PRINCETON STUDIES IN INTERNATIONAL FINANCE NO. 15

Foreign Exchange, Capital Flows, and Monetary Policy

E. Ray Canterbery

INTERNATIONAL FINANCE SECTION
DEPARTMENT OF ECONOMICS
PRINCETON UNIVERSITY • 1965

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IN INTERNATIONAL FINANCE

This is the fifteenth number in the series called PRINCETON STUDIES IN INTERNATIONAL FINANCE, published from time to time under the sponsorship of the International Finance Section of the Department of Economics at Princeton University.

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FRITZ MACHLUP
Director

Princeton University
June 1965

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L.C. Card 65-21049

Printed in the United States of America for Princeton University Press
by the William Byrd Press, Inc., Richmond, Virginia

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I. INTRODUCTION

A. THE PAYMENTS DEFICIT AND MONETARY POLICY

The United States experienced deficits in its international balance of payments in all but one of the fourteen years, 1950-1964. The deficits averaged $1.5 billion yearly during 1950-1956, and rose to $3.2 billion annually during 1958-1962. A striking feature of this deficit position since 1950 is that it prevailed in the face of a substantial surplus in the balance of trade. But this excess of merchandise exports over imports has not been sufficient to offset military and foreign-aid expenditures abroad, plus the outflow of both long-term and short-term capital.

When the gold-exchange system was reestablished at Bretton Woods after World War II, its supporters argued that the viability of the new payments mechanism depended upon "timely" exchange-rate adjustments. If a member nation of the newly created International Monetary Fund experienced difficulty in stabilizing its exchange rate over a period of years and was losing foreign-exchange reserves, it could ask the IMF for the privilege of altering its exchange rate by setting a new par value for its currency in terms of gold. If it wished to revalue by more than ten per cent, the nation had to demonstrate that it was enduring a "fundamental disequilibrium."

In the intervening years the United States has become a key-currency nation. During the Kennedy-Johnson administrations, the monetary authorities decided that this status could not be maintained unless the par value of the dollar was kept constant. Thus, because of the key-currency role, Under Secretary of the Treasury for Monetary Affairs Robert V. Roosa, as administration spokesman on the payments problem, ruled out the possibility of devaluation as a solution to the chronic payments deficit, arguing that devaluation would leave the world without a generally acceptable major currency.[1] Hence the United States experienced a predicament not foreseen at Bretton Woods: that is, a nation wishing to maintain its role of a key-currency country is forced to violate the basic tenet of that agreement by re-

[1] Robert V. Roosa, "Assuring the Free World's Liquidity," *Factors Affecting the United States Balance of Payments,* compilation of studies prepared for the Subcommittee on International Exchange and Payments, Joint Economic Committee, 87th Cong., 2d Sess., 1962, p. 343.

jecting "timely" exchange-rate adjustments as an instrument of balance-of-payments policy.

The policy options of the United States were narrowed, by the peculiar circumstances of its role as a key-currency country, to two basic long-term approaches. It could reduce the level of its domestic economic activity in order to correct the payments imbalance. Or it might impose direct and indirect constraints on various components of its balance of payments. The orthodox attack would be to apply measures that would tend to dampen economic expansion, thus tending also to reduce merchandise imports and stimulate exports. The alternative would be to establish tariffs and import quotas to curb imports, legislate restrictions on long-term and short-term capital movements, and raise interest rates with a view to slowing short-term capital outflows. The carefully formulated purpose of the Bretton Woods Agreement was to avoid both sets of policies, which were described as the "evils" of the discarded gold standard.

Under either approach, monetary policy can be employed. Variations in the money supply and interest rates can affect the balance of payments in three ways: (a) through the current account; (b) through interest-induced capital movements; and (c) through speculative capital movements. The first of these is the classical adjustment mechanism. Falling income and prices, as possible consequences of the absolute or relative contraction of credit and domestic spending, would tend to dampen imports and improve the balance of trade. However, since 1960 Federal Reserve official publications have stressed the dual objectives of stimulating economic growth *and* reducing the payments deficit.[2] Also, the Kennedy-Johnson administration's official domestic policy goal was to support economic expansion.

Thus the Democratic administration ostensibly chose the second general set of policies for eliminating the payments problem. The Federal Reserve System was assigned the task of curtailing interest-induced and speculative capital flows abroad. The authorities could work on the first type of outflow by changing relative yields to deter arbitrageurs and certain types of speculators. According to traditional theory, speculation in foreign exchange is a result of expected depreciation or devaluation of the home currency. An interest-rate rise is a signal that the monetary authorities will defend the exchange rate at the sacrifice of domestic employment and growth. Confidence in the currency is

[2] See Board of Governors of the Federal Reserve System, *Annual Report*, 1960-1963.

sustained if potential speculators know that maintenance of the current rate of exchange is given priority over all other national goals.

To accomplish their objective, the monetary authorities placed a floor under short-term interest rates and eventually pushed them higher in order to reduce the differential between rates here and abroad. This policy was initiated by a changed directive to the Federal Open Market Committee in August 1960. In its *Annual Report* for 1961 the Board of Governors expressed its view that a widening of the differential between domestic and foreign money-market rates "could have led to greater outflow of short-term capital and so worsened the balance of payments." Although other measures have been introduced by both the Federal Reserve and the U. S. Treasury during the Kennedy-Johnson administration, such as currency swaps and foreign-denominated government-security (non-negotiable) issues, this interest-rate increase was the main action taken by the System.

While the objectives of rapidly expanding the money supply and raising interest rates diverge within this context, in their separate effects on the domestic economy they cannot be wholly segregated. For instance, if the coefficient of elasticity of short-term interest rates to changes in the supply of and demand for Treasury bills is very low and the degree of sensitiveness of commercial-loan demand to interest-rate movements is higher, pegging of interest rates during a period of slow business activity results in a moderation or contraction in the growth of bank reserves and ultimately of the money supply. Under these conditions, large net sales of Treasury bills by the Open Market Committee to support interest rates could have an adverse effect on the money supply. Indeed, this has undoubtedly occurred, as there has been no noticeable decline (even seasonal) in the Treasury-bill rate between August 1960 and this writing (January 1965).[3]

If it is further hypothesized that a faster-growing money supply and lower interest rates are more expansionary for the private economy than a slower rate of growth in money and higher interest rates, the monetary authorities may have been violating their goal of assisting economic growth. This is an argument having substantial support among Federal Reserve and academic economists. Consequently, regardless of whether this payments-motivated policy successfully lessens the payments deficit, it may have undesirable effects on domestic business.

Given the constraint of supporting the domestic economy, a massive

[3] See the accompanying chart.

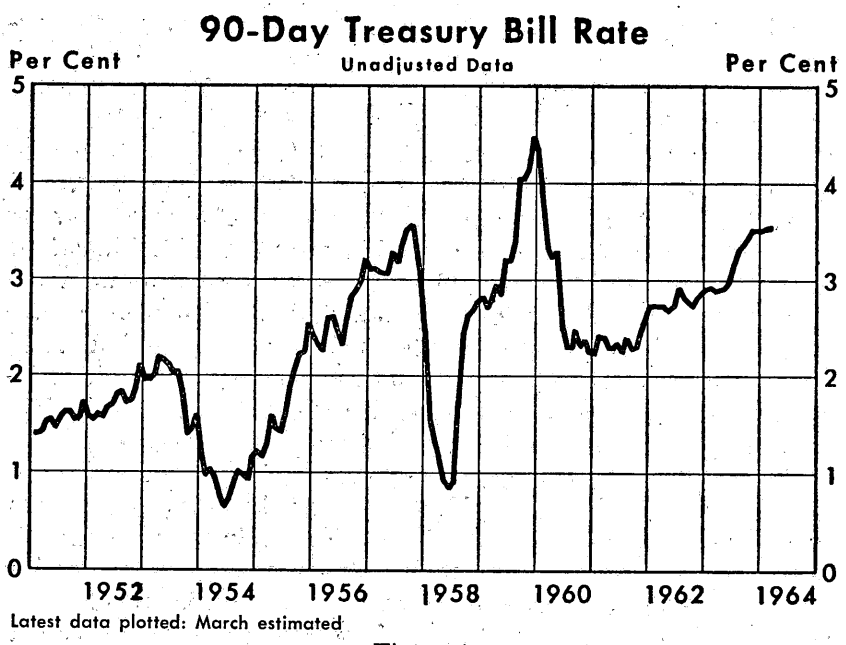

Figure 1

attack by the Federal Reserve could be brought to bear on only one category of payments. Foreign borrowings for trading purposes are related directly to the current account. The restoration of confidence in the dollar (when lacking) through monetary policy could best be accomplished by restrictions that *clearly* forfeit domestic economic expansion.[4] Prospects for reducing the chronic payments deficit then rested with the expected impact of higher short-term interest rates on arbitrage. Thus, our attention will be focused primarily on these short-term movements and monetary policy.

