PRINCETON STUDIES IN INTERNATIONAL FINANCE NO. 34

American Monetary Policy and the Structure of the Eurodollar Market

Richard C. Marston

INTERNATIONAL FINANCE SECTION
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INTRODUCTION

Recent international events have underscored the essential interdependence of the world's financial markets. Shifts in national monetary policies have induced sizable movements of short-term capital between the U.S. market and markets in Europe. At the center of the network linking the principal national markets is the Eurodollar market.[1] As the focal price in an interdependent system, the Eurodollar interest rate reflects all the pressures exerted by conditions in national markets.[2] Although the dependence of this rate upon American interest rates is well known, no study has yet investigated the specific ways in which Eurodollar deposits and loans respond to changes in American rates. Over the recent period, U.S. banks are known to have borrowed heavily in the market, but the exaggerated rise in the Eurodollar rate that resulted from this borrowing remains somewhat of a mystery. We know that non-American funds responded to the inflated price paid for Eurodollars. Indeed, the high rate on Eurodollars drew money from all corners of the international system. In the words of one international banker (Eurodollar and Eurobond International Seminar, 1969): "The right rate seems to pull money right out of the woodwork. Look at rates for 3 months Euro in December of 1968, 7 per cent — then in June 1969, 13 per cent — and out came $8.5 bil." Yet we lack knowledge of the quantitative relationship between the Eurodollar rate and the supply of funds to the market.

The Eurodollar market is linked to the national markets through its deposit and loan relations. Over the period from 1965 to mid-1970, the

The author is indebted to Charles Kindleberger, Jagdish Bhagwati, William Branson, Ralph Bryant, Franklin Fisher, Richard Herring, Lawrence Krause, Edwin Kuh, and Walter Salant for their comments and criticisms on an earlier draft, and to the Federal Deposit Insurance Corporation and the Brookings Institution for fellowship support.

[1]Previous studies of the Eurodollar market include two detailed investigations by Einzig (1970) and Clendenning (1970). Both books contain extensive bibliographies testifying to the burgeoning literature on institutional aspects of the market. Econometric studies have been limited to those dealing with general international capital flows (see Leamer and Stern, 1970, for references), a recent study of U.S. bank borrowing from the Eurodollar market by Black (1971), and a study of the Eurodollar market itself by Hendershott (1967).

[2]The Eurodollar market offers a range of deposits and loans of varying maturities, each with a distinct interest rate. By *the* Eurodollar rate we refer to the rate on a standard maturity, such as three-month deposits.

American demand for funds dominated the market for Eurodollar loans, while sources outside the United States provided the bulk of Eurodollar deposits. Of the new lending provided by the market throughout the years 1965–69, 52 per cent was channeled to the United States, with the remainder split between Europe and the rest of the world. Of the new deposits entering the market, 50 per cent came from the major European countries, but only 11 per cent came from the United States.[3] From this interregional pattern emerges a distinct structure of deposit and loan relations.

In this study we present structural equations explaining the supply of deposits and the demand for loans. The end points of the period under investigation, first quarter 1965 and first quarter 1970, coincide (as closely as feasible) with the introduction of U.S. balance-of-payments guidelines in early 1965 and the relaxation of interest-rate ceilings on U.S. bank deposits in mid-1970. Chapter I will outline a deposit supply function, Chapter II a loan demand function. Chapter III then will discuss the overall structure of the Eurodollar market, and Chapter IV will present the results of estimation.

[3]The Bank for International Settlements *Thirty-eighth*, *Thirty-ninth*, *Fortieth Annual Reports*, 1968–70. The figures cited are derived from BIS estimates of the size of the market free of the inter-Eurobank deposits that inflate the asset/liability statistics (see Chap. III below and Chap. I and III of Marston, 1972).

I. THE SUPPLY OF EURODOLLAR DEPOSITS

The Eurodollar deposit has been the preferred medium for much short-term investment. The Eurodollar market has attracted funds previously committed only to domestic markets by offering yields that were at times far in excess of those available domestically. High yields have also drawn to the market a considerable portion of the foreign money traditionally held in New York.

The market has attracted deposits from all geographical areas, but the major source of funds has been Western Europe. The Bank for International Settlements estimates that in 1969, for example, 57 per cent of Eurodollar funds came from Western Europe, including 50 per cent from the "inside area" of the Eurodollar market (Belgium-Luxembourg, France, West Germany, Italy, the Netherlands, Sweden, Switzerland, and the United Kingdom), while 10 per cent came from the United States (BIS *Fortieth Annual Report*, 1970, p. 158). Because Western Europe has played a dominant role in the supply of funds,we will discuss at some length the major investment alternatives available to European investors. We cannot hope to provide a wholly satisfactory account of investment decisions by this diverse group of financial institutions, industrial corporations, and private individuals, but we can specify a general supply relation incorporating the major market variables influencing such decisions.

For the European investor, the interest rate paid on Eurodollar deposits must be competitive with rates in the domestic market or in other national markets, particularly the U.S. market. But the choice between foreign investment, including investment in Eurodollars, and domestic investment is generally complicated by the element of exchange risk. Hence investors with funds denominated in domestic currency may choose to invest in Eurodollars on either a covered or uncovered basis. We will discuss each type of investment in turn.

If he invests locally, the investor earns the prevailing rate on domestic deposits, i_d. If instead he transfers funds to a Eurodollar deposit, the investor may purchase a forward contract to cover the exchange risk. The return on the transaction would then consist of the interest paid on Eurodollar deposits, i_e, less the forward premium on the domestic currency, f_d, where $f_d = (F_d - S_d)/S_d$. (F_d and S_d are the forward and spot exchange rates, respectively, in dollars per unit of domestic currency.)

As an alternative to covered investment in Eurodollars, the investor could place his funds in dollar deposits (or other money-market instruments) in New York. His return would then consist of the rate of interest on U.S. deposits, i_{us}, less the forward premium, f_d. Any sizable differential between the domestic rate and the covered return on either type of dollar deposit would generate a flow of funds between domestic and foreign markets. But under normal conditions this flow would induce an equilibrating adjustment in the forward premium (and to a lesser extent in the Eurodollar rate) that would eliminate the incentive for further flows. Covered arbitrage would thus be self-limiting.[1] During much of the period under study, however, central banks provided incentives for the continued flow of funds either by offering special swap rates or intervening directly in the forward market to set favorable rates (see Chap. III below). Flows of funds on a covered basis were thus larger than market conditions alone would have allowed.

Alternatively, the investor may decide to invest on an uncovered basis, repatriating his funds at whatever exchange rate prevails when his investment matures. In this case, the return on Eurodollar investment would consist of the Eurodollar rate, i_e, less any appreciation of the exchange rate, $\dot{S}_d$, where $\dot{S}_d = (S_d^{t+T} - S_d^t)/S_d^t$. [S_d^t, S_d^{t+T} are the spot exchange rates at the beginning (t) and end ($t + T$) of the investment period.] Similarly, the return on uncovered investment in the United States would consist of the U.S. rate, i_{us}, less the appreciation of the exchange rate, $\dot{S}_d$.[2] Whether the investment is in Eurodollars or in New York, the return is subject to

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[1]In a market free of transactions costs and risks, the movement of funds would proceed until the returns were equalized; that is, $i_d = i_e - f_d$. The actual adjustment will be less than complete as long as the risk of capital controls and considerations of liquidity enter the calculations. (For a full discussion of covered arbitrage, see Tsiang, 1959, and Officer and Willett, 1970.) Movements between dollar and nondollar Eurocurrency deposits provide the investor with an additional opportunity for covered arbitrage. But this form of arbitrage has been limited by the size of the markets in Eurocurrencies other than the dollar.

[2]Some investors, particularly nonfinancial institutions such as industrial corporations, tend to ignore exchange rates in all but crisis periods. They are prepared to disregard the minor spot fluctuations that occur in normal periods and to make investment decisions solely on the basis of nominal returns. *The Economist* cites an extreme instance of this behavior. British firms, *The Economist* reports, are so accustomed to ignoring exchange risk that they neglected to cover even when the dollar was allowed to float in August 1971. "Most British companies, household names among them, are abysmally ignorant about foreign exchange — and intend to remain so. . . . Surprisingly few companies have been using forward cover; finance directors obviously prefer to spend sleepless nights wondering what the rate is going to do" (*The Economist*, Aug. 28, 1971, pp. 59–60).

uncertainty, since the exchange-rate appreciation, $\dot{S}_d$, is a random variable. To simplify the analysis, we will assume that the investor takes account only of the expected value of the appreciation, $X_d = E(\dot{S}_d)$, plus some measure of the risk attached to the uncovered transaction, denoted simply by σ_d.[3]

European investors generally consider covered and uncovered returns on all money-market investments when deciding whether to place funds in the Eurodollar market. The basic elements in the supply decision are the interest rates on domestic and dollar-denominated investments (i_e, i_d, i_{us}), the forward premium on the domestic currency (f_d), and the expected value (X_d) and risk (σ_d) of exchange-rate appreciation. Thus

$$Q_{dep} = d^s(i_e, i_d, i_{us}, f_d, X_d, \sigma_d, \ldots).$$

In Chapter III we discuss the specific European interest-rate and exchange-rate variables employed to estimate this relationship.

