, the findings of this dissertation strongly support the hypothesis that the Euro-dollar rate is an international opportunity cost rate. As such, the Euro-rate transmits interest rate and forward rate variations among countries whenever such changes either affect the current highest comparable rate or replace the formerly highest rate. The transmission mechanism itself is in the form of competition for funds among the Euro-dollar and other equivalent securities.

Furthermore, the findings suggest that the Euro-market has changed over time and that the primary cause of this change is restrictions. One restriction, in particular, can be seen as epitomizing those that cause shifts in the Euro-dollar market: the imposition of reserve requirements on U.S. bank borrowings. The imposition of reserve requirements removed most of the special attractiveness of Euro-dollars as a source of loanable funds in the U.S. Consequently, the monopsonistic nature of the Euro-dollar market diminished and the Euro-dollar alignment with the highest comparable interest rate has become more complete.

Given these findings, what will be the future of Euro-rates and their relationship to U.S. rates? During 1974, both the Voluntary Credit Restraint program and the Interest Equalization Tax were revoked. Removal of both of these restrictions on capital outflows from the U.S. should increase the

supply of Euro-dollars, thereby lowering Euro-dollar rates. The reduction in Euro-dollar rates, however, should not be seen as a movement toward alignment with U.S. rates but rather as the effect of increased Euro-loans to the country with the highest comparable interest rates. If the demand for funds in the country with the highest comparable rate is highly elastic, Euro-rates will bearly decline and either U.S. rates will increase or the U.S. will experience continued loss of short term capital funds.

The combination of the Euro-rate as the highest comparable interest rate and the removal of restrictions on U.S. outflows should result in increased correlation of U.S., Euro-dollar and foreign interest rates. Isolation of domestic U.S. monetary policy from its effects on short term capital flows will no longer be possible, and large capital outflows can be predicted whenever equivalent U.S. rates are artificially held below the Euro-dollar rates. Consequently, increased fluctuations in the size of U.S. liquidity balance of payments deficits and surpluses can be expected and short term capital flows will reflect internal versus external policy conflicts.

APPENDIX I

REGULATIONS AFFECTING THE EURO-DOLLAR MARKET

Federal Reserve Regulations

1. Regulation D - imposes reserve requirements on borrowings from foreign banks by U.S. member banks. The requirement of 10% was established October, 1969. This requirement was increased to 20% in 1971 subsequently has been reduced to 8%.

2. Regulation M - re-defines demand deposits in order to require U.S. banks to maintain reserves against foreign bank deposits computed on the basis of net balances due from their domestic offices.

3. Regulation Q - establishes maximum interest rates payable by member banks on various types of deposits. Ceiling interest rates were suspended on time deposits in denomination of $100,000 or made for 30-89 days in June, 1970.

Voluntary Credit Restraint Act of 1964

Restricted loans from U.S. banks to foreigners to fixed percentage increases over a base year amount. This restriction was removed January, 1973.

APPENDIX II-A

BASIC DATA FOR REGRESSIONS

Red = Euro-dollar rate

$R_f - \frac{fs}{s}$ = Foreign Comparable rate (same as R_f - Fx)

Rus = U.S. treasury bill rate

R_f^{AV} = Average foreign interest rate

$\frac{f-s}{s}^{av}$ = Average forward rate

BPS = U.S. Balance of Payments - Euro-dollar money supply approximation

GNP_F = Average index of growth in GNP for Germany, Neitherlands and United Kingdom

GNP_{US} = U.S. gross national product

M_f^s = Average foreign money supply

Q_2, Q_3, Q_4 = Quarterly dummy variables

Dev = Devaluation speculation (same as SW)

V = Voluntary Credit Restraint Act

Rev = Revaluation speculation (same as SS)

D = Restrictions on dollar inflows into Germany (same as FSR)

Res = Reserve requirements (same as USRR)

Res = Re-definition of demand deposits (same as USD)