Academic economists, as well as Federal Reserve officials, were confronted with many unanswered questions regarding these short-term capital movements. Suppose the type of capital movements sensitive to interest-rate differences is relatively insignificant. It is possible, for instance, that portfolio or direct investments abroad represent the main cause of disequilibrium in the U. S. balance of payments. Suppose the capital flows which the Federal Reserve and Treasury can in-

[4] Even the sharp British Bank-Rate increase from 5 to 7 per cent on November 20, 1964 was not sufficient to stem speculation against the pound sterling that month.

fluence within relevant interest-rate ranges is even less important in the overall payments picture.[5]

What if the arbitrary increase in the short-term domestic interest rate generates forces which tend to cancel its original intent? Or, what if such an advance tends at times to worsen the payments deficit? Even if a great part of capital movement is demonstrably interest-rate sensitive, pegging of short-term rates may well meet with countervailing forces.

The thesis of this inquiry is that domestic monetary policy was *unnecessarily* constrained by a Federal Reserve-Treasury policy of artificially supporting short-term interest rates between late 1960 and early 1965. While United States business might have benefited from a faster-growing supply of money and lower interest rates, the degree of credit restraint exercised was not sufficient to enforce "balance-of-payments discipline" via the current account, nor to reverse speculation. The failure of monetary policy to curb interest-induced arbitrage and speculation becomes the relevant hypothesis to be tested.

B. OBJECTIVES AND METHOD

The task is not a simple one. The main weakness of earlier studies of capital movements is their lack of a cohesive and coherent theory. As the only identifiable data related to short-term flows through *forward* exchange contracts are forward exchange rates, the initial approach is to develop a theory of the forward market. Because the forward and spot markets are inseparable in both a theoretical and practical sense, this requires formulating a theory of the exchange market.

Thus, short-term capital movements are to be traced through the exchange markets, and in this manner identified by type. In doing so, it is also imperative to state a more general theory of foreign exchange, as exchange-rate variations are functions, in part, of trade and long-term capital flows. The institutional framework for such a model is presented in Chapter II. In this discussion, the institutional motives leading to transactions in foreign exchange are summarized, with special emphasis on short-term capital.

Equilibrium conditions in which capital movements are stabilized are specified in Chapter III. The Keynesian concept of interest-rate

[5] While an average U. S. commercial-loan rate of 20 per cent might seriously discourage borrowing by Canada from the United States, the technical ability of the Federal Reserve and Treasury to raise rates within this "relevant" range is doubtful.

parity is the main tool of analysis. This traditional idea is modernized by bringing its assumptions into closer alignment with the present-day foreign-exchange market. The focus of this section is upon a description of the operation of interest-rate arbitrage and its importance in moderating short-term capital outflows.

With the motivations for capital movements defined and the interest-rate-parity equilibrium updated, the way is clear for the presentation of a dynamic theory of foreign exchange in Chapter IV. The effect of various forms of exchange speculation on exchange rates, including a newly defined concept of "speculative confidence," is contrasted with that of covered interest-rate arbitrage.[6] Speculation and arbitrage are reduced to mathematics, and spot and forward price-determination equations are generated. In turn, relative price movements in the spot and forward markets distinguish the main forces at work in the forward exchange market. These causes of observed price behavior indicate either continued exchange-rate stability or possible instability.

Monetary policy is described throughout as a possible exogenous influence on exchange-price fluctuations, both in terms of its influence on the availability of arbitrage funds and on interest-rate differentials. In Chapter V, the interrelationship between interest-rate changes, short-term capital flows, and the forward exchange rate is analyzed. In a practical policy demonstration it is discovered that the forward exchange rate is not always "well-behaved" when the monetary authorities peg interest rates. Indeed, rather than discourage the outflow of interest-arbitrage funds, the forward rate may move in the "wrong" direction in the face of higher interest rates.

If it is found that the predominant motivation is speculation, including uncovered interest-rate arbitrage and trade-related transactions, the effects of monetary policy are likely to be quite different from the results of the same policy on covered interest-rate arbitrage. There are certain capital movements which, because of their very nature, are not likely to be altered within relevant interest-rate ranges by monetary policy. This is the case with foreign-trade credits. If an examination of the type of capital upon which monetary policy is most likely to exert a substantial effect yields negative results, the efficacy of monetary policy in coping with short-term capital outflows is put to a severe test.

[6] These and other exchange-market terms are defined in a "Glossary of Foreign-Exchange Terms." While many of these items have a commonly accepted meaning, the definitions of some had to be modified or originated for the purposes of this study.

II. MOTIVATIONS AND CAPITAL MOVEMENTS

For an explanation of short-term capital movements we examine the foreign-exchange market. It is necessary to show the characteristics of today's exchange market, to specify the types of exchange transactions, and to identify the motivations of those bank and non-bank firms operating in the exchange market. In this manner it is possible to determine monetary policies most likely to be effective in reducing capital outflows. This also provides an institutional framework for a theory of foreign exchange.

A theory of foreign exchange endeavors to identify the forces behind all foreign-exchange transactions, whether or not they come directly to market. A part of the short-term capital entering the market at any particular time may be attracted by interest-rate differentials between one nation and another.

A. REAPPRAISAL OF TRADITIONAL EXCHANGE CONCEPTS

Three major empirical studies—by Professors Philip W. Bell of Haverford College, Peter B. Kenen of Columbia University, and Benjamin J. Cohen of Princeton University—have been conducted in recent years on the responsiveness of U. S. short-term capital movements to changes in interest-rate differentials.[7] These inquiries have been used as references by policy-makers in the Treasury and the Federal Reserve. While they fail to prove a high elasticity of changes in claims payable in foreign currency to deviations in interest rates, the studies find nonfinancial corporate dollar claims on Canada and Continental Europe to be sensitive to interest differentials. Recorded increases in claims on foreigners comprise short-term capital outflows in the U. S. balance of payments. Conventional theory also supports the view that claims payable in foreign currency are interest-rate sensi-

[7] Philip W. Bell, "Private Capital Movements and the U. S. Balance of Payments Position," *Factors Affecting the United States Balance of Payments,* compilation of studies prepared for the Subcommittee on International Exchange and Payments, Joint Economic Committee, 87th Cong., 2d Sess., 1962, pp. 395-482; Peter B. Kenen, "Short-term Capital Movements and the U. S. Balance of Payments," *The United States Balance of Payments,* Hearings before the Joint Economic Committee, 88th Cong., 1st Sess. Part I, 1963, pp. 153-191. The Cohen Study was completed at the Federal Reserve Bank of New York, and summarized in a memorandum to the Treasury on January 29, 1963.

tive.[8] In the years 1957–1962, about 30 per cent of the recorded short-term capital outflow from the United States is attributed to nonfinancial corporate dollar claims on Canada and Continental Europe plus foreign-currency claims. Thus, it is imperative to determine the motivations for such movements.

Mysterious capital movements and the sometimes eccentric behavior of exchange rates in recent years are not adequately explained by available theories. Peter B. Kenen, in his well-known study of the British balance of payments for 1951-1957, seemed puzzled by the contrast between theory and reality regarding the transfer of short-term capital.