The deposit function retains the same form if the investor is interested in the dollar value rather than the domestic-currency value of his investment. Suppose a European investor has dollar funds at his disposal and anticipates future commitments in that currency.[4] He would then compare the nominal rates of interest on Eurodollar deposits and U.S. dollar investments (i_e and i_{us}) with the covered return ($i_d + f_d$) and uncovered return ($i_d + \dot{S}_d$) on domestic deposits. The same factors would thus appear in the deposit supply function, although the importance of the individual factors might vary. (For example, an investor of this type would be more likely to prefer a U.S. deposit to a domestic deposit, covered or uncovered, when seeking a substitute for a Eurodollar deposit.)

Non-European investment in Eurodollar deposits may be treated as if motivated by similar factors. The major difference is that non-European investors may be less influenced by returns in the European financial

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[3]The variance of $\dot{S}_d$ would be an adequate measure of this risk if (1) the investor's utility function were quadratic, or (2) the probability distribution of $\dot{S}_d$ were normal. In the more general case, the portfolio choice would be a function of the higher moments of $\dot{S}_d$ as well, and the measure of risk could not be so unambigously defined (see Samuelson, 1970). Note that in the estimation below, the variable X_d alone appears in the final equations, since attempts to specify proxies for exchange risk (σ_d) proved unsuccessful.

[4]The affiliates of U.S. corporations resident in Europe, for example, in many cases would be concerned with the dollar value rather than the domestic (European) currency value of their funds.

markets.[5] The extreme case would be that of the American investor who is influenced almost exclusively by the U.S.-Eurodollar rate differential. The deposit supply function for the non-European investor would be of the same form as the European function, but the influence of European domestic rates would be considerably reduced.

The American interest rate is a factor in both European and non-European supply, although it may be less dominant than a decade ago because of restrictions placed on American participation in the Eurodollar market. In 1965 the U.S. administration introduced its voluntary credit-restraint program. As part of that program, U.S. banks and nonbank financial institutions were requested to limit the liquid assets they held abroad. The program thus restricted the supply of funds from these institutions to the Eurodollar market and, with this restriction, the potential influence of U.S. rates upon the total supply of Eurodollar funds was reduced accordingly.[6] Indeed, without these restrictions the Eurodollar rate might never have risen to a premium of 4 per cent over U.S. interest rates in mid-1969.

Having considered the principal determinants of Eurodollar deposit supply, we now briefly investigate the form of the supply function. Since investment in any asset is dependent upon total wealth, we include a wealth variable, W_0, in the deposit function. But we assume that the distribution of funds among assets is not dependent upon the level of wealth. Thus we require that the deposit supply function be homogeneous of degree 1 in wealth:

$$Q_{dep} = d^s(\ldots, W_0) = q^s(\ldots)W_0 .$$

A doubling of wealth doubles the holdings of each asset, including Q_{dep}.

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[5]Consider the case of investors from the Middle East or Latin America, both areas being important sources of Eurodollar funds. Most investors from these areas find it necessary to invest their funds in a money market abroad because of the lack of a suitable short-term domestic money market. Their choice of markets and, in many cases, their treatment of exchange risk are much the same as those of the European investor. This is because many of these investors treat one of the major currencies (ordinarily the dollar or one of the Western European currencies) as a numeraire. Their commitments are likely to be in one of these currencies, and they presumably judge investment performance relative to that currency.

[6]Anticipating results to be presented below, U.S. interest rates are shown to exert considerably less influence on Eurodollar deposit supply than on Eurodollar loan demand.

By adopting this assumption we reduce by one the number of parameters that must be estimated.[7]

A second assumption concerns the comparative static behavior of this function. We require that all assets be gross substitutes. That is, the supply of Eurodollar deposits should rise with an increase on the own rate (the Eurodollar rate), and fall with an increase in any other rate, covered or uncovered. Given these two assumptions, the supply of Eurodollar deposits can be expressed as follows:

$$Q_{dep} = q^s(i_e, i_{us}, i_d, f_d, X_d; \sigma_d)W_0 ;$$

$$q_1^s > 0 ; q_2^s, q_3^s, q_4^s, q_5^s < 0 .$$

[7]The growth of wealth over the six-year period of the study was insignificant (by any measure) in comparison with the growth of the Eurodollar market itself. Thus, even if the wealth elasticity of the supply function were significantly different from one, the bias introduced by this assumption would be minimal. The assumption of a unit-elastic supply function, moreover, is itself empirically appealing, unless there is reason to believe that preferences for certain types of assets increase as aggregate wealth grows. Thus we adopt the homogeneity assumption as a first approximation. The assumption has been widely employed in previous studies of financial flows (see the discussion in Leamer and Stern, 1970, Chap. 4).

II. THE DEMAND FOR EURODOLLAR LOANS

From early 1965, balance-of-payments restrictions limited U.S. participation in the supply of Eurodollar deposits; during this same period, however, American monetary policy dominated the demand for Eurodollar loans. Through credit restriction and the peculiar regulatory restraints imposed upon U.S. banks, American monetary policy induced the larger banks to borrow heavily in the Eurodollar market, mainly through their foreign branches. Borrowing first rose to high levels in the credit squeeze of 1966; by December of that year the liabilities of U.S. banks to their foreign branches had risen to $4.0 billion, three times the 1965 level. The banks reduced their borrowing in 1967 as domestic conditions eased. In 1968 and 1969, however, their borrowing far exceeded the high 1966 levels, as the American monetary authorities resumed and intensified their policy of credit restraint. Banks' liabilities to their branches reached $7 billion in the fall of 1968, $13 billion by mid-1969, and a peak of $15 billion in the third week of November.[1]

In response to this borrowing, credit tightness in the United States spread abroad. The foreign branches of U.S. banks bid up Eurodollar interest rates in order to satisfy home-office needs. And as Eurodollar rates rose, traditional demanders of funds restricted their own requirements and occasionally withdrew completely from the market.

Eurodollar borrowing by U.S. banks thus represents a key element in total Eurodollar demand. The specification of the loan demand function must be designed to reflect the behavior of American banks in this period. For this purpose, a function describing U.S. bank borrowing alone will be developed first and then incorporated into a market demand function.

Loan Demand by U.S. Banks

The key to understanding the rise in Eurodollar borrowing by U.S. banks lies in the portfolio behavior of large banks during periods of credit restraint, as contrasted with behavior in normal periods.

In normal periods, time deposits, particularly negotiable time certificates of deposit (CDs), represent a dependable source of funds for these banks. Whenever the pattern of demand deposits and commercial loans leads to

[1]From the table "Liabilities of U.S. Banks to Their Foreign Branches," *Federal Reserve Bulletin* (monthly), 1969–70.

a shortage of free reserves, the CD rate can be adjusted to provide additional funds. The higher the prevailing rate on the banks' investments (commercial loans, acceptances, Treasury bills), the higher the CD rate that the banks can offer on time deposits. In such normal times, borrowing from the Eurodollar market and from the federal funds market represent alternatives to an expansion of CDs. High Eurodollar rates, however, have ordinarily discouraged tapping of the Eurodollar source. Bank liabilities to their branches averaged less than $1.5 billion throughout 1965, a period when U.S. monetary conditions were still relatively relaxed. For such normal periods a function describing U.S. bank borrowing from the Eurodollar market can be specified as follows: The rate of return on bank investments is one key determinant of borrowing; as the rate of return rises, the larger U.S. banks tend to expand their Eurodollar borrowing (while simultaneously increasing their borrowing from the federal funds market and expanding the issue of CDs). The commercial loan rate (the prime rate) might be deemed to represent the relevant return on bank investments, but this rate responds sluggishly to changing credit conditions. Instead we use the commercial-paper rate, i_{cp}, which is far more sensitive to general credit conditions. A second determinant of Eurodollar borrowing is the cost of alternative sources of funds. The interest rates on CDs, i_{cd}, and on federal funds, i_{ff}, both influence bank decisions and are included in the function. The third determinant is the own rate on Eurodollar borrowing, i_e. The borrowing function for normal periods takes the following form:

$$b^n = b^n(i_e, i_{cp}, i_{cd}, i_{ff}) \,;\, b_1^n < 0 \,;\, b_2^n, b_3^n, b_4^n > 0 \,. \qquad (\textit{Normal periods})$$

Borrowing should be positively related to the investment return, the CD rate, and the federal funds rate, and inversely related to the own rate.