Reg. Q = Regulation Q (same as USRQ)

	Red	$Rf-\frac{fs}{s}$	Rus	Rf^{av}	$\frac{f-s}{s}^{av}$	BPS	GNP_F	GNPus	M_F^S	Q_2	Q_3	Q_4	D	V	D	D	D	Req. Q Dus
7/64	4.24	4.11	3.46	4.41	-.54	-762	100.0	634.8	8.5	0	1	0	0	0	0	0	0	0
8/64	4.25	3.87	3.50	4.42	-.46	-892	100.0	634.8	16.3	0	1	0	0	0	0	0	0	0
9/64	4.44	3.87	3.53	4.43	-.60	-1021	100.0	634.8	24.3	0	1	0	0	0	0	0	0	0
10/64	4.50	4.09	3.57	4.40	-.58	-1137	102.3	641.1	31.6	0	0	1	0	0	0	0	0	0
11/64	5.00	4.19	3.64	4.71	-2.02	-1253	102.3	641.1	39.1	0	0	1	0	0	0	0	0	0
12/64	4.50	4.10	3.84	5.69	-2.02	-1369	102.3	641.1	46.6	0	0	1	0	100	0	0	0	0
1/65	4.50	3.83	3.81	5.51	-1.98	--999	104.5	657.6	54.9	0	0	0	0	100	0	0	0	0
2/65	4.56	4.18	3.93	5.50	-2.15	-604	104.5	657.6	63.2	0	0	0	0	100	0	0	0	0
3/65	4.81	4.86	3.93	5.52	-2.40	-185	104.5	657.6	71.7	0	0	0	0	101	0	0	0	0
4/65	4.81	4.65	3.93	5.55	-1.66	-60	106.4	686.5	80.7	1	0	0	0	102	0	0	0	0
5/65	5.25	4.53	3.89	5.55	-1.75	+164	106.4	686.5	90.2	1	0	0	0	102	0	0	0	0
6/65	4.81	4.96	3.80	5.08	-1.16	+189	106.4	686.5	99.5	1	0	0	0	103	0	0	0	0
7/65	4.63	4.50	3.83	5.12	-1.51	-210	108.6	704.4	109.0	0	1	0	0	103	0	0	0	0
8/65	4.44	4.30	3.84	5.10	-1.79	-608	108.6	704.4	118.3	0	1	0	0	103	0	0	0	0
9/65	4.94	4.51	3.92	5.02	-1.21	-1006	108.6	704.4	127.3	0	1	0	0	104	0	0	0	0
10/65	5.00	4.19	4.02	4.95	-.91	-782	111.2	721.2	137.0	0	0	1	0	104	0	0	0	0
11/65	5.31	4.72	4.08	5.12	-.81	-558	111.2	721.2	146.5	0	0	1	0	105	0	0	0	0
12/65	5.31	4.77	4.37	5.11	-.67	-335	111.2	721.2	155.5	0	0	1	0	105	0	0	0	0
1/66	5.38	4.44	4.58	5.29	-.56	-239	113.1	732.3	164.5	0	0	0	0	105	0	0	0	0