> Certain authors have argued that these controls, and higher interest rates, sharply curbed overseas speculation in 1952, but their position is not supported by the available data. The statistics on bill finance suggest that monetary policy did not much reduce its volume.[9]

Kenen compared this experience with that of United States investment in the United Kingdom during the same period. But this behavior too contrasted with what one might conclude from accepted theory.

> Statistics of United States short-term investment in the United Kingdom are no more satisfying from the standpoint of interest-rate policy. During the first nine months of 1955, interest rates were rising in London. But private traders and banks borrowed $120 million more in London than they lent.[10]

More recently, John H. Auten raised a somewhat different question, but one that again has not been adequately explained by a systematic exchange theory. He observed that a large volume of short-term capital had moved from the United States to the United Kingdom during 1960. If this had been covered interest-rate arbitrage, the forward exchange rate should have declined sharply, under traditional theory. Rather, he argued, "It is generally agreed that, during 1960, movements of capital from New York to London were frequently left uncovered

[8] See Charles P. Kindleberger, *International Short-term Capital Movements* (New York: Columbia University Press, 1937); A. E. Jasay, "Bank Rate or Forward Exchange Policy," *Banca Nazionale del Lavoro Quarterly Review,* Vol. XLIV (March 1958); J. H. Auten, "Monetary Policy and the Forward Exchange Market," *The Journal of Finance,* Vol. XIV (December 1961); Merlyn N. Trued, "Interest Arbitrage, Exchange Rates and Dollar Reserves," *Journal of Political Economy,* Vol. LXV (October 1957).

[9] Peter B. Kenen, *British Monetary Policy and the Balance of Payments, 1951-1957* (Cambridge, Mass.: Harvard University Press, 1960), p. 154.

[10] *Ibid.,* p. 155.

against exchange risks." The reason, he suggests, is that "the practice of covering forward may have been abandoned by some investors simply because the likelihood of sterling devaluation in 1960 seemed quite remote."[11] This is in contrast with accepted doctrine, according to which an investment in foreign bills or certificates is a riskless transaction only if covered (protected) in the forward market.

That same year the Bank of England had attempted to influence short-term capital transfers by varying the Bank Rate. But the Radcliffe Committee discovered that the Bank did not know the impact of Bank-Rate policy upon the foreign-exchange market and upon capital flows.[12]

These unidentified capital flights and the disorganized state of current exchange-market theory has led me to a reexamination of some basic exchange concepts. This investigation may parallel a reorientation of Federal Reserve-Treasury policy. While the main payments weapon of the monetary authorities during 1961, 1962, and early 1963 was the short-term interest rate, Federal Reserve activity in forward exchange contracts has increased substantially since. This tactical change may foreshadow a growing awareness of the reprecussions of arbitrary interest-rate changes upon the forward exchange market. In this discussion, primary emphasis will be placed on United States institutions; that is, the New York money market, American commercial banks, and non-bank firms.

B. THE PARTICIPANTS AND THEIR MOTIVES

First let us consider in detail *who* might move short-term capital through foreign exchange, and their motives. Commercial banks with large foreign-exchange departments and a few foreign-exchange brokers are the risk-bearers in foreign exchange and "make" the foreign-exchange market. The main motive of the 125 U. S. commercial banks engaged in exchange operations is for profits from deposit accounts and loans to firms dealing in foreign exchange. A secondary objective, in the New York money-market center, is profits on large sales of currency. Each of these banks has an inventory of various currencies and maintains at least one account in a bank in the nation of each cur-

[11] John H. Auten, "Forward Exchange Rates and Interest-Rate Differentials," *The Journal of Finance,* Vol. XVIII (March 1963), p. 17. See also Bank of England, *Quarterly Bulletin,* Vol. I (December 1960), p. 9: *Federal Reserve Bulletin,* Vol. XLVII (August 1961), pp. 891-892.

[12] Committee on the Working of the Monetary System, *Minutes of Evidence* (London: HMSO, 1960), para. 3215-3219 and 1479-1490.

rency. With such balances, the banks are able to expedite the conversion of one currency into another.[13]

As a consequence of these banking arrangements, important spot and forward exchange markets now exist in London, New York, Montreal, Toronto, Frankfurt, Paris, Zurich, Amsterdam, and Brussels. Of these, London is by far the most significant, while Toronto may well have the second largest forward market for U. S. dollars.

Financing Imports-Exports

The *demand* for foreign exchange originates primarily from the financing of trade. At some point in the trading process, payments from a country usually require the conversion of one national currency into another. Many of these transactions are canceling, and take place only on the balance-sheets of commercial banks. Buying and selling orders by customers of the same bank are often "married," and only the difference (or balance) between them comes to the market. None the less, the total quantities demanded and supplied may lead to excess supply or demand in the market.

There are several ways of settling international import-export accounts. The exchange of money for goods may be for cash at the time of sale. If a foreign currency is required in the transfer, it is purchased in the spot market. On the other hand, payment may be for some future date, say 90 days. During any interval between purchase and payment, the price of foreign exchange (value of foreign currency in home-currency units) may change so that the merchant's loss or gain in terms of the currency alone may exceed his loss or gain on the traded commodity. The trader can avoid the risk of exchange-price fluctuations by appropriate dealings in the forward exchange market.

Whereas transactions in spot exchange are for cash (one currency being exchanged for another), a forward contract is for the comple-

[13] In the following exposition of exchange-market concepts, the author relied primarily on the writings of Paul Einzig and Jerome Stein for background reading. Wherever specific credit can be given, sources are cited. However, in general this discussion is an uncharted excursion into the merger of theory and practice. For its practical aspects, the author benefited from discussions with the export-import credit managers of several companies, the foreign-exchange departments of several companies, the foreign-exchange departments of some commercial banks, and economists of the Treasury, Federal Reserve System, and other central banks. The author is indebted to William Bryan, Senior Economist at the Federal Reserve Bank of St. Louis, for some stimulating discussions on this topic. In addition to editorial and substantive criticism from Dr. Bryan, similar assistance was received from Professors Irvin Sobel and Edward Greenberg at Washington University.

tion of a spot deal at a later date.[14] The price of forward exchange may be either higher or lower than the spot price, although more often it is lower in the low-interest-rate nation. As long as the difference is small in percentage terms the trader can be protected from currency-price changes by puchasing or selling a forward contract. Such transactions are ordinarily handled by the importer's bank.

Traditional theory has the importer of French dresses, for instance, *always* buying French francs to pay for the fashions. But an importer in a key-currency nation, such as the United States or Great Britain today, finds his dollars or pounds acceptable to the Frenchman. In turn, it is the responsibility of the "foreigner" to sell the dollars or pounds for francs, unless he wishes to hold the key currencies. In like manner, the United States exporter or importer, theoretically, covers all his transactions for future payment or delivery. In commerce with relatively stable currencies, however, most U. S. commercial traders find such "insurance" unnecessary. In the early 1960's, covering by either U. S. exporters or importers was negligible. But covering by those trading with the United States was quite common.[15]

Simplified Import-Export Equations

These import-export transactions can be expressed within a simple framework. Let us assume that the supply of spot foreign exchange has a one-to-one relationship to the dollar volume of domestic exports, and the supply of forward foreign exchange bears an identical relationship to exports for future delivery. While not a necessary condition, for simplicity net direct foreign industrial investment, net long-term portfolio purchases and sales, and net military and foreign-aid expenses are disregarded at this point.[16] Prices in both the spot and forward markets are presumed to be market-determined. Assuming the home currency to be a key one, covering by domestic exporters and

[14] Two days are normally allowed for delivery of spot exchange.

[15] This was strongly affirmed by heads of foreign-exchange departments of commercial banks and foreign-credit managers of several large firms, who were interviewed during the early stages of this study.