In periods of credit restraint, portfolio behavior changes substantially; it is this change which must be captured in the specification of demand. Monetary restraint alone would be sufficient to drive up U.S. money-market rates relative to the Eurodollar rate and to induce greater Eurodollar borrowing. But it is the Regulation Q ceiling on CD rates that dramatically alters bank behavior.[2] In the face of a continuous demand

[2]Under Regulation Q, a ceiling is imposed on the interest rates paid to all time depositors except foreign governments and international institutions. The maximum rates are set by the Federal Reserve and changed rather infrequently. The Regulation Q ceiling of course applies only to the CD rate in the primary market (i.e., where new CDs are issued). The CD rate in the secondary (resale) market is free to reflect conditions prevailing in the rest of the U.S. money market.

for commercial loans and a rising return on all the bank investments, banks would normally raise CD rates to attract additional funds. The Regulation Q ceiling prevents this, however, forcing the banks to tap alternative sources. The federal funds market is one such source, and in times of credit restraint the large banks draw upon this market extensively. In the credit squeezes of 1966 and 1968–69, however, borrowing from the Eurodollar market also assumed major importance. Eurodollar loans appeared especially attractive because they offered funds with maturities similar to those of the time deposits they replaced.

With the Regulation Q constraint so central to the banks' behavior, the relationship between the CD rate and the Regulation Q ceiling emerges as a key determinant of Eurodollar demand. The higher the prevailing money-market rates rise above the ceiling, the greater the rundown of CDs and consequent loss of loanable funds by the banks. Thus the movement of U.S. rates relative to the Regulation Q ceiling should reflect the extent to which banks are driven to the Eurodollar market as an alternative source of funds. The difference between the secondary-market CD rate and the Q ceiling ($R_Q = i_{cd} - Reg\ Q$) is therefore used as a measure of the effect of Regulation Q policy. As in normal periods, the U.S. commercial-paper rate represents the banks' return on their investments, and the Eurodollar and federal funds rates, i_e and i_{ff}, represent, respectively, the cost of Eurodollar borrowing and the alternative cost of funds:

$$b^e = b^e(i_e, i_{cp}, i_{ff}, R_Q)\,;\ b_1^e < 0\,;\ b_2^e, b_3^e, b_4^e > 0\,.\ (\textit{Credit-restraint periods})$$

The borrowing function can be simplified by adopting a single form for all periods. In both normal and restraint periods, the return on bank investments measures the profitability of marginal funds. But the sources of bank funds differ in the two periods. CDs constitute the principal source of funds in normal periods, while the borrowing of Eurodollars and federal funds assumes greater importance in periods of restraint. Since the rates on CDs and on federal funds move together in normal periods, the federal funds rate may be used to represent the cost of domestic funds in all periods, and the borrowing function can be simplified as follows:

$$b = b(i_e, i_{cp}, i_{ff}, R_Q)\,;\ b_1 < 0\,;\ b_2, b_3, b_4 > 0\,.$$

In this form the return on bank investments, i_{cp}, and the federal funds rate, i_{ff}, are constrained to have the same effect in both normal and

credit-restraint periods. The Regulation Q variable ($R_Q = i_{cd} - Reg\ Q$) then absorbs the full impact of the CD constraint. Since the Regulation Q variable is set at zero in normal periods, the function $b\ (\cdot)$ is identical to the normal-period function whenever the ceiling is inoperative.

Over much of the period, the incentive for banks to borrow from the Eurodollar market was enhanced by the fact that such borrowing was free of reserve requirements and of the insurance fees of the FDIC. In mid-1969, however, the Federal Reserve moved to eliminate this added incentive by imposing 10 per cent reserve requirements on marginal Eurodollar borrowing. Effective in September 1969, the new regulation placed the requirement on all borrowings above the May 1969 level. The cost to the banks of this regulation can be approximated by the return that could have been earned on these reserves in the absence of the new regulation. Using the Eurodollar rate to measure the return on the banks' marginal assets, the cost can be approximated by adding a 10 per cent premium to that rate from September 1969. (A provision of this regulation required that any reduction of borrowing below the May 1969 level — which for banks as a whole totaled approximately $9.5 billion — would also reduce the total of *reserve-free* borrowing. But since borrowing remained far above this level until July 1970, the provision was of only limited importance prior to that time.)[3]

A more radical change occurred when, in June 1970, the Federal Reserve lifted Regulation Q ceilings on large time deposits (of 30 to 89 days term). Because this change substantially altered the profitability of Eurodollar borrowing, we chose to terminate this investigation prior to that date.

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[3]A further advantage of Eurodollar borrowing, particularly borrowing on an overnight basis, was that "bills payable checks" and "London drafts" issued to settle Eurodollar repayments did not have to be included in the deposits of the remitting bank, even though they could be deducted as "cash items in the process of collection" from the demand deposits of the receiving bank. The reserves required by the remitting bank were therefore reduced by the amount of the Eurodollar borrowing as long as the check transferring ownership had not yet cleared (see Klopstock, 1968, for details of such operations). Effective July 1969, however, the Federal Reserve changed its regulations, requiring that U.S. banks count as demand deposits subject to reserve requirements the checks they issued on behalf of foreign branches. This provision raised the cost of overnight borrowing and should have led to a reduction in the general level of borrowing. But a dummy variable introduced for the period covered by the new provision proved non-significant. It may be that the effect of this provision cannot be distinguished empirically from the change in reserve requirements that occurred two months later.

Other Loan Demand

In comparison with U.S. bank borrowing, other demand elements were of secondary importance in total Eurodollar borrowing. Eurodollar loans to nonbank borrowers in the United States were limited throughout the period, because New York rates were consistently lower than Eurodollar rates. Of greater significance were the loans to U.S. corporations and their foreign affiliates for use abroad. The U.S. balance-of-payments program, besides restricting U.S. resident investment in the Eurodollar market, also curbed U.S. bank lending abroad, including lending to U.S. corporations. These corporations naturally turned to the Eurodollar market for their needs, often arranging loans with the foreign branches of the banks they dealt with at home. Mendenhall (1971, pp. 2–3) estimated that such loans totaled $4 billion over the three-year period 1968–70. The Eurodollar interest rate should be the principal factor determining both the timing and scope of this borrowing. United States interest rates are an additional factor, but only to the extent that the balance-of-payments regulations permitted some of the financing to be done at home.

Non-American borrowing is so dispersed that careful study of the official data is required to identify the chief outlets.[4] It is thus difficult to specify appropriate relationships. Consider the case of borrowing by Britain. Traditionally, local-authority deposits have been a major outlet for Eurodollar funds, and during 1965–67 considerable inward arbitrage did occur. Eurodollar banks committed funds to the local-authority market whenever the covered return on local-authority deposits exceeded the Eurodollar loan rate. But such arbitrage terminated abruptly with the November 1967 devaluation, when the Bank of England abandoned its policy of intervention in the forward market. Wide discounts on forward sterling developed in 1968–69, eliminating any incentive to move funds into sterling. Prior to the devaluation, then, Eurodollar borrowing was a direct function of the covered local-authority rate, while after devaluation movements of the rate ceased to influence total Eurodollar borrowing because forward cover was prohibitively expensive. We have attempted to reflect this state of affairs by including the covered rate $(i_{uk} + f_{£})$ in the loan equation only for the pre-devaluation period.

[4]Trade financing is a case in point. Although the BIS reports continually cite trade loans as an important outlet of Eurodollar funds, the statistics give little information on which countries' trade is being financed. We have not attempted to specify an aggregate trade variable, since such a variable would be impossible to interpret.

Recently, other U.K. borrowers have been more active than the local authorities; firms hard pressed by Britain's restrictive monetary policy have resorted to the Eurodollar market for short- and medium-term financing, primarily on an uncovered basis. But this type of borrowing did not assume major proportions until the last quarter of 1970.[5]

Japan has also been an important borrower on occasion. Japanese firms have maintained ties with the market since its inception, arranging loans in London whenever credit conditions tightened in Japan. Such borrowing should be sensitive to the domestic Japanese loan rate, i_j, although the interest-rate series that are available may not adequately reflect Japanese credit conditions.[6]

Some Eurodollar borrowing has been of a purely speculative character. Particularly since the devaluation of sterling in November 1967, the dollar has come under periodic attack, and in each such attack the demand for Eurodollar loans has increased as borrowers sought to take advantage of any impending realignment of exchange rates. German corporations have been among the leading borrowers,[7] but a number of international corporations have also been active. To reflect this speculative demand, we include in the equation variables representing the expected value (X_d) and risk (σ_d) of exchange-rate appreciation.

Total Loan Demand

An expression for the total demand for Eurodollar loans is readily derived as a function of U.S. and non-U.S. elements. As in the case of

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[5]Dollar loans to British companies for domestic purposes started rising in the first two quarters of 1970. A fairly accurate estimate of this borrowing can be derived from the series "Net External Liabilities of U.K. Banks in Dollars," *Bank of England Quarterly Bulletin*. Net liabilities rose by £78 million in the first and second quarters of 1970 combined, and by £86 million in the third quarter. In the last quarter, however, liabilities soared by a further £519 million. In January 1971, the Bank reacted to this upsurge in borrowing by prohibiting further loans of less than five years' term (see the *Quarterly Bulletin* of March 1971, p. 8).

[6]The interest rates available for Japan are administered rates controlled by the large banks and hence are poor barometers of credit conditions. This may account for the nonsignificance of the Japanese-rate coefficients in the equations presented below.