	Red	Rf-$\frac{fs}{s}$	Rus	Rf^{av}	$\frac{f-s}{s}^{av}$	BPS	GNP$_F$	GNPus	M$_F^S$	Q_2	Q_3	Q_4	D	V	D	D	D	Req. Q Dus
2/66	5.41	4.60	4.65	5.20	-.70	-143	113.1	732.3	173.3	0	0	0	0	106	0	0	0	0
3/66	5.81	5.33	4.58	5.27	-.64	- 47	113.1	732.3	181.8	0	0	0	0	106	0	0	0	0
4/66	5.78	5.39	4.61	5.25	-.58	- 81	115.0	744.6	189.3	1	0	0	0	106	0	0	0	0
5/66	6.09	5.16	4.63	5.44	-.50	-115	115.0	744.6	196.8	1	0	0	0	107	0	0	0	0
6/66	6.44	5.69	4.50	5.48	-.53	-149	115.0	744.6	204.8	1	0	0	1	107	0	0	0	0
7/66	6.84	5.77	4.78	5.91	-1.09	-331	117.4	748.8	212.1	0	1	0	1	107	0	0	0	0
8/66	7.06	6.19	4.95	6.16	-.59	-513	117.4	748.8	218.4	0	1	0	1	108	0	0	0	0
9/66	7.06	6.65	5.36	6.20	-.47	-695	117.4	748.8	224.7	0	1	0	0	108	0	0	0	0
10/66	7.06	6.11	5.33	6.21	-.38	-619	118.2	762.1	229.5	0	0	1	0	108	0	0	0	0
11/66	7.13	5.63	5.31	6.25	-.39	-543	118.2	762.1	234.8	0	0	1	0	109	0	0	0	0
12/66	6.56	5.78	4.96	6.29	-.48	-466	118.2	762.1	240.1	0	0	1	0	109	0	0	0	0
1/67	5.56	5.41	4.72	5.93	-.57	-423	118.5	776.3	245.4	0	0	0	0	109	0	0	0	0
2/67	5.69	5.42	4.56	5.60	-.54	-381	118.5	776.3	249.7	0	0	0	0	109	0	0	0	0
3/67	5.38	5.38	4.26	5.40	-.60	-238	118.5	776.3	254.2	0	0	0	0	109	0	0	0	0
4/67	4.69	4.83	3.84	5.18	-.84	-232	120.1	775.1	259.0	1	0	0	1	109	0	0	0	0
5/67	5.13	4.93	3.60	4.22	-.55	-226	120.1	775.1	264.5	0	0	0	1	109	0	0	0	0
6/67	5.38	5.12	3.53	4.90	-.29	-220	120.1	775.1	269.5	0	0	0	1	109	0	0	0	0
7/67	5.13	4.92	4.20	5.03	-.45	-551	121.3	791.2	275.0	1	1	0	0	109	0	0	0	0
8/67	5.03	4.87	4.36	4.97	-.52	-882	121.3	791.2	280.8	1	1	0	1	109	0	0	0	0

	Red	Rf-$\frac{fs}{s}$	Rus	Rf^{av}	$\frac{f-s}{s}^{av}$	BPs	GNP_F	GNPus	M_F^S	Q_2	Q_3	Q_4	D	V	D	D	D	Req. Q Dus
9/67	5.78	5.63	4.42	4.97	-.43	-1212	121.3	791.2	286.6	0	1	0	0	109	0	0	0	0
10/67	5.78	5.13	4.55	5.15	-.61	1434	124.0	811.0	293.4	0	0	1	1	109	0	0	0	0
11/67	6.56	6.26	4.72	5.86	-.39	-1656	124.0	811.0	300.7	0	0	1	0	109	0	0	1	0
12/67	6.31	6.23	4.96	6.57	-1.85	-1879	124.0	811.0	308.0	0	0	1	0	109	0	0	0	0
1/68	5.44	5.33	4.99	6.55	2.12	-1342	125.9	831.2	316.0	0	0	0	0	109	0	0	0	0
2/68	5.66	5.35	4.97	6.48	2.00	-805	125.9	831.2	324.0	0	0	0	0	109	0	0	0	0
3/68	6.38	6.33	5.16	6.40	-5.27	-267	125.9	831.2	331.3	0	0	0	0	109	0	0	0	0
4/68	6.66	6.30	5.37	6.46	3.39	-143	127.8	852.9	338.1	1	0	0	0	108	0	0	0	0
5/68	7.16	6.58	5.65	6.59	5.34	-19	127.8	852.9	344.4	1	0	0	1	108	0	0	0	0
6/68	6.31	6.26	5.52	6.66	4.21	105	127.8	852.9	352.2	1	0	0	1	107	0	0	0	0
7/68	6.31	5.90	5.31	6.56	1.60	-66	130.5	871.0	361.0	0	1	0	0	106	0	0	0	0
8/68	6.16	6.54	5.08	6.41	-2.01	-237	130.5	871.0	369.8	0	1	0	0	106	0	0	0	0
9/68	6.25	5.20	5.20	6.38	-1.48	-408	130.5	871.0	378.1	0	1	0	0	106	0	0	0	0
10/68	6.59	6.78	5.15	6.06	-.81	-26	134.1	892.5	386.6	0	0	1	1	105	1	0	0	1
11/68	6.94	7.35	1.25	6.16	-2.75	356	134.1	892.5	396.9	0	0	1	0	104	0	0	1	0
12/68	7.13	7.09	5.94	6.41	-2.95	738	134.1	892.5	405.2	0	0	1	0	104	0	0	1	0
1/69	7.69	7.47	6.13	6.44	-1.94	69	136.8	908.7	414.0	0	0	0	0	103	0	0	1	0
2/69	8.50	7.62	6.12	6.88	-1.95	-600	136.8	908.7	421.5	0	0	0	0	103	0	0	1	0
3/69	8.53	7.90	5.90	7.51	-2.11	-1268	136.8	908.7	429.5	0	0	0	0	103	0	0	1	0