[16] In this discussion, exports and imports are defined as merchandise and non-financial service exports-imports. Empirically, the dollar volume of exports in the spot market also would include net direct investment in the home country by foreigners plus net domestic long-term bond and stock (common stocks assumed long-term by definition rather than by any date of maturity) purchases by foreigners. The dollar volume of imports in the spot market also would include net military and foreign-aid expenditures by the home nation, plus net direct investment by domestic businessmen abroad, plus net transactions in long-term foreign bonds and stocks by foreigners.

importers is negligible. Initially, there is no official intervention in the exchange market by monetary authorities. Furthermore, there are no speculative or arbitrage operations, and the three-month contract is the only "futures" offering.

Letting the following be our symbols,

X = Dollar volume of domestic exports
M = Dollar volume of domestic imports
Qd = Quantity of foreign exchange demanded
Qs = Quantity of foreign exchange supplied
x = Spot foreign-exchange rate
y = Three-month forward exchange rate
t = The current month

the identities for the spot exchange market then become,

$$\text{(II.1)} \qquad Qd(t) = M_t x_t + M_{t-3} y_{t-3}\,, \qquad Qs(t) = X_t\left(\frac{1}{x_t}\right) + X_{t-3} y_{t-3}$$

The reciprocal of the foreign spot price is the exchange rate in the foreign nation.

The forward exchange equalities are,

$$\text{(II.2)} \qquad Qd(t) = M_{t-3} y_t\,, \qquad Qs(t) = X_{t-3}\left(\frac{1}{y_t}\right)$$

As forward transactions at maturity augment spot demand and supply, the forward market is the thinner one. Hence the forward market is more price-elastic than the spot.[17]

Both markets are in equilibrium when spot imports equal spot exports, maturing forward import contracts equal maturing forward export contracts, and future scheduled imports equal future exports. These conditions yield the following equations.

(II.3) Spot Equation:

$$M_t x_t + M_{t-3} y_{t-3} = X_t\left(\frac{1}{x_t}\right) + X_{t-3} y_{t-3}$$

[17] The greater price elasticity of the forward market is assured by the conditions, $M_t > M_{t+3}$. Letting the demand for exchange in each market equal functions of prices, $M_t = \theta x_t + \alpha y_{t-1}$ and $M_{t+3} = \alpha y_t$. It is known that the forward prices are similar during a normal period and the proportion of forward contracts maturing is a very small per cent of total spot exchange. Thus, it can be assumed that $y_{t-3} = y_t$ and $\theta > \alpha$. Price elasticity in each market would be, $\eta_x = -\theta x_t / M_t$ and $\eta_y = -\alpha y_t / M_{t+3}$. The difference, $(M_t - M_{t+3})$ equals θx_t and the difference in numerators equals $(\theta x_t - \alpha y_t)$. Since $(\theta x_t) > (\theta x_t - \alpha y_t)$, $\eta_y > \eta_x$.

(II.4) Forward Equation:

$$M_{t+3}y_t = X_{t+3}\left(\frac{1}{y_t}\right)$$

Thus, if there were no speculation, interest-rate arbitrage, or exchange arbitrage, under perfect competition the purchases of the home currency by foreign commercial traders would equal the purchases of foreign currency by the domestic importers-exporters. The foreign-exchange market and the balance of payments would be in equilibrium.

During a so-called "normal" period, there is confidence in the stability of a given set of spot and forward rates. When exchange-rate variations occur, the market expects them to be eliminated rapidly, as any surplus or deficit in the balance of payments is presumed ephemeral.[18] Under such conditions, there is an inverse relationship between the spot price of a foreign currency and its forward premium. Importers in foreign nations will purchase spot dollars as required for current trade, and on delayed transactions will simultaneously cover by selling an identical amount of their exchange forward. On delayed deliveries, foreign exporters at the time of the trade will sell forward an identical amount of the trading partner's currency.

During periods of relative stability, temporary exchange-rate fluctuations are unlikely to alter the volume of trade between one country and another. Moreover, under current International Monetary Fund provisions, spot exchange rates of member nations are allowed to fluctuate only within a specified range. In most member nations this range is ¾ to one per cent either side of a stated par value of the currency.[19]

Thus, in equations one and three, the spot exchange rate (x) becomes a constant at the upper and lower support limits. Since World War II most *forward* markets have been relatively free.

In order for such minor exchange-rate variations to affect the balance of trade, import-export commodity demand would have to be

[18] This definition of a normal period is presented by Jerome Stein, *The Nature and Efficiency of the Foreign Exchange Market,* Essays in International Finance, No. 41 (Princeton University, International Finance Section, March 1963), p. 28. It also appears to be the implicit definition employed by Paul Einzig, *A Dynamic Theory of Forward Exchange* (London: St. Martins Press, 1961).

[19] These par values, which are expressed in terms of the price of gold, can be changed by agreement of the member nations of the International Monetary Fund. The nation seeking such a change must show that it is suffering a "fundamental disequilibrium."

highly price-elastic. But there are numerous advantages to purchasing domestically produced products. Those goods and services demanded through foreign trade are usually either not obtainable in the home market or have a *substantial* price advantage (or quality differential) over domestic substitutes. This suggests that the physical volume of imports-exports is not *highly* elastic to price alterations.[20]

In the Netherlands, for instance, the price of the guilder varies only between 3.5484 and 3.6916 U. S. dollars in the spot market. For some purposes, as we shall see, this is a wide range. But, unless devaluation or revaluation is expected, divergence within this span is unlikely to affect the volume of trade between the United States and the Netherlands.

Suppose the guilder appreciates the entire range from 3.5484 to 3.6916 dollars. That is, the dollar *depreciates* to its lower support level. A Dutch importer of $20,000 worth of farm machinery could pay for it with 220 less guilders than before. But this is a savings of less than 4 per cent for the Dutch purchaser—not much more than transatlantic shipping costs. Even if the coefficient of price elasticity were as high as unity, this exchange-rate decline would advance the quantity of United States farm machinery purchased by only 4 per cent.

Because trade is unresponsive to these moderate exchange-rate changes, continued pressure on the dollar may hold it near the lower price for long periods. This, in turn, may require purchases of dollars by foreign central banks, leading to gold sales by the U. S. Treasury and to the loss of U. S. reserves. In practice, this dollar depreciation may be the consequence of "political imports" rather than of rising private commodity or service imports. A nation that makes foreign-aid or military grants abroad is importing IOU's upon which no collection is to be imposed. Such transactions by the United States can lead to greater exports of dollars than imports of the foreign currency.

Thus, so long as the par values of two currencies are fixed, the physical volume of private exports-imports is not likely to vary with changes in the exchange rate. A sharp devaluation or revaluation of either currency is likely to cause a once-and-for-all modification in the volume of exports-imports between the two nations, creating an effect

[20] Traditional economic theory derives the demand functions for imports by subtracting home supply from home demand. Thus the demand for imports is "excess demand," and has a greater price elasticity than domestic demand. Such a theory assumes that the coefficients for the determinants of import-merchandise demand (price, income, wealth, taste, etc.) are identical to those for the same determinants of home-merchandise demand. The author's argument is simply that they are not.

similar to that of a substantial commodity-price change. Hence in the absence of speculation or arbitrage, the price of foreign exchange (exchange rate) within the *stabilization limits* is determined by the ratio between the dollar volume of private merchandise and nonfinancial service imports and exports (M/X).[21] Thus, although the physical volume of trade is in part a function of the exchange rate, in any individual experiment the spot rate (x) can be assumed to be constant in an equation expressing such a relationship.[22]

The conclusion that a fairly fixed exchange rate precludes alterations in the pattern of trade is neither new nor surprising. But, this dramatizes the importance of a timely restructuring of par values of currencies which are over- or undervalued. For without these substantial downward or upward adjustments, a member nation's trade and capital movements will continue to be in disequilibrium, unless it swallows the bitter "classical medicine" of depressing national income.