[7]The German corporate borrowing initially took place despite higher interest rates charged on Eurodollar loans than on domestic loans (although this borrowing remained moderate in scope until 1970). Only toward the very end of the period of study did tight credit conditions in Germany combine with easier conditions in the Eurodollar market to raise nominal domestic rates above Eurodollar rates.

the supply function, we include a wealth variable (W_0) in the final expression.[8] The assumption that all liabilities are gross substitutes requires that Eurodollar loan demand fall with an increase in the Eurodollar rate and rise with an increase in any other rate. The Eurodollar loan demand function is then

$$Q_{loan} = q^d(i_e, i_{cp}, i_{ff}, R_Q, i_{uk} + f_{\mathfrak{L}}, i_j, X_d; \sigma_d)W_0 ;$$
$$q_1^d < 0 ; q_k^d > 0; k = 2, \ldots 7 .$$

[8]For U.S. banks, portfolio decisions are clearly influenced by some scale variable, whether net worth or total assets. But this is also true of other borrowers once it is recognized that their decisions to borrow involve the same type of portfolio choice that U.S. banks face. We thus include a wealth variable in the loan demand function and again adopt the homogeneity restriction on this variable.

III. THE STRUCTURE OF THE EURODOLLAR MARKET

The Structural Equations

The previous chapters have derived two functions describing deposit supply and loan demand in the Eurodollar market. The supply of deposits is a function of U.S. and European interest returns and exchange-rate factors. The demand for loans is dominated by U.S. interest-rate factors, but includes British and Japanese interest-rate and exchange-rate elements as well. We now adopt an explicit linear form for the deposit and loan equations, expressing each equation in terms of the Eurodollar rate to bring out the dependence of this rate upon the national interest rates.

The linear equation for deposit supply (where v_t is an error term) is given by

$$i_e = a_0 + a_1 Q_{dep}/W_0 + a_2 i_{usb} + a_3 i_{sw} + a_4 f_{sf} + a_5 i_g + a_6 f_{DM} + a_7 X_d + a_8 \sigma_d + v_t .$$

Specification of the supply equation leaves some latitude in the choice of European interest-rate variables. To avoid problems of multi-collinearity, we restrict the choice to two representative rates — those on Swiss and German deposits.[1] In the final specification, we therefore include the Swiss and German interest rates (i_{sw} and i_g) and the Swiss franc and Deutsche Mark forward premiums (f_{sf} and f_{DM}). The other determinants of Eurodollar supply are the U.S. interest rate (represented by the U.S. Treasury bill rate i_{usb}) and the expected value and risk of exchange-rate appreciation (X_d and σ_d), the specification of the latter variables to be discussed below.

The linear equation for loan demand (where u_t is an error term) is given by

$$i_e = b_0 + b_1 Q_{loan}/W_0 + b_2 i_{cp} + b_3 i_{ff} + b_4 R_Q + b_5 (i_{uk} + f_{£}) + b_6 i_j + b_7 X_d + b_8 \sigma_d + u_t .$$

The determinants of loan demand are the U.S. commercial paper rate (i_{cp}), the federal funds rate (i_{ff}), and the Regulation Q variable ($R_Q = i_{cd} - Reg$ Q), the covered British local-authority rate ($i_{uk} + f_{£}$), the Japanese call-money rate (i_j), and the exchange-rate factors (X_d and σ_d).

[1] Italian deposits might have been preferred to German deposits, since the Italian position in the market was generally larger than the German, but no satisfactory Italian interest-rate and forward-premium series were available.

The two equations represent a subsector of a larger system encompassing the money and exchange markets of the major industrialized countries. Within this subsector the Eurodollar interest rate and the levels of Eurodollar deposits and loans are simultaneously determined. Given the simplifying assumption that Eurodollar loans are maintained at the level of Eurodollar deposits, the two equations determine the equilibrium interest rate, i_e, and the level of Eurodollar deposits and loans ($Q_{dep} = Q_{loan}$).[2]

Because the foreign-exchange markets and the Eurodollar market are closely linked, the forward premiums appearing in the Eurodollar equations must be treated as endogenous variables as well. Not all covered arbitrage is confined to the free market, however, since central banks have periodically offered swap contracts independently of normal forward transactions.[3] This distinction between market-determined and policy-determined forward premiums is reflected in our treatment of the exchange-rate variables.[4]

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[2]As discussed below, the loan equation is estimated using asset statistics, while the deposit equation is estimated using liability statistics. We then impose the restriction that Eurodollar deposits are equal to Eurodollar loans, and derive the reduced-form expression for the Eurodollar rate. In practice, Eurodollar deposits and loans are not equal in value, but the imbalance between them is generally limited. (The corresponding liability and asset statistics differ on average by approximately 5 per cent through the 1965–70 period.) In earlier versions of the study, we had imposed this restriction before estimating the deposit and loan equations by employing the series for Eurodollar liabilities in both the loan and deposit equations. In Chapter IV, we show that the loan equation is little changed whichever series is used. Note that we also ignore the distinction between the Eurodollar deposit rate and the Eurodollar loan rate. In practice, these two rates are separated by a fairly constant markup.

[3]The German Bundesbank and the Bank of Italy have both used official swaps to encourage the outward flow of funds. The Bank of England, in contrast, has intervened directly in the forward market to alter arbitrage margins.

[4]The series for the DM forward premium, f^{**}_{DM} (see below), consists of the policy-determined rate on special Bundesbank swaps whenever these were available and of the instrumental-variable estimate of the free-market rate for all other periods. The instrumental-variable estimate was formed by regressing f_{DM} on the principal (exogenous) determinants of this premium, including the German deposit rate, the U.S. commercial-paper rate, a gold-price index (to reflect exchange-rate expectations), and current and lagged values of German exports and imports. In the case of the sterling forward premium, the Bank of England chose to intervene directly in the forward market. Official intervention altered the normal relationship between the market rate and its principal determinants. Hence, in deriving instrumental-variable estimates of the sterling forward premium, $f^{**}_{£}$, we have allowed for a structural shift in the forward-premium relationship for that period when the Bank was intervening in the market (i.e. the period prior to the November 1967 devaluation). The exogenous determinants of $f^{**}_{£}$ include the U.K. local-

With respect to national interest rates, our approach to estimation follows that of earlier studies of national capital movements. Thus we treat national interest rates as exogenous to the international sector. Even in the absence of a national monetary policy, domestic interest rates would be less responsive to international influences than the Eurodollar rate, since domestic monetary factors play a major role in national markets. If conditions in the international market do threaten to alter domestic rates, action by the monetary authorities may counteract such influence. Indeed, if the authorities pursue any type of independent monetary policy, countervailing action is automatically taken as money-market conditions change. Though efforts to control domestic conditions may fail in times of international crisis, it is reasonable to assume that national rates are determined primarily within national markets in normal periods.[5] In fact, this assumption is necessary if we are to avoid having to formulate separate models for each of the national money markets.

The treatment of the Eurodollar equations therefore recognizes that the Eurodollar interest rate and the level of deposits and loans are jointly determined, and that conditions in this market and in the exchange markets are jointly determined as well. But it stops short of treating conditions in national markets as endogenous to the international system.

The Impact of American Monetary Policy

Before considering the approach to estimation in specific terms, we should discuss the peculiar influence of American monetary policy upon

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authority rate, the U.S. commercial-paper rate, and the current and lagged values of British exports and imports. (Chapter IV of Marston, 1972, discusses the treatment of the exchange-market variables in greater detail.)

[5]In the case of U.S. interest rates, domestic factors were of predominant importance simply because of the overwhelming size of the U.S. money market. Of the remaining interest-rate variables in the final equations, the German and British covered rates were determined primarily by the forward-market intervention policies of the respective central banks. In both cases, forward intervention reinforced traditional monetary policy in maintaining rates independent of those abroad. (Note that in 1969, however, the German authorities had difficulty controlling domestic monetary conditions because of the abnormal speculative inflows and outflows of funds.) The other interest variable appearing in the final equations, the nominal rate on Swiss deposits, might be expected to have been more sensitive to Eurodollar conditions. The National Bank, however, generally succeeded in maintaining Swiss rates at relatively low levels (at a time when the Eurodollar rate was rising to record levels) through a policy of direct credit restriction. (For a discussion of Swiss monetary policy in relation to the Eurodollar market, see Stopper, 1970.)

both Eurodollar deposits and loans. We would expect American monetary policy to be of predominant importance in determining conditions in the Eurodollar market, since the American money market dwarfs the Eurodollar market in size. Shifts in U.S. credit policy explain much of the variation in Eurodollar rates; the potential for independent variation in market rates is limited. But the *growth* of the market during periods of tight U.S. credit cannot be explained in terms of monetary conditions per se. Nor can the dramatic rise in Eurodollar rates in 1966 and 1968–69 be so explained. On the contrary, the expansion of the market and the unparalleled rise in Eurodollar rates are direct products of U.S. market restrictions, particularly the restrictions on U.S. bank behavior.