	Red	$Rf-\frac{fs}{s}$	Rus	Rf^{av}	$\frac{f-s}{s}^{av}$	BPS	GNP_F	GNPus	M^S_F	Q_2	Q_3	Q_4	D	V	D	D	D	Req. Q Dus
4/69	5.56	7.72	6.21	7.39	-2.47	-2117	141.7	924.8	436.8	1	0	0	0	103	0	0	1	0
5/69	10.56	9.48	6.03	7.40	-5.17	-2966	141.7	924.8	443.6	1	0	0	0	103	0	0	1	0
6/69	10.56	10.60	6.43	7.57	-2.34	-3816	141.7	924.8	450.6	1	0	0	0	103	0	0	1	0
7/69	10.44	10.00	6.98	7.59	-1.80	-3535	144.5	942.8	456.4	0	1	0	1	103	1	0	1	1
8/69	11.31	11.43	6.97	7.64	-6.11	-3234	144.5	942.8	460.7	0	1	0	1	103	1	0	0	0
9/69	11.25	10.44	7.18	7.78	-3.57	-2927	144.5	942.8	464.7	0	1	0	1	103	1	0	0	0
10/69	10.00	9.12	6.99	7.69	- .73	-1649	147.6	951.7	468.0	0	0	1	0	103	0	0	0	0
11/69	11.00	10.09	7.24	7.77	- .17	- 326	147.6	951.7	473.8	0	0	1	0	103	0	0	0	1
12/69	10.06	10.02	7.81	7.76	- .30	998	147.6	951.7	479.8	0	0	1	0	103	0	0	0	0
1/70	9.59	9.70	8.20	7.67	- .28	249	149.5	959.5	485.3	0	0	0	0	103	0	0	0	0
2/70	9.44	9.45	7.13	7.83	- .46	- 509	149.5	959.5	489.6	0	0	0	0	103	0	0	0	0
3/70	8.63	8.71	6.63	7.61	- .54	-1250	149.5	959.5	495.4	0	0	0	0	103	0	0	0	0
4/70	8.69	8.62	6.50	7.27	- .28	-1148	151.7	971.1	501.4	1	0	0	0	103	0	1	0	0
5/70	9.19	8.98	6.83	7.15	- .32	-1046	151.7	971.1	506.9	1	0	0	0	103	0	0	0	0
6/70	9.06	8.99	6.97	7.12	- .09	- 945	151.7	971.1	513.2	1	0	0	0	103	0	0	0	0
7/70	8.50	8.75	6.45	7.02	- .09	- 856	153.6	985.5	519.5	0	1	0	0	103	0	0	0	0
8/70	8.00	8.02	6.41	7.08	- .62	- 767	153.6	985.5	527.3	0	1	0	0	103	0	0	0	0
9/70	8.50	8.76	6.12	6.98	- .75	- 679	153.6	985.5	535.1	0	1	0	0	103	0	0	0	0
10/70	7.72	7.41	5.90	6.93	- .69	- 755	156.5	989.9	543.9	0	0	1	0	103	0	0	0	0