In the real world, of course, sales and purchases of domestic or foreign securities, direct industrial investment abroad, and long-term banking loans between nations often give rise to a demand for and supply of foreign exchange. Moreover, in the special case of the United States, large foreign military and economic-aid expenditures may enter the exchange market. All those transactions giving rise to a demand for foreign exchange could be summed under "imports" and those giving rise to a change in supply under "exports," remembering that the quantity of domestic currency demanded by foreigners *is* the supply of foreign exchange.[23]

Going a step further, if it is assumed that all such dealings enter the spot exchange market, these entries would become a portion of the ex-

[21] If, for example, the U. S. dollar and the British pound had the same par values (in terms of gold) and U. S. exports to and imports from Great Britain were equal, the foreign-exchange rate would equal $1.

[22] In a theoretical market experiment the price is the dependent variable to be determined by the quantities demanded and supplied, whereas in an individual experiment the price is given and quantities demanded and supplied are the dependent variables. Ordinarily, the market experiment is an aggregation of individual experiments.

[23] It is an easy matter to confuse transactions which give rise to exchange demands with those which alter supply. For instance, import fluctuations are largely a function of variations in domestic income levels while increased purchases of foreign securities by domestic investors are in great part a function of rising income or profit levels in the *foreign* nation. Yet, in terms of the influence of such dealings on the price of foreign exchange, both tend to advance the spot price, inasmuch as foreign currency is purchased for both imports and foreign securities.

port-import ratio. But, almost without exception, transactions in long-term securities, long-term bank loans, foreign aid, and direct investments do not enter the *forward* exchange market. Consequently, if the main points of concern are (a) the formulation of a theory of the *forward market* and (b) the flow of *short-term capital,* these dealings can be viewed as disturbances to a system that otherwise excludes them. At the same time, this approach has the inescapable merit of simplicity, while isolating short-term capital movements in the forward market. Thus, in a theoretical sense, imports and exports continue to be viewed as commodity and nonfinancial service items.

Speculation

In practice, the export-import equilibrium will be disturbed by trade barriers and other imperfections. When this occurs—even temporarily—there tend to be compensating short-term capital transfers, as well as exchange-rate changes. These movements are characteristics of either a theoretical model of a free exchange-rate system or of the regulated gold-exchange mechanism.

Commercial traders often adopt at least two other roles—when the exchange-rate fluctuates temporarily (during normal periods) and when the market expects a change in the "normal" set of prices (*abnormal periods*). They take on the roles of "hedgers" and "leaders and laggers." In abnormal periods, a balance-of-payments deficit or surplus is expected to be long-term at current exchange rates; there may or may not be pure speculation in foreign currencies.[24] If companies have large holdings of a currency, either at home or abroad, they may sell some quantity of it forward to offset in part any devaluation of its assets. This hedging is distinct from a complete covering operation.

Commercial ventures also give rise to leads and lags in *payments* as a consequence of either good business practice or outright speculation. If the foreign currency is believed strong, that is, if it appears that its price in terms of the domestic currency is rising, domestic importers may accelerate their purchases of spot exchange, while domestic exporters will tend to postpone spot sales. The domestic importer may develop a long position in the foreign currency. This may be considered prudent business practice, but it is a passive speculative position

[24] Pure speculation is defined as the deliberate assumption or retention of a net open position in foreign exchange in order to make a predicted profit through expected change in the spot rate. While Jerome Stein describes the abnormal spot rate as one of "speculation," it is argued in a later section of this study that an abnormal period can develop in the absence of *pure speculation.*

since the spot purchases are not fully covered.[25] Also, foreign importers' sales forward will usually be of an increasing maturity. The foreign exporter will either not cover or do so at a lesser maturity. This type of speculation is common among holders of foreign claims and liabilities.

Thus it is necessary to modify the simple export-import equations. If the leading and lagging of exporters-importers is based on the *expected* future exchange price, the supply and demand of exporters and importers (X and M) must be altered by some function of the anticipated future price (x^*_{t+1}). Letting beta be a constant greater than one, this change would equal $\beta(x^*_{t+1} - x_t)$. Thus, if the expected price is higher than the current market rate, in the spot market M would rise by this amount and X would fall by this quantity.

Assuming that the quantities of maturing contracts (M_{t-3} and X_{t-3}) are equal, the equations for the spot market become:

$$\text{(II.5)} \quad Qd(t) = M_t + \beta(x^*_{t+1} - x_t), \qquad Qs(t) = X_t - \beta(x^*_{t+1} - x_t).$$

These conditions would be expressed in the forward market as:

$$\text{(II.6)} \quad Qd(t) = M_{t+3} - \beta(x^*_{t+1} - x_t), \quad Qs(t) = X_{t+3} + \beta(x^*_{t+1} - x_t).$$

In reality, even though the total dollar volume of exports and imports may be insensitive to "moderate" exchange-price changes, the *quantity* of exchange demanded and supplied is not. Hence, as a consequence of the propensity of traders to engage in leads and lags, exchange variations lead them to vary their demand for foreign exchange.

If domestic owners of foreign currencies expect a foreign currency to be devalued or to depreciate, they may accelerate their sales of that currency and increase their inventories of another in order deliberately to make a profit in the devaluation or depreciation. In any case, it is difficult to distinguish between leading and lagging by importers-exporters and outright speculation during abnormal periods, just as it is difficult to distinguish between speculation and sound business practice by commercial banks.

The important consideration is that firms do have a speculative motive and speculation from any source can cause wide movements in free forward exchange markets in important foreign money centers. Such price gyrations are not subject to the restraints imposed directly upon

[25] Passive speculation is defined as an uncovered exchange position ancillary to some transaction other than pure speculation.

the spot market by the requirements of the International Monetary Fund.

Interest-Rate Arbitrage

Large non-bank firms engage in interest-rate arbitrage when interest-rate differentials are favorable for profit-making. Insurance and oil companies, industrial giants with international markets, and shipping firms engage in *active* interest-rate arbitrage. Since arbitrage is usually profitable solely on a very large scale, only firms with large liquid reserves (demand deposits, cash, and U. S. Treasury bills) can normally participate.

In dealing with nations without exchange restrictions on investments in credit instruments, commercial banks, such as the larger New York City banks, are sometimes tempted to engage in interest arbitrage. Earnings from the securities of such countries can be converted into the home currency.

Active interest-rate arbitrage by the non-bank firms (mostly non-financial firms) can take two forms. When interest differentials are favorable, such firms can purchase foreign Treasury bills for their higher net yields. This is active interest-rate arbitrage in the form of an investment. If the *covered* differential becomes extremely large (perhaps 1.5 to 2.0 per cent), commercial banks are likely to step up their interest-arbitrage operations. The converse to short-term investing is short-term borrowing.

Both investing in Treasury bills and borrowing from commercial banks are acts of risk-avoiders, as long as all their deals are covered in the forward market. If these transactions are not covered, the motive for investing or borrowing overlaps with a speculative one.

During speculative periods when non-bank firms accumulate uncovered holdings of a foreign exchange with the expectation of either appreciation or revaluation, we sometimes say they are engaged in "exchange arbitrage." Again, however, if such accumulations go uncovered, it is a form of pure speculation and the term "arbitrage" is inappropriately ambiguous.[26]

Large non-bank domestic companies with branches or affiliates abroad practice direct, *passive* exchange arbitrage in addition to ac-

[26] True exchange arbitrage occurs in an almost simultaneous three-way transaction wherein exchange dealers observe a profit opportunity in a temporary difference in exchange rates between two currencies in terms of a third. This arbitrage tends to equalize the exchange value of one currency and a second against the price of a third.

tive interest-rate arbitrage. The home office of such firms passively accumulate the liquid reserves of branches or affiliates with higher-valued currencies, with the exchange risk covered. They make their profits by failing to undo their commitments. Quantitatively, passive arbitrage volume is minute.[27]

C. SUMMARY

In defining the causes of short-term capital flows it is useful to know the institutional motives prompting purchases and sales of foreign exchange. The essential motives can be classified as three; (a) to finance exports and imports, including forward sales and purchases for the protection of commitments in particular currencies; (b) to gain profits from speculation against the future expected value of a currency; (c) to gain an extra profit differential through interest-rate arbitrage. The first two normally are inducements for non-bank firms only, while the latter is sometimes a motive of commercial banks.