Consider a hypothetical international monetary system in which the institutions of the Eurodollar market are similar to those that presently exist but in which the large national dollar market (the United States) is free of all *official restrictions*. In this system, U.S. interest rates would be a major factor in the supply of Eurodollar deposits; a rise in the U.S. rate would pull domestic funds home and draw foreign funds from the Eurodollar market, raising the Eurodollar deposit rate. This suggests a simplified version of the deposit equation that relates the Eurodollar interest rate to the general level of U.S. interest rates and the level of Eurodollar deposits:[6]

$$i_e = a_0 + a_1 Q_{dep} + a_2 i_{us} + \ldots . \quad (\textit{Deposit equation})$$

On the demand side of this hypothetical system, U.S. loans would be competitive with Eurodollar loans. A tightening of U.S. credit conditions would raise U.S. interest rates, thereby shifting loan demand to the Eurodollar market. Yet *no excessive rise* in U.S. bank borrowing from the Eurodollar market would occur, since banks could compete freely for domestic funds. The Eurodollar rate would rise and fall with U.S. rates, but the relationship between the rates would remain the same in normal and credit-restraint periods alike. Expressing the loan equation in simplified form,

$$i_e = b_0 + b_1 Q_{loan} + b_2 i_{us} + \ldots . \quad (\textit{Loan equation})$$

A rise in U.S. rates would lead to a rise in Eurodollar rates because of both a reduction in Eurodollar deposits and an expansion of Eurodollar

[6]In the expressions for the deposit function and loan function (below), we replace the specific U.S. interest-rate variables appearing in the more general equations above with the single U.S. interest-rate variable, i_{us}, representing the general level of U.S. interest rates.

loans. But the effect on the size of the market would be indeterminate. Consider the (reduced form) expression for the quantity of Eurodollar deposits (assumed equal to the quantity of Eurodollar loans):

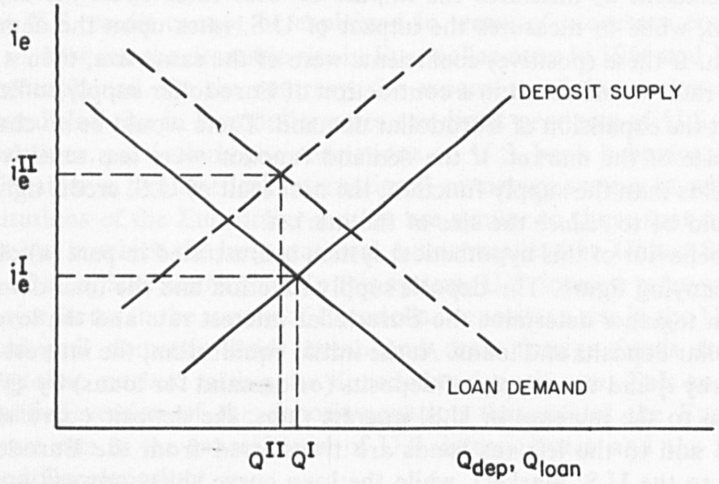
$$Q = [1/(a_1 - b_1)](b_0 - a_0 + b_2 i_{us} - a_2 i_{us} \ldots).$$

The coefficient a_2 measures the impact of U.S. rates upon the supply function, while b_2 measures the impact of U.S. rates upon the demand function. If these (positive) coefficients were of the same size, then a rise in U.S. rates would result in a contraction of Eurodollar supply sufficient to offset the expansion of Eurodollar demand. There would be *no* change in the size of the market. If the demand function were less sensitive to U.S. yields than the supply function, the net result of U.S. credit tightening would be to *reduce* the size of the market.

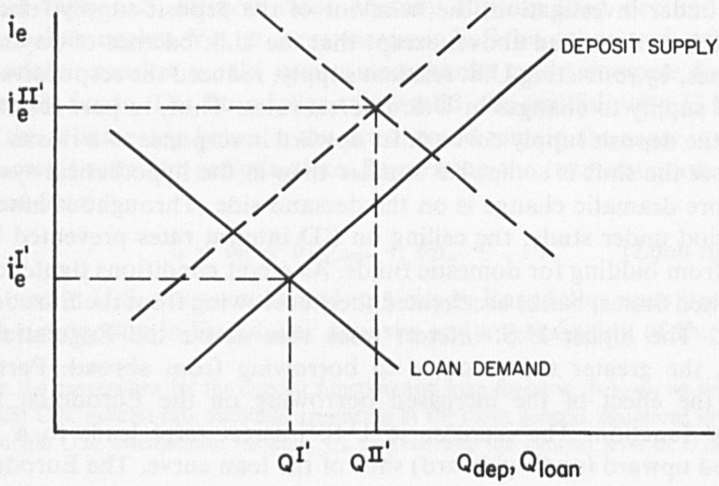
The behavior of this hypothetical system is illustrated in part (a) of the accompanying figure. The deposit supply function and the loan demand function together determine the Eurodollar interest rate and the level of Eurodollar deposits and loans. At the initial equilibrium, the interest rate is given by i_e^{I} and the supply of deposits (or demand for loans) by Q^{I}. In response to the increase in U.S. interest rates, the deposit curve shifts upward and to the left (as funds are transferred from the Eurodollar market to the U.S. market), while the loan curve shifts upward and to the right (as borrowing is transferred from the U.S. to the Eurodollar market). The Eurodollar rate rises to i_e^{II} and the level of Eurodollar deposits (in this particular illustration) decreases to Q^{II}.

Now contrast the hypothetical case with the actual system. During the period under investigation, the behavior of the deposit supply function was much as described above, except that the U.S. balance-of-payments guidelines, by restricting U.S. resident supply, reduced the responsiveness of total supply to changes in U.S. interest rates. Thus, in part (b) of the figure, the deposit supply curve shifts upward in response to a rise in U.S. rates, but the shift is somewhat smaller than in the hypothetical system. The more dramatic change is on the demand side. Throughout much of the period under study, the ceiling on CD interest rates prevented U.S. banks from bidding for domestic funds. As credit conditions tightened in the United States, banks accelerated their borrowing from the Eurodollar market. The higher U.S. interest rates rose above the Regulation Q ceiling, the greater the recourse to borrowing from abroad. Part (b) shows the effect of the increased borrowing on the Eurodollar loan demand function. The increase in U.S. interest rates leads to a pronounced upward (and rightward) shift of the loan curve. The Eurodollar

(a) HYPOTHETICAL SYSTEM



(b) ACTUAL SYSTEM



interest rate rises from $i_e^{I\prime}$ to $i_e^{II\prime}$, and the supply of deposits (or demand for loans) increases from $Q^{I\prime}$ to $Q^{II\prime}$. The shift is considerably larger than it would be in normal periods when the Regulation Q ceiling is not binding, and larger than in the hypothetical system illustrated in (a).

In the periods of credit restraint in 1966 and 1968–69, the tightening of U.S. credit conditions induced just such a shift in the loan demand function. The increase in U.S. bank borrowing in those years led to a dramatic expansion of the market and an unprecedented rise in the Eurodollar interest rate. The Eurodollar funds demanded by U.S. banks were obtained mainly from non-American sources. The system thus worked by bidding funds away from foreign uses. Like the proverbial nineteenth-century rise in bank rate which could attract funds from the moon, the rise in the Eurodollar rate succeeded in drawing forth supply, but at the cost of disrupting normal credit flows abroad.

The Approach to Estimation

Estimation of the Eurodollar system will take two forms. First we will estimate the structural equations directly, using simultaneous-equation techniques. Structural estimation has obvious advantages over estimation of a reduced-form expression for the Eurodollar rate alone, since our principal interest lies in the deposit and loan relations as such, rather than any reduced-form expression. The disadvantage of structural estimation is that it must rely upon two rather unsatisfactory quarterly series for Eurodollar deposits and loans. The liability and asset statistics provided by the Bank for International Settlements include interbank deposits and exclude positions vis-à-vis residents. The ideal series would consist only of transactions between Eurocurrency banks and (1) banks outside the market and (2) resident and nonresident nonbanks. Using the BIS series would bias the estimation if the *extent of redepositing* were systematically related to other factors in Eurodollar supply or demand.[7] Although information on interbank depositing is far from complete, there is no evidence that this was the case and we have therefore decided that the advantages of structural estimation justify risking the bias that may result from use of these series.

[7]If the extent of redepositing is not systematically related to the variables in the Eurodollar equations, then instrumental-variable estimates will yield consistent estimates, as in the classic errors-in-variable problem (see Johnston, 1963, Chap. 6). Since instrumental-variable estimates of Q_{dep} are formed in the first stage of the simultaneous-equation estimation procedure discussed below, the presence of measurement error requires no modification of this procedure.