APPENDIX II-B

INTEREST RATES

r_{ed} - Euro-dollar rate

r_{us} - U.S. rate

r_f - Highest effective rate

F = France

G = Germany

U.S. = United States

N = Neitherlands

Sources: Federal Reserve Bulletin
International Monetary Fund Statistics

APPENDIX II-B

	Red	Rus	Rf-FX	
7/64	4.25	3.46	4.11	G
8/64	4.25	3.50	3.87	G
9/64	4.44	5.53	3.87	F
10/64	4.50	3.57	4.09	F
11/64	5.00	3.64	4.19	F
12/64	4.50	3.84	4.10	F
1/65	4.50	3.81	3.83	F
2/65	4.56	3.93	4.18	N
3/65	4.81	3.93	4.86	G
4/65	4.81	3.93	4.65	G
5/65	5.25	3.89	4.53	F
6/65	4.81	3.80	4.06	G
7/65	4.63	3.83	4.50	F
8/65	4.44	3.84	4.30	F
9/65	4.94	3.92	4.51	G
10/65	5.00	4.02	4.19	F
11/65	5.31	4.08	4.72	F
12/65	5.31	4.37	4.77	F
1/66	5.38	4.58	4.42	G
2/66	5.41	4.65	4.60	G
3/66	5.81	4.58	5.33	G
4/66	5.78	4.61	5.39	G
5/66	5.84	4.63	5.16	F
6/66	6.09	4.50	5.69	G
7/66	6.44	4.78	5.77	F
8/66	6.34	4.95	6.19	F
9/66	7.06	5.36	6.65	F
10/66	7.06	5.33	6.11	F
11/66	7.13	5.31	5.63	F
12/66	5.56	4.96	5.79	G
1/67	5.56	4.72	5.81	F
2/67	5.69	4.65	5.42	F
3/67	5.38	4.26	5.38	F
4/67	4.69	3.84	4.83	F
5/67	5.13	3.60	4.83	G
6/67	5.38	3.53	4.71	N
7/67	5.13	4.20	4.92	G
8/67	5.03	4.26	4.87	F
9/67	5.28	4.42	5.03	F
10/67	5.78	4.55	5.13	F
11/67	6.56	4.72	6.26	F
12/67	4.31	4.96	6.23	F

APPENDIX II-B (CON'T)

	Red	Rus	Rf-FX	
1/68	5.44	4.99	5.33	F
2/68	5.66	4.97	5.31	F
3/68	6.38	5.16	6.33	F
4/68	6.66	5.37	6.30	F
5/68	7.16	5.65	6.48	G
6/68	6.88	5.52	6.16	G
7/68	6.31	5.31	5.90	F
8/68	6.16	5.08	5.64	F
9/68	6.25	5.20	5.20	US
10/68	6.59	5.35	6.78	F
11/68	6.24	5.45	8.35	F
12/68	7.13	5.94	7.09	F
1/69	7.69	6.13	7.47	F
2/69	8.50	6.12	7.62	F
3/69	8.53	6.01	7.90	F
4/69	8.56	6.11	7.72	G
5/69	10.56	6.03	8.48	F
6/69	10.56	6.43	10.60	G
7/69	10.44	6.98	10.00	G
8/69	11.31	6.97	11.43	G
9/69	11.25	7.08	10.14	F
10/69	10.00	6.99	9.12	F
11/69	11.00	7.24	9.98	F
12/69	10.06	7.81	10.02	F
1/70	9.59	7.37	9.70	F
2/70	9.44	7.13	9.45	F
3/70	8.63	6.63	8.71	F
4/70	8.69	6.50	8.62	F
5/70	9.19	6.83	8.68	F
6/70	9.06	6.67	8.99	F
7/70	8.50	6.45	8.75	G
8/70	8.00	6.41	8.02	F
9/70	8.50	6.12	9.26	G
10/70	7.72	5.46	8.06	G