Under prevailing international arrangements the spot price of foreign exchange within the stabilization limits is primarily determined by the relationship of merchandise and nonfinancial service exports to imports. This holds true so long as there is no speculation or arbitrage, and net direct investment, military and aid expenditures, and portfolio investment are held constant. In any individual study specifying the determinants of the volume of imports demanded and exports supplied, the spot rate can be assumed to be unchanging. This is contrary to the free exchange-rate system. On the other hand, if speculation and arbitrage are highly elastic to rate changes, a relatively fixed exchange-rate system often would generate substantial short-term capital movements without bringing about adjustments in trade patterns.

[27] In the case of U.S. branches or affiliates, it is virtually impossible to obtain a qualified credit manager for such offices or factories. It is considerably more difficult to place a foreign-exchange expert abroad for the purpose of "dealing" in the market. Moreover, the primary goal of most nonfinancial firms is to market and sell a commodity or service in their foreign operations, not to gain profits from exchange manipulation.

III. KEYNES' PARITY VERSUS THE MODERN EXCHANGE MARKET

If certain short-term capital flows are sensitive to interest-rate differentials, it is useful to define an equilibrium condition in which these movements must cease. As such capital outflows are usually dependent upon differences in spot and forward rates as well as the spread between foreign and domestic interest rates, an equilibrium position would be achieved wherever the relationship among these variables induces no outward or inward capital flows. Such stability is assured by Keynesian "interest-rate parity," a concept which is extremely useful in determining whether capital flows are stabilizing or destabilizing.[28] This parity concept will be defined and reviewed, and its assumptions will be matched against present-day reality.

In an uncertain (or even certain) world the spot rate of exchange is not determined simply by the relationship of imports to exports. A significant force on both the spot and forward exchange rates, in addition to speculation, is the movement of short-term capital for the purpose of interest-rate arbitrage. Relative movements of these exchange prices will vary according to whether the arbitrage is uncovered or covered in the forward exchange market. In turn, if stability in the flow of short-term capital is envisioned as the achievement of Keynesian interest-rate parity, the nature and magnitude of this arbitrage can be either stabilizing or destabilizing.

The validity of the interest-parity doctrine rests on the assurance that arbitrage funds will flow out of the deficit country and into the surplus country. In the absence of intervention in the forward exchange market, a policy of raising domestic interest rates to curb covered-interest-arbitrage outflows will be successful only if the forward exchange rate is "well-behaved." But, using the interest-parity concept, the forward rate will move in the proper direction only if the authorities are *unsuccessful* in stopping outward capital movements. Thus, as will be demonstrated more precisely in a later chapter, an arbitrary advance in the Treasury-bill rate is likely to generate forces to offset the original intent of the authorities. Indeed, the in-

[28] See John M. Keynes, *A Tract on Monetary Reform* (London: Macmillan and Co., 1923), pp. 115-139. This is the first instance, in the literature, in which forward exchange theory is expounded clearly.

centive for short-term capital outflows may be increased. In this event, the monetary authorities would at best accomplish nothing, and at worst possibly damage the domestic economy and increase any payments deficit.

A. THE INTEREST-RATE-PARITY CONCEPT

Keynes' well-known interest-rate-parity concept simply states that "funds available for short-term investment will be placed in that money market which yields the greatest return." The difference between the spot and forward exchange rates is a measure "of the preference of the money and exchange markets for holding funds in one country rather than another."[29] All else being equal, the interest rate on money lent or deposited for short periods in the money markets of any two nations would be the primary factor attracting or repelling funds.

If the interest rate were higher abroad than at home, arbitrage covered in the forward market would continue until the "covered" foreign interest rate equaled the domestic rate of interest. Thus, capital movements between two countries through interest-rate arbitrage would bring about an appropriate relationship between (a) the spot and forward rate differential in each country and (b) short-term interest-rate spreads between these two money centers. Clearly, the arbitrage operation is the equilibrating force.

Suppose the spot and forward exchange rates for the French franc from the standpoint of the United States are very similar, the forward rate being slightly below the spot. The cost of covering forward is then negligible. Suppose, at the same time, the interest rate on French 90-day Treasury bills is 3 per cent per annum, while the U. S. Treasury-bill rate is 2 per cent. Also, by lending dollars in New York for 3 months the lender can earn only 3 per cent per annum; by lending francs in France for a similar period he can earn 4 per cent.[30]

As long as the forward discount on the French franc is less than one per cent, United States firms can purchase, and cover, French Treasury bills for a higher net yield than U. S. bills. On the date of the purchase the American investor would purchase francs with dollars for

[29] *Ibid.*

[30] In practice, since the New York money market is the most highly developed, largest, most efficient, and most accessible in the world, and because there is a favorable political climate in the United States, borrowers are attracted in spite of higher rates than those prevailing elsewhere and lenders in spite of lower rates. The London market today would rank second, using the same criteria.

the amount of the transaction. To insure the higher return, he would *sell* an equal sum of francs for dollars in the forward market. This simultaneous purchase and sale of foreign exchange of different maturities enables the investor to cover his position. If the *covered* differential widens even more, a growing number of commercial banks are likely to invest in foreign bills.[31]

If one *borrows* in a foreign market for, say, 90 days, he may be repaying a different sum as a result of exchange-rate changes. During normal times he will be uncertain as to whether the repayment will be greater or less than the original loan. Thus a Frenchman borrowing from a U. S. commercial bank will buy francs in spot exchange with the loan. At the same time he will purchase an equal sum of dollars forward for delivery in 90 days as assurance that he will have the appropriate value in dollars for repayment. Most likely, he will sell francs on credit for the dollars. This is the process of borrowing in a foreign country when that country has a lending rate lower than the domestic rate, with the exchange risk covered.

The interest-rate-parity concept can be expressed in notation form. Let:

u = Domestic 90-day Treasury-bill rate per annum
v = Foreign 90-day Treasury-bill rate per annum
x = Spot foreign-exchange rate
y = Forward foreign-exchange rate, 90-day contract.

Interest-rate parity is assured when,

$$365\left(\frac{y-x}{x}\right) = (u-v). \tag{III.1}$$

If

$$\left|365\left(\frac{y-x}{x}\right)\right| < |u-v|,$$

[31] It appears that slow-growing non-bank firms have more funds available for exchange arbitrage than commercial banks or faster-growing nonfinancial firms. If an aggressive chemical firm is experiencing rapidly expanding markets, most of its surplus will be plowed back into the financing of new plant and equipment expenditures. Its opportunity costs are highest in developing its own products. Lower opportunity costs in slower-growing industries help to explain the important role in recent years of oil and shipping firms in the arbitrage field. Non-bank service firms, such as larger insurance corporations, by their very nature usually have large reserves for investment or speculation in the money markets. In short, the foreign-credit manager of a large, slow-growing non-bank firm will probably be first to take advantage of profit opportunities arising from interest differentials. Commercial banks are likely to be a lesser influence in the market. This observation is supported by the large increases in claims on foreigners by nonfinancial firms in recent years.

with $x > y$ and $v > u$, there will be outward arbitrage and capital will flow abroad, tending to raise the forward discount on the foreign currency. Downward pressure on the forward rate is a consequence of the rising supplies of foreign currency entering that market. The home currency is sometimes said to be "overvalued."

If

$$\left|365\left(\frac{y-x}{x}\right)\right| > |u-v|,$$

with $x > y$ and $v > u$, there will be inward arbitrage and capital will flow into the home country, tending to reduce the forward discount on the domestic currency.[32]

The equilibrium condition can be described by the relationship of interest rates and exchange rates between Canada and the United States on Valentine's Day, 1963. The Canadian bill rate was 3.66 per cent per annum and the U. S. bill rate 2.92 per cent, leaving an uncovered spread in favor of Canada (—) of 0.74 per cent. However, the spot foreign-exchange rate was $0.92750 per one Canadian dollar and the forward rate $0.92578, thus yielding a forward discount of —0.74 per cent per annum. With the cost of forward exchange equal to the interest-rate difference, there was no interest-rate differential between Canada and the United States with the exchange risk covered.