In addition to structural estimation using the quarterly deposit and loan series, we will estimate a monthly equation for the Eurodollar rate alone. Solving the linear deposit supply and loan demand equations, we obtain the reduced-form expression for the Eurodollar rate (where e_t is an error term):

$$i_e = c_0 + c_1 i_{cp} + c_2 i_{ff} + c_3 R_Q + c_4(i_{uk} + f_{\pounds}) + c_5 i_j + c_6 i_{usb} + c_7 i_{sw} + c_8 f_{sf} + c_9 i_g + c_{10} f_{DM} + c_{11} X_d + c_{12}\sigma_d + e_t.$$

This equation can be interpreted as an expanded version of the reduced-form relation between the Eurodollar rate and the U.S. Treasury bill rate estimated by Hendershott (1967) for 1959–64 data. But since the equation is based on a more complete model of the Eurodollar system, the parameter estimates will provide much more information regarding the several determinants of the Eurodollar rate. And by covering a period of credit restraint in the United States, our estimates will reveal the full impact of the restrictions imposed by American policy.

Most of the data used in the estimation are drawn directly from official publications. The interest and exchange-rate series are listed in the Appendix, together with their sources. Three other series, those for Eurodollar deposits (Q_{dep}) and loans (Q_{loan}) and for wealth (W_0), are discussed in detail in the Appendix.

A fourth series representing exchange-rate expectations is of particular interest and will be discussed here. If spot rates were free to reflect private market forces, we might be able to predict current expectations from movements of the spot rate. This approach would be valid under a flexible exchange-rate system such as existed in Canada until 1962 (see Stoll, 1968), or under the IMF system in a period when private market fluctuations required only limited intervention by the authorities (see Branson, 1968, Chap. 3). But in a time of recurring exchange crises such as the period under study, official demand is varied specifically to counter speculative movements in the spot rate. The greater the expectation of exchange-rate changes, the more likely it is that the authorities will intervene to forestall changes in the exchange rate. Past movements of the spot rate therefore offer a poor basis on which to formulate an index of current expectations.

To develop an acceptable index, we turn to a market largely dominated by speculative influences, the gold market. Speculation in gold, in one form or another, has been a consistent feature of every recent exchange crisis. Since the speculation has been directed against the dollar more than any other currency, the gold price is particularly appropriate as an

index of expectations for use in the Eurodollar equations. There has been a free-market price for gold since March 1968, when the two-tier system was established. Earlier, a forward market in gold contracts existed in Zurich. We will use series from both markets to construct a continuous index of gold-price expectations.[8] The variable G_{PR} will represent the (absolute) excess of the free-market price (earlier, the forward price) over the official price of $35 an ounce.[9]

[8]The spot price for gold appears in the *Bank of England Quarterly Bulletin* (average bid in dollars per fine ounce), the forward price in *Pick's Currency Yearbook* (expressed as per cent of official price). Makin (1971) previously used this forward series as an index of expectations in a study of reserve-asset preferences. The index has been constructed by converting the forward (percentage) premium to a dollar (absolute) premium, and interpolating the five-month gap between the closing of the Zurich forward market in November 1967 and the inauguration of the two-tier market.

[9]In the final specification, there is no variable representing exchange risk (σ_d). Several attempts were made to construct such a variable (by using the deviations from the mean of various exchange-rate proxies), but this variable proved even more elusive than the exchange-rate expectations variable.

IV. THE RESULTS OF ESTIMATION

Each of the two structural equations was estimated using an instrumental-variable procedure. In each equation the instrumental variables, Q^*_{dep}/W_0 (or Q^*_{loan}/W_0) and $f^*_d (d = £,\text{sf},\text{DM})$, replaced the endogenous series for Eurodollar deposits (or loans) and the forward-exchange premiums.[1] Estimation of the modified deposit and loan equations then proceeded along normal lines.

The Supply of Deposits

The specification of the supply equation includes three interest-rate variables. The U.S. Treasury bill rate, i_{usb}, represents the return on U.S. investments. The Swiss and German nominal interest rates, i_{sw} and i_g, and the Swiss franc and Deutsche Mark forward premiums, f^*_{sf} and f^*_{DM} represent returns on European investments. Other variables are the premium on gold (representing exchange-rate expectations) and the level of Eurodollar deposits deflated by the wealth variable, Q^*_{dep}/W_0. Since the Swiss franc forward premium proved to be nonsignificant, it was dropped from the equation in the final estimation; this left the covered return on German deposits ($i_g + f^*_{DM}$) and the nominal rate of interest on Swiss deposits, i_{sw}, to represent the return on European investments. The equation for the supply of deposits is as follows (with the t-statistics below in parentheses):

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[1]The instrumental-variable estimates were formed as follows: For each forward premium, instrumental-variable equations were estimated using as instruments the principal exogenous determinants of each forward premium (see footnote 4, Chap. III). From these equations we derived the instrumental variables, $f^{**}_{£}$, f^{**}_{sf}, and f^{**}_{DM}. In the case of Eurodollar deposits and loans, the variables Q_{dep}/W_0 and Q_{loan}/W_0 were regressed on all the exogenous variables in the deposit and loan equations to obtain the instrumental variables, Q^{**}_{dep}/W_0 and Q^{**}_{loan}/W_0. Since the instruments in the Eurodollar and exchange-rate equations differed, however, there was no guarantee that each instrumental variable (or the exogenous variables appearing in the equation to be estimated) would be asymptotically uncorrelated with the residuals in the final stage of estimation. That is, variables from one first-stage regression might have been correlated with the residuals from another first-stage regression. To ensure consistency in the final stage of estimation, Q_{dep}/W_0 (Q_{loan}/W_0) and f_d (d = £, sf, DM) were regressed on the instrumental variables, Q^{**}_{dep}/W_0 (Q^{**}_{loan}/W_0) and f^{**}_d, and the exogenous variables appearing in the particular equation, to form the variables, Q^*_{dep}/W_0 (Q^*_{loan}/W_0) and f^*_d. For discussion of this procedure, see Fisher (1965) and Mitchell and Fisher (1970).

$$i_e = \underset{(1.98)}{.0299}\, Q^*_{dep}/W_0 + \underset{(1.51)}{.489}\, i_{usb} + \underset{(2.30)}{.419}\, i_{sw} + \underset{(3.42)}{.427}(i_g + f^*_{DM}) + \underset{(1.32)}{.0587}\, G_{PR} - \underset{(-1.42)}{1.010}.$$

$$\bar{R}^2 = .974 \qquad d.w. = 1.37 \qquad s.e. = .316$$

The deposit supply function is positively inclined, as expected. Each of the other coefficients is also of correct sign: A rise in the return on any alternative investment reduces supply and leads to a rise in the Eurodollar rate. Thus these investments are all gross substitutes for Eurodollar deposits. All the coefficients are significant at the 5 per cent level except those of the U.S. Treasury bill rate (with a t-ratio of 1.51) and the gold premium (with a t-ratio of 1.32).[2] The size of the Swiss and German interest-rate coefficients suggests that European monetary conditions are of considerable importance in determining deposit supply. Note that these are structural coefficients: The U.S. bill-rate coefficient, for instance, indicates that a 1 percentage point rise in the bill rate leads to a .489 percentage point rise in the Eurodollar rate. In the reduced-form expression for the Eurodollar rate (which allows deposits to vary), on the other hand, the same rise in the bill rate leads to only a .280 percentage point rise in the Eurodollar rate (see below).

The Demand for Loans

The demand specification includes three U.S. interest-rate variables. The commercial-paper rate, i_{cp}, measures the return on bank investments in both normal and credit-restraint periods. The federal funds rate, i_{ff}, measures the cost of alternative funds in both periods. The Regulation Q variable, R_Q, defined as the premium of the CD rate above the Regulation Q ceiling (and set equal to zero in normal periods), serves as an index of credit restraint: the greater the gap between the free-market CD rate and the Regulation Q ceiling, the greater the extent to which U.S. banks are priced out of the market for domestic funds and have to turn to Eurodollar borrowing. In the final estimation, the federal funds rate had to be dropped from the specification because i_{cp} and i_{ff} are highly collinear. The coefficient of the commercial-paper rate is left to reflect the cost of alternative funds (in normal and credit-restraint periods) as well as the return on bank investments. Of the non-American variables, the

[2]Although the t-statistic for the coefficient of the Treasury bill rate is low, the coefficient itself is stable in all versions of the equation (varying by less than one-half its standard error under alternative specifications of the Eurodollar supply function).

Japanese rate was dropped because it was nonsignificant. This left the covered return on local-authority deposits in Britain ($i_{uk} + f^*_{£}$) and the premium on gold, G_{PR} (reflecting the speculative return from borrowing dollars). The equation for Eurodollar borrowing is as follows:

$$\underset{}{i_e} = \underset{(-1.24)}{-.0402 Q^*_{loan}/W_0} + \underset{(3.95)}{1.032 i_{cp}} + \underset{(3.85)}{1.130 R_Q} + \underset{(2.32)}{.1141 G_{PR}} + \underset{(.987)}{.0602(i_{uk} + f^*_{£})} + \underset{(.609)}{.604}.$$

$$\bar{R}^2 = .981 \qquad d.w. = 2.27 \qquad s.e. = .294$$

The loan demand function is negatively inclined, as expected. The other coefficients are also of correct sign: A rise in U.S. or foreign rates leads to a rise in borrowing and an increase in the Eurodollar rate.