APPENDIX II-C

SHORT TERM ASSETS AND LIABILITIES VIS-A-VIS NON-RESIDENTS

UK = United Kingdom

Ger. = Germany

Neither. = Neitherlands

Fr. = France

Source: Bank for International Settlements, Annual Report

SHORT TERM ASSETS IN DOLLARS VIS-A-VIS NON-RESIDENTS
($ millions)

(Percentage of eight country total in parenthesis)

	UK	Germ.	Nether.	Fr.	Eight Countries
9/64	$3,190 (39.7%)	$ 420 (5.2%)	$ 280 (3.5%)	$ 720 (9.0%)	$ 8,040
12/64	3,670 (40.8%)	440 (4.9%)	390 (4.3%)	860 (9.6%)	9,000
3/65	3,410 (38.2%)	510 (5.7%)	420 (4.7%)	890 (10.0%)	8,920
6/65	3,520 (38.6%)	460 (5.1%)	380 (4.2%)	830 (16.0%)	9,110
9/65	4,000 (39.5%)	400 (4.0%)	360 (3.6%)	980 (9.7%)	10,140
12/65	4,550 (39.2%)	440 (3.8%)	420 (3.6%)	1,220 (10.5%)	11,590
3/66	4,880 (42.8%)	440 (3.9%)	360 (3.2%)	1,160 (10.2%)	11,400
6/66	5,620 (45.8%)	470 (3.8%)	450 (3.7%)	1,280 (10.4%)	12,260
9/66	6,330 (45.4%)	660 (4.7%)	440 (3.1%)	1,570 (11.1%)	14,060
12/66	7,310 (45.5%)	400 (2.5%)	550 (3.4%)	1,860 (11.6%)	16,060
3/67	6,960 (45.6%)	760 (5.0%)	470 (3.1%)	1,620 (10.6%)	15,260
6/67	7,650 (46.1%)	790 (4.8%)	480 (2.9%)	1,660 (10.1%)	16,580

ASSETS (CON'T)

	UK	Germ.	Nether.	Fr.	Eight Countries
9/67	8,520 (46.7%)	810 (4.4%)	600 (3.3%)	1,780 (9.8%)	18,240
12/67	9,210r (46.3%)	1,030 (5.3%)	650 (3.3%)	1,890 (9.5%)	19,880r
3/68	10,580 (47.5%)	1,140 (5.2%)	780 (3.5%)	2,390 (10.7%)	22,270
6/68	12,960 (50.1%)	750 (2.9%)	820 (3.2%)	2,690 (10.5%)	25,560
9/68	13,710 (50.0%)	1,160 (4.2%)	880 (3.2%)	2,980 (10.9%)	27,430
12/68	14,980 (49.2%)	1,490 (4.9%)	980 (3.2%)	3,430 (11.3%)	30,430
3/69	17,610 (52.3%)	1,650 (4.9%)	1,170 (3.5%)	3,230 (96.0%)	33,650
6/69	22,390 (53.0%)	2,380 (5.6%)	1,450 (3.4%)	4,030 (9.5%)	42,230
9/69	24,460 (54.6%)	2,330 (5.2%)	1,710 (3.8%)	4,330 (9.7%)	44,780
12/69	25,260r (53.0%)	1,670 (3.5%)	2,140r (4.5%)	5,430 (11.4%)	47,630r
3/70	25,310 (53.9%)	1,670 (3.6%)	2,240 (4.8%)	5,160 (11.0%)	46,970
6/70	27,850 (53.5%)	1,490 (2.9%)	2,630 (5.1%)	5,240 (10.1%)	52,030
9/70	27,680 (52.3%)	1,670 (2.7%)	2,820 (5.3%)	5,200 (9.2%)	52,930
12/70	29,250 (48.5%)	2,050 (3.4%)	2,970 (4.9%)	6,010 (10.0%)	60,370

r = revised

SHORT TERM LIABILITIES IN DOLLARS VIS-A-VIS NON-RESIDENTS
($ millions)