On the next day the U. K.-U. S. bill-rate spread favored the United Kingdom by 0.74 per cent. With the spot rate for pound sterling at $2.8030 and the forward rate at $2.7983, there existed a covered-interest-rate differential of .25 per cent favoring the flow of arbitrage capital into the United States. Interest-rate parity was not achieved, the discount on forward sterling being more than sufficient to offset the bill-rate spread which favored the United Kingdom. Relative to the U. S. dollar, one would say the pound sterling was weak that day.

While these are illustrative days, it must not be concluded that, ideally, interest-rate parity is a normal daily event. The achievement of "equilibrium" in United States-Canadian exchange relations on Valentine's Day is no more significant than the choice of that holiday. Rather, it is only expected that over a period of months the average covered differential is not very great. In the literature, one-half of one per cent is most frequently deemed the minimum to induce interest

[32] Henceforth, the difference between the forward and spot rates $(y - x)$ is understood to be expressed in per cent per annum terms. That is, $(y - x)$ equals $365[(y - x)/x]$.

TABLE 1

SHORT-TERM INTEREST-RATE DIFFERENTIALS WITH FORWARD COVER, SELECTED COUNTRIES

(Per cent per annum)

	1961			1962				1963
	II	III	IV	I	II	III	IV	I
Canada vs. United States								
U.S. Treasury-Bill Rate	2.32	2.32	2.48	2.74	2.71	2.86	2.80	2.90
Canadian Treasury-Bill Rate	3.06	2.50	2.59	3.10	3.64	5.22	4.05	3.63
Differential	−.73	−.18	−.11	−.36	−.93	−2.36	−1.25	−.73
Premium or Discount (−) on forward (3-month) Canadian Dollar	−.42	−.02	.20	−.02	−.73	−2.03	−.72	−.75
Differential, with cover	−.31	−.16	−.31	−.34	−.20	−.33	−.53	.02
France vs. United States								
U.S. Treasury-Bill Rate	2.32	2.32	2.48	2.74	2.71	2.86	2.80	2.90
French Treasury-Bill Rate	3.79	3.58	3.57	3.57	3.83	3.53	3.51	3.43
Differential	−1.47	−1.26	−1.09	−.83	−1.12	−.67	−.71	−.53
Premium or Discount (−) on forward (3-month) French Franc	−.59	−.64	−.43	−.36	−.55	.02	.13	−.19
Differential, with cover	−.88	−.62	−.66	−.47	−.57	−.69	−.84	−.34
United Kingdom vs. United States								
U.S. Treasury-Bill Rate	2.32	2.32	2.48	2.74	2.71	2.86	2.80	2.90
U.K. Treasury-Bill Rate	4.45	6.14	5.57	5.21	4.00	3.79	3.71	3.56
Differential	−2.13	−3.82	−3.09	−2.47	−1.29	−.93	−.91	−.66
Premium or Discount (−) on forward (3-month) Pound Sterling	−2.48	−3.95	−2.66	−2.37	−1.04	−.62	−.42	−.98
Differential, with cover	.35	.13	−.43	−.10	−.25	−.31	−.49	.32
West Germany vs. United States								
U.S. Treasury-Bill Rate	2.32	2.32	2.48	2.74	2.71	2.86	2.80	2.90
German Call-Money Rate	2.85	2.68	2.70	2.24	2.77	2.85	2.79	3.36
Differential	−.53	−.36	−.32	.50	−.06	.01	.01	−.46
Premium or Discount (−) on forward (3-month) Deutsche Mark	1.94	1.38	.83	.78	.37	.66	.51	.04
Differential, with cover	−2.47	−1.74	−1.15	−.28	−.43	−.65	−.50	−.50

Note:

All figures are average rates per annum. Treasury-bill rates are averages of daily or weekly rates while forward-exchange premiums on discounts are computed from average monthly rates. Any divergencies because of differences in averaging are insignificant.

Source:

International Monetary Fund, *International Financial Statistics* data, with calculations as shown.

arbitrage.[33] With the development of the Eurodollar market, however, most analysts argue that a much smaller differential, perhaps one-sixteenth of one per cent, is sufficient to move dollars to London to be loaned elsewhere.

B. UNITED STATES EXPERIENCE, 1961-1962

The accompanying table (1) of short-term interest differentials for Canada, France, the United Kingdom, and West Germany for a selected, recent period indicates that, on the average, interest-rate parity was seldom attained for the United States. Specifically, in the fourth quarter of 1962 the U. S. investor could have gained, on the average, 0.53 per cent per annum (minus any difference in bankers' commissions) more on Canadian Treasury bills than on U. S. bills with the exchange risk apparently covered.

In reality these are, of course, not the only interest differentials. There are interest-rate differences between domestic and foreign time deposits, loans of various maturities, demand deposits, and bankers' acceptances. None the less, because of the high mobility of intranational funds, borrowing (bank loans, etc.) rates or investing (Treasury bills, etc.) rates of similar maturities tend to cluster.

C. THE UNSTATED ASSUMPTIONS OF PARITY

Behind this parity concept are several assumptions, most of which are frequently left unstated and some of which are insignificant anyway. In any case, they need to be re-examined.

1. Only two countries are involved.
2. The Treasury-bill rate in each nation is a proxy variable for all 90-day rates, including the lending rates.
3. The only maturity traded in the forward market is the three-month contract.
4. The spot market is defined as the current market for exchange. Although delivery is normally after two days, to consider the spot market a short-term "futures" market is to complicate the analysis unnecessarily.
5. The transactions cost of exchange (service charge) is negligible or canceling between the two countries.
6. The spot exchange rate is allowed to fluctuate only within a certain predetermined range, a movement at times quite wide in terms of per cent per

[33] See John Spraos, "The Theory of Forward Exchange and Recent Practice," *The Manchester School of Economic and Social Studies*, Vol. XXI (May 1953), p. 95; and Paul Einzig, *A Dynamic Theory of Forward Exchange* (London: St. Martins Press, 1961), p. 274.

annum. Under the old gold standard and in Keynes' exposition of interest-rate parity, the extremities of such movements were determined by the gold export and import points. Under present institutional arrangements in the United States, the monetary authorities willingly lose reserves in order to support the lower exchange value of the home currency (dollar).

7. The supply of arbitrage funds is sufficient to achieve interest-rate parity. By definition, the supply of funds is "sufficient" if interest-rate parity is achieved through the flow of short-term capital.

8. There are no exchange restrictions, and no expectations regarding the future imposition of retroactive controls.

9. The probability of devaluation or revaluation of either currency is zero.

10. The political climates in both nations are equally favorable for the transfer of funds.

Taking these conditions in turn, we find one through six to be fairly realistic today. Furthermore, during normal times traders will believe the probability of changes in the relationship of a particular currency to gold to be very low.

Interest-rate arbitrage between more than two nations is a highly complex operation. Thus, triangular interest arbitrage is believed to be minimal during normal times, although it undoubtedly can become important during certain periods of excessive speculation. Three-way transactions through the Eurodollar market have increased since about 1961. Despite this, given the other assumptions, interest-rate parity will tend to be sustained in all three markets. Thus, the two-nation restriction is not a severe one.

Differences between investing (Treasury bill) and borrowing (bank loan) rates in any country will at times lead to more investment than borrowing arbitrage, and vice-versa. The important consideration is that both types of arbitrage tend to affect the forward exchange rate in the same direction. Hence, if one is concerned only with interest-rate parity, the inducement for arbitrage is irrelevant as long as "sufficient funds" are available for lending *or* borrowing.

The supposition of a 90-day forward market is a reasonable one. Very few exchanges have a viable market for longer maturities. The next most common "futures" are for 30 days, but quotations are available in only a few exchanges. Judging from the frequency of dealings in 90-day forward contracts, therefore, this traditional assumption is both useful and realistic.