The coefficients of the U.S. interest-rate variables are of particular interest. They imply that changes in U.S. rates have a different impact in periods of credit restraint than in normal periods. In normal periods, a rise in the general level of U.S. rates raises Eurodollar rates by a factor of 1.032. (Recall that these are shifts in the loan demand function alone, with the level of loans held constant.) In periods of credit restraint, by contrast, the same increase in U.S. rates raises Eurodollar rates by the factor 2.162 (1.032 + 1.130). This difference should not be surprising in light of the tremendous increase in Eurodollar borrowing that occurred whenever the Regulation Q ceiling prevented U.S. banks from bidding for domestic funds.

Reduced-Form Expression for the Eurodollar Rate

A different perspective on these results can be gained from the reduced-form expression for the Eurodollar rate.[3] Solving the two structural equations for the Eurodollar rate (eliminating the deposit and loan variables, Q^*_{dep}/W_0 and Q^*_{loan}/W_0), we obtain[4]

$$i_e = .440 i_{cp} + .482 R_Q + .280 i_{usb} + .240 i_{sw} + .245(i_g + f^*_{DM}) + .026(i_{uk} + f_{£}) + .0823 G_{PR} - .323.$$

[3]Note that this is a reduced-form expression with respect to the Eurodollar structural equations only, since instrumental-variable estimates of the forward premiums are included in the expression.

[4]The assumption that Eurodollar deposits are equal to Eurodollar loans allows us to solve the two structural equations for the Eurodollar interest rate. In earlier versions of this study, we had imposed this equality between deposits and loans even before estimating the structural equations; we had used the liability statistics to represent Q_{loan} as

Here, with the level of deposits and loans free to vary, a rise in the Swiss interest rate of 1 percentage point leads to a rise of .240 percentage points in the Eurodollar rate. A similar result obtains for the German covered rate. A rise of 1 percentage point in the general level of U.S. interest rates, on the other hand, raises Eurodollar rates by 1.202 percentage points (.440 + .482 + .280) whenever the Regulation Q ceiling is binding, and by .720 percentage points (.440 + .280) if the CD rate lies below the ceiling. Even more interesting is the impact of U.S. interest rates on each side of the market. Although U.S. rates figure in the supply of deposits, their influence upon the demand for loans is substantially greater. (The supply coefficient is .280, while the demand coefficients sum to .922). This result confirms the predominance of U.S. bank borrowing in the two-way relationship between the U.S. money market and the Eurodollar market.

Monthly Estimation of the Reduced Form

Estimation of the same reduced-form equation using monthly data yields results that in many respects are surprisingly similar to those above. We would expect differences to arise between the two forms of estimation for several reasons. Because each structural equation is over-identified, structural estimation should provide more efficient estimates than estimation of the reduced form. On the other hand, because the series for Eurodollar deposits is not available monthly, the structural equations can be estimated only on a quarterly basis. In such a highly efficient market as this, quarterly estimation involves far more temporal aggregation than is desirable. Finally, multi-collinearity is more of a problem in estimating the reduced form; the three U.S. interest-rate variables that appear together in the reduced form are particularly collinear.

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well as Q_{dep} in the structural estimation. It is interesting to note that the estimates of the loan function do not seem to be particularly sensitive to the specific series used. The Eurodollar loan equation estimated with the liability rather than the asset statistics is as follows:

$$\underset{}{i_e} = \underset{(-1.05)}{-.0423\ Q_{loan}/W_0} + \underset{(3.93)}{.974\ i_{ep}} + \underset{(3.22)}{1.218\ R_Q} + \underset{(1.94)}{.0865\ G_{PR}} + \underset{(1.10)}{.0709\ (i_{uk} + f^*_{\$})} + \underset{(.782)}{.888.}$$

$$\bar{R}^2 = .980 \qquad d.w. = 2.18 \qquad s.e. = .302$$

The two equations are similar, with only minor differences in individual coefficients.

The monthly equation was estimated for the same period as the structural equations, from the beginning of 1965 through the first quarter of 1970. The same variables appear in both sets of equations, with two exceptions: The German interest rate and forward premium have been entered separately,[5] while the gold premium has been dropped from the equation because it was nonsignificant.[6] The results of estimating the reduced form confirm many of the conclusions of the structural estimation:

$$i_e = \underset{(2.87)}{.501}i_{cp} + \underset{(4.79)}{.461}R_Q + \underset{(2.23)}{.373}i_{usb} + \underset{(2.78)}{.277}i_{sw} + \underset{(2.41)}{.157}i_g + \underset{(5.62)}{.301}f^*_{DM} + \underset{(2.59)}{.072}(i_{uk} + f^*_{£}) - \underset{(-1.80)}{.920}.$$

$$\bar{R}^2 = .976 \qquad d.w. = 1.72 \qquad s.e. = .299$$

The American influence upon loan demand remains as large as in the quarterly estimation; the coefficients of i_{cp} and R_Q change little from those appearing in the quarterly reduced-form expression (.501 vs. .440 for i_{cp}; .461 vs. .482 for R_Q). The total impact of U.S. interest rates upon the Eurodollar rate has increased to 1.335 from 1.202, largely as a result of the higher bill rate coefficient in the monthly equation (.373 vs. .280).

Foreign interest rates are again important in explaining movements in the Eurodollar rate. The Swiss and German interest-rate coefficients are roughly of the same magnitude as before (.277 vs. .240 for i_{sw}; .157 vs. .245 for i_g). Only the coefficient of the British local-authority rate changes substantially between quarterly and monthly estimation (.072 vs. .026). The combined influence exerted by European interest rates is sizable, even though U.S. interest rates remain dominant in determining Eurodollar market conditions. A 1 percentage point rise in both Swiss and German interest rates, for instance, leads to an increase in the Eurodollar rate of .434 percentage points. All coefficients in the monthly equation are significant at the 5 per cent level.[7]

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[5]The combined return proved nonsignificant in the monthly equation, and so the two variables were entered separately. When specified in this form, the forward premium may reflect speculative elements as well as interest arbitrage, since the forward premium itself is partially a function of speculative factors.

[6]Although the gold premium served as an adequate proxy for exchange-rate expectations in the structural equations, it performed poorly in the monthly estimation. As noted above, the DM forward premium may reflect some of the speculative influence otherwise unaccounted for.

[7]In addition to the equation reported above, we estimated a monthly equation of the same form but with the lagged value of the Eurodollar interest rate included in the speci-

We can investigate further the relationship between U.S. interest rates and the Eurodollar rate by comparing our results with those of Hendershott (1967) for the 1957–64 period. In his study, the Eurodollar rate was related to the U.S. Treasury bill rate in a simplified reduced-form expression that omitted foreign interest-rate influences. The study found that a 1 percentage point rise in the U.S. Treasury bill rate induced shifts in supply and demand that jointly resulted in a 1.07 percentage point rise in the Eurodollar rate.

In the more recent period studied here, the relationship between the U.S. and Eurodollar rates has been altered by two factors: the balance-of-payments program has reduced the responsiveness of investment flows to U.S. interest rates, while resort by U.S. banks to heavy Eurodollar borrowing has radically altered the demand for Eurodollar loans. United States bank borrowing has been so important, in fact, that the relationship between U.S. interest rates and the Eurodollar rate has been found to vary widely between normal and credit-restraint periods. In normal periods, a 1 percentage point rise in the general level of U.S. rates has induced supply and demand adjustments that raised the Eurodollar rate by .720 percentage points (by .874 points in monthly estimation). In periods of credit restraint, however, heavy Eurodollar borrowing has inflated the Eurodollar rate. A 1 percentage point rise then has raised the Eurodollar rate by 1.202 percentage points (by 1.335 points in monthly estimation). With the leverage afforded by the massive borrowing of U.S. banks, a rise in U.S. interest rates in periods of credit restraint has raised the Eurodollar rate by much more than in normal periods. And with each increase in the Eurodollar rate has come greater disruption of international markets. These results underscore the crucial role of Regulation Q in distorting normal credit flows.

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fication (see Koyck, 1954, for a discussion of this common lag specification). The lagged value of i_e was nonsignificant (and negative, contrary to the normal specification). In such a highly efficient market, the failure to detect a lag is not surprising. Adjustment in international money markets should proceed too rapidly for any sizable lags to appear in the monthly estimation. The substantial lags reported in the Hendershott study (1967) may well have arisen because non-U.S. variables had been omitted from the Eurodollar equation. (Hendershott had found that, in an equation containing only the U.S. bill rate, the Eurodollar rate adjusted quite slowly to changes in the bill rate.) Note that in Black's (1971) recent study of Eurodollar borrowing by U.S. banks, weekly estimation revealed only limited lags.