(Percentage of eight country total in parenthesis)

	UK	Germ.	Nether.	Fr.	Eight Countries
9/64	$ 3,390 (47.9%)	$ 290 (3.6%)	$ 310 (3.8%)	$ 620 (7.6%)	$ 8,130
12/64	4,380 (45.4%)	440 (4.6%)	360 (3.7%)	810 (8.4%)	9,640
3/65	4,560 (49.6%)	230 (2.5%)	360 (3.9%)	730 (7.9%)	9,200
6/65	4,410 (48.3%)	250 (2.7%)	400 (4.4%)	770 (8.4%)	9,140
9/65	4,750 (48.7%)	270 (2.8%)	400 (4.1%)	920 (9.4%)	9,760
12/65	5,260 (46.3%)	370 (3.3%)	530 (4.7%)	1,070 (9.4%)	11,350
3/66	5,440 (51.7%)	290 (2.8%)	570 (5.4%)	770 (7.4%)	10,480
6/66	6,080 (52.8%)	300 (2.6%)	650 (5.7%)	810 (7.0%)	11,510
9/66	6,870 (52.7%)	330 (2.5%)	670 (5.1%)	1,100 (8.4%)	13,070
12/66	7,590 (51.6%)	330 (2.2%)	790 (5.4%)	1,330 (9.0%)	14,720
3/67	7,760 (54.2%)	260 (1.8%)	690 (4.8%)	1,170 (8.2%)	14,330
6/67	8,130 (54.8%)	270 (1.8%)	730 (4.9%)	1,020 (6.9%)	14,850
9/67	9070 (55.0%)	250 (1.5%)	780 (4.7%)	1,290 (7.8%)	16,490

LIABILITIES (CON'T)

	UK	Germ.	Nether.	Fr.	Eight Countries
12/67	9,560 (53.5%)	280 (1.6%)	810 (4.5%)	1,700 (9.4%)	17,980
3/68	11,100 (54.7%)	280 (1.4%)	910 (4.5%)	2,150 (10.6%)	20,280
6/68	13,420 (60.0%)	330 (1.5%)	870 (3.9%)	1,890 (8.5%)	22,360
9/68	14,130 (59.5%)	420 (1.8%)	880 (3.7%)	2,040 (8.6%)	23,740
12/68	15,396r (57.2%)	510 (1.9%)	970 (3.6%)	3,040 (11.3%)	26,860r
3/69	17,000 (60.0%)	490 (1.6%)	960 (3.2%)	3,340 (11.9%)	29,860
6/69	22,720 (60.0%)	890 (2.4%)	1,300 (3.4%)	3,900 (10.3%)	37,880
9/69	24,890 (60.1%)	1,060 (2.6%)	1,350 (3.4%)	4,600 (11.1%)	41,420
12/69	25,640r (55.3%)	2,000 (4.3%)	1,590 (3.4%)	5,310 (11.5%)	46,200r
3/70	26,050 (56.5%)	2,020 (4.4%)	1,760 (3.8%)	5,150 (11.2%)	46,050
6/70	25,550 (57.7%)	1,660 (3.8%)	1,960 (4.4%)	5,100 (11.5%)	40,440
9/70	28,590 (56.9%)	1,930 (3.9%)	1,840 (3.7%)	5,410 (10.8%)	50,230
12/70	31,400 (53.5%)	2,490 (4.2%)	2,020 (3.4%)	6,650 (11.3%)	58,700

r = revised

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