V. CONCLUSION

This study has analyzed the behavior of the Eurodollar market over a difficult period in the market's history. The analysis has involved estimating structural equations for the supply of deposits and demand for loans, reflecting the very different forces operating on each side of the market. The specification of the loan demand equation has centered primarily on the portfolio behavior of American banks, while the specification of the deposit supply equation has centered on the more traditional portfolio decisions of non-American investors, particularly European investors. The specification of the two equations has been designed to show how American monetary policy induced bank borrowing from the Eurodollar market, and how Eurodollar supply responded to the pressures resulting from the unprecedented demand for funds on the part of American banks. At times during the period, the strain caused by the borrowing appeared to stretch market resources to the limit. The market proved resilient, surmounting each succeeding crisis without major incident. The technical efficiency of the market, however, could not prevent the inflated demand for funds from sending Eurodollar rates to record levels of 10 and 12 per cent.

Conditions in the Eurodollar market are of major concern because this market plays a pivotal role in the international system. By mobilizing a large volume of short-term capital and distributing it worldwide, the Eurodollar market has had a disproportionate effect upon the distribution of international financial resources. Trading firms and corporations with multinational interests have found in the market the flexibility necessary for international operations. In the absence of an integrated European money market, the Eurodollar market has considerably increased the efficiency of international financing and investment. It was upon this market that U.S. banks imposed their enormous demands in the 1966 and 1968–69 periods of credit restriction. The market's role in the international economy spread the strain caused by such borrowing far beyond the confines of the market itself.

Since 1970, the reversal of American monetary policy has released massive sums into the international system. With the relaxation of U.S. credit conditions and the abolition of Regulation Q ceilings on large deposits in mid-1970, U.S. banks have cut back sharply their borrowing from the Eurodollar market. The resulting disruption to the international

system has compounded earlier problems. Not only has the return flow played havoc with foreign exchange rates, but the abrupt change in interest rates has left national authorities hard-pressed to protect their money markets from being swamped with funds. The result has been a major international crisis, but one that could have been foreseen in earlier developments.

DATA APPENDIX

Interest-Rate and Forward-Premium Series

Each series is described as it appears in the published source. In cases where the published series is in weekly form, the monthly series used in the estimation was obtained by averaging the weekly figures. Each quarterly series was obtained by averaging the monthly series.

i_e Rate for three-month Eurodollar deposits in London. Friday quotations from Bank of England *Quarterly Bulletin* (Thursday quotations through December 1965).

i_{uk} Rate for three-month local-authority deposits in London. Friday quotations from Bank of England *Quarterly Bulletin* (Monday quotations through June 1965).

i_{sw} Rate for three-month deposits with big banks in Zurich. Monthly average of rates on return dates (7th, 15th, 23rd, and last day of month) from Deutsche Bundesbank *Monthly Report*.

i_g Rate for three-month loans in Frankfurt. Monthly average of daily figures from Deutsche Bundesbank *Monthly Report* (until February 1967, monthly average of weekly figures).

i_j Rate on call money in Tokyo. Monthly mode of daily rates from OECD *Main Economic Indicators*.

i_{usb} Rate on three-month U.S. Treasury bills. Monthly average of bids on new issues from the IMF *International Financial Statistics*.

i_{cd} Rate on three-month negotiable certificates of deposit in New York (secondary market). Wednesday quotations from *The Economist*.

i_{cp} Rate on four- to six-month prime commercial paper in New York. Monthly average of daily rates from the *Federal Reserve Bulletin*.

i_{ff} Rate on federal funds. Monthly average of daily rates from the *Federal Reserve Bulletin*.

f_{sf} Three-month Swiss franc forward premium in Zurich (expressed as per cent per annum of spot rate). End-of-month quotations from IMF *International Financial Statistics*.

$f_{£}$ Three-month sterling forward premium in London (expressed as per cent per annum of spot rate). Calculated from the spot rate and forward differential, both expressed in dollars, appearing in the Bank of England *Quarterly Bulletin* (Thursday quotations through 1965; thereafter Friday quotations).

f_{DM} Three-month DM forward premium in Frankfurt (expressed as per cent per annum of spot rate). Monthly average of daily quotations from Deutsche Bundesbank *Monthly Report*. (For months when official swaps were available, the series consists of a weighted average of the official swap rates from the Deutsche Bundesbank *Monthly Report* — the weights being the per cent of days of the month each swap rate was in effect.)

Other Series

Q_{dep}, Q_{loan} Value of Eurodollar deposits and loans, respectively. Quarterly series (in millions of U.S. dollars) for the dollar liabilities and assets, respectively, of the commercial banks of the eight countries comprising the inside area of the Eurodollar market (Belgium-Luxembourg, France, Germany, Italy, the Netherlands, Sweden, Switzerland, and the United Kingdom). Taken from a table in the BIS *Annual Reports* entitled "Short Term Liabilities and Assets of Ten Countries' Commercial Banks in Certain Foreign Currencies vis-a-vis Non-residents."

W_0 Wealth (or scale) variable. The wealth variable is designed to reflect the influence of portfolio size upon both investment and borrowing decisions. No data series can easily correspond to all the various portfolio concepts we have in mind when discussing such decisions. Since we are dealing with a short-term market, the scale variable most relevant to investment/borrowing decisions may be the total of liquid assets in each economy. In the absence of a series for liquid assets, we have chosen a series consisting of money plus quasi-money (time deposits, etc.). The series was constructed by aggregating the national figures for the EEC countries, Switzerland, the United Kingdom, and the United States. (All statistics are drawn from the IMF *International Financial Statistics*, and converted to billions of dollars at par value.)

REFERENCES

Black, S. W., "An Econometric Study of Euro-dollar Borrowing by New York Banks and the Rate of Interest on Euro-dollars," *Journal of Finance*, 26 (March 1971), pp. 83–88.

Branson, W. H., *Financial Capital Flows in the U.S. Balance of Payments*, Amsterdam, North-Holland, 1968.

Clendenning, E. W., *The Euro-dollar Market*, Oxford, Clarendon Press, 1970.

Einzig, P., *The Euro-dollar System*, London, Macmillan, 1970.

Eurodollar and Eurobond International Seminar, *Transcript of Speeches*, London, Investment and Property Studies, Dec. 10, 11, 1969.

Fisher, F. M., "Dynamic Structure and Estimation in Economy-wide Econometric Models," in J. S. Duesenberry *et al.*, *The Brookings Quarterly Econometric Model of the United States*, Chicago, Rand McNally, 1965.

Hendershott, P. H., "The Structure of International Interest Rates: The U.S. Treasury Bill Rate and the Euro-dollar Deposit Rate," *Journal of Finance*, 22 (September 1967), pp. 455–465.

Johnston, J., *Econometric Methods*, New York, McGraw-Hill, 1963.

Klopstock, F. H., "Euro-dollars in the Liquidity and Reserve Management of United States Banks," *Federal Reserve Bank of New York Monthly Review*, 50 (July 1968), pp. 130–138.

Koyck, L. M., *Distributed Lags and Investment Analysis*, Amsterdam, North Holland, 1954.

Leamer, E. E., and R. M. Stern, *Quantitative International Economics*, Boston, Allyn & Bacon, 1970.

Makin, J. H., "Swaps and Roosa Bonds as an Index of the Cost of Cooperation in the 'Crisis Zone'," *Quarterly Journal of Economics*, 85 (May 1971), pp. 349–356.

Marston, R. C., "The Structure of the Euro-currency System," Cambridge, Massachusetts Institute of Technology, Dissertation, 1972.

Mendenhall, W. K., "Euro-dollars — Are Controls Needed?" London, Address before the European Atlantic Group, June 30, 1971.

Mitchell, B. M., and F. M. Fisher, "The Choice of Instrumental Variables in the Estimation of Economy-wide Econometric Models: Some Further Thoughts," *International Economic Review*, 11 (June 1970), pp. 226–234.

Officer, L. H., and T. D. Willett, "The Covered Arbitrage Schedule: A Critical Survey of Recent Developments," *Journal of Money, Credit, and Banking*, 2 (May 1970), pp. 247–257.

Pick's Currency Yearbook, New York, Pick, 1966–68.

Samuelson, P. A., "The Fundamental Approximation Theorem of Portfolio Analysis in Terms of Means, Variances, and Higher Moments," *Review of Economic Studies*, 37 (October 1970), pp. 537–542.

Stoll, H., "An Empirical Study of the Forward Exchange Market under Fixed and Flexible Exchange Rate Systems," *Canadian Journal of Economics*, 1 (February 1968), pp. 56–78.

Stopper, E., "The Eurodollar Market: A View from Switzerland," in H. V. Prochnow, ed., *The Eurodollar*, Chicago, Rand McNally, 1970.
Tsiang, S. C., "The Theory of Forward Exchange and Effects of Government Intervention in the Forward Exchange Market," *IMF Staff Papers*, 7 (April 1959), pp. 75–106.

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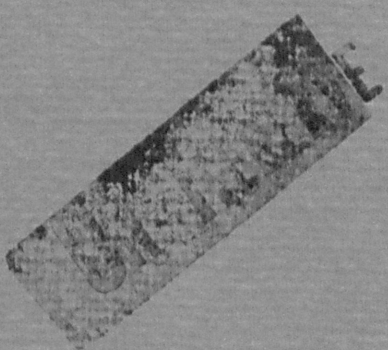

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