The Availability of Arbitrage Funds

The availability of funds for arbitrage purposes is the qualification

most frequently added by recent writers on foreign exchange.[34] On the lending side (bank loans), availability of credit is limited not only by the excess reserves of commercial banks but by opportunity costs to the banks.[35] On the investment side (Treasury bills), arbitrage funds are provided by the excess liquidity of both non-bank firms and commercial banks.

Irrespective of whether or not a nation is experiencing payments difficulties, there are institutional restraints on interest-rate arbitrage which come into play long before any overt action is taken by the monetary authorities. Central banks augment these restraints through moral suasion, if by no other device. Central bankers in developed nations are continually decrying the "unsoundness" of such arbitrage. After a short lag during which firms mobilize their funds, capital flows in response to interest differentials may be quite large. But sensitiveness is likely to diminish rapidly as the most volatile funds are expended. In explaining such movements in Great Britain, A. E. Jasay has stated:

> As Arbitrage is riskless, its responsiveness to the extra net yield is, at first, likely to be extremely high. A small rise in the forward sterling rate, lifting it from just below interest parity to just above it, should transform a large outflow (Hedged Lagging) into a large inflow (Inward Arbitrage) of dollars into the reserves. However, after the most mobile international funds have moved, any further inflow may require a successively narrower forward discount relative to interest parity, as a higher reward is needed to overcome the inertia of holders who do not habitually look for very fine yield differences.[36]

Several considerations are involved here. If the commercial banker has only limited working capital, he can augment his balance of one currency only by depleting his balances of another. Normally, the bank will need to maintain a minimum inventory in several currencies to service the needs of its export-import customers. These currency reserves are used to supply both spot payments for regular trade transactions and exchange to non-bank firms for interest arbitrage. Moreover, some banks at certain times will have higher opportunity costs elsewhere, so that the expected profit from servicing the foreign currency needs of their clients for whatever purpose may be less than ex-

[34] See especially Einzig, *op. cit.*

[35] Opportunity cost is most precisely measured as the present discounted value of return over the life of an investment.

[36] A. E. Jasay, "Bank Rate or Forward Exchange Policy," *Banca Nazionale del Lavoro Quarterly Review,* Vol. XLIV (March 1958), p. 64.

pected profits from alternative uses. These are all restrictions on the ability of non-bank firms to engage in—or borrow for—arbitrage investment.

At the same time, banks are potential arbitrageurs themselves. But to engage in arbitrage on a significant scale might result in curtailment of domestic advances and a loss of permanent clients. Part of a bank's opportunity cost is its expected loss from sacrificing future domestic (or international) business. In general, banks are reluctant to tie up funds in foreign-exchange balances for very long periods for either themselves or their clients. Thus the inventory of arbitrage funds for the banks' own purposes is limited.[37]

As far as borrowing arbitrage is concerned, foreign firms can borrow from domestic banks only until their borrowing interferes with the needs of domestic bank customers. Domestic commercial banks are not willing to sacrifice the demands of their regular domestic clients in favor of the more risky foreign firms. "For considerations of financial or political uncertainty, or because they prefer to employ their resources at home," states Paul Einzig, "the banks do not commit in arbitrage more than a small proportion of their reserves."[38]

As the first job of nonfinancial firms is to sell their products, most non-bank firms in the United States will not desire to borrow to engage in arbitrage investment operations. Such transactions would not be profitable anyway unless the covered interest-rate differential exceeded the cost of the loan. Even if they did wish to borrow, these companies are faced with limited liquidity in their own portfolios, as well as the aforementioned reluctance of commercial banks to supply spot foreign exchange. When the margin between covered rates is narrow, an extremely large volume of funds is necessary to make a return greater than the nuisance cost of the transaction. And, of course, non-bank firms must compare these anticipated net arbitrage returns with expected alternative profits.

Nevertheless, it is likely that very large non-bank establishments in the lower-interest-rate country will be seeking more profitable outlets for surplus funds than are available locally. But if that nation is running a chronic payments deficit, its government may be imposing credit restrictions for the dual purposes of reducing imports and curb-

[37] For a discussion of these arguments, see Jerome Stein, *The Nature and Efficiency of the Foreign Exchange Market,* Essays in International Finance No. 41 (Princeton University, International Finance Section, March 1963), pp. 18-20.

[38] Einzig, *op. cit.,* p. 180. This was confirmed also in interviews with bank foreign-exchange departments in a large midwestern city.

ing outward flows of capital. The same country may take steps to prevent foreign borrowing in its money and capital markets.

Either through a reduction in bank reserves or explicit exchange controls, official monetary actions are likely to lessen even further the availability of arbitrage funds. And we are reminded by the criteria established in equation III.1 that interest-rate parity is achieved only if the outflow of arbitrage capital pushes the forward exchange rate to a greater discount. Thus monetary policy would supplement the institutional ceiling already in vogue among commercial bankers, and credit restrictions would make interest-rate parity a more distant goal.

In view of these arguments, four conditions for direct, active interest-rate arbitrage by banks and non-banks (mostly nonfinancial firms) between two nations can be stated emphatically.

1. Such firms must believe with reasonable certainty that they will not need these arbitrage funds during the subsequent 90 days (or other forward maturity).
2. The discount on forward foreign exchange must not exceed the interest-rate differentials between the two given countries. Most frequently, the forward discount must be fairly low to induce the movement of funds. This condition applies with greater force to banks than to non-banks.
3. Non-bank firms must have large liquid reserves and banks must have large excess reserve holdings, or else these firms must have large domestic Treasury-bill holdings which can be switched into foreign bills or deposits.[39]
4. The respective money markets of the two nations must be accessible.

Exchange Restrictions and the Probability of Devaluation or Revaluation

At this point, let us briefly discuss the last three assumptions underlying the parity concept. Expectation of exchange restrictions, the probability of changes in the price of gold, and political stability often are interrelated. With the exception of relatively fixed spot exchange rates, there currently are no direct exchange controls in the United States.

While the *forward* market in most nations is free, the U. S. Treasury did begin limited operations in forward exchange in March 1961, and in February 1962 the Federal Reserve began buying and selling foreign exchange in various maturities on its own account. The magnitude of these Treasury-Federal Reserve transactions was relatively small be-

[39] In switching from domestic into foreign bills, any principal lost in selling domestic bills before maturity reduces the profit gained from the foreign investment.

fore the final quarter of 1963. But by August 1964 reciprocal currency *agreements* had reached $500 million with the Bank of England and $250 million each with the central banks of Canada, West Germany, and Italy. While quarterly country drawings ordinarily have run between only $5 and $50 million since February 1962, there were drawings of $250 million by Canada in the second quarter of 1962 and $136 million by West Germany in the fourth quarter of 1963.

Thus, prior to 1964 the foreign forward exchange rate in recent years has moved quite freely against most countries. However, its interdependence with the regulated spot rate at times moderated its fluctuations.

The drafting in mid-1963 of a bill to tax purchases of foreign securities, while not an overt exchange regulation, had the effect of reducing foreign security sales and consequently the demand for foreign exchange. This, in turn, appears to have raised the expectation of future imposition of retroactive exchange restrictions, having a result similar to actual controls. Even though the purpose of the tax was to discourage long-term capital outflows, Treasury officials, particularly Under Secretary Robert V. Roosa, quickly attempted to dispel fears that any such controls were imminent.

Looking abroad, explicit exchange controls are the rule rather than the exception.[40] Undoubtedly, this places considerable pressure on the highly accessible money and capital markets of the United States. But, at the same time, free entry to United States money and capital markets plus political stability enables the U. S. dollar to function as a key international currency and helps to assure the United States position as a key-currency nation.

The Concept of Speculative Confidence

Looking, finally, at the hypothesis that the probability of devaluation or revaluation is zero, complete certainty or uncertainty are extreme cases. Indeed, expectations of change *or stability* frequently cause lapses from interest-rate parity. Beyond this, speculation, which is here assumed nonexistant, can result in excessive forward premiums or discounts on a currency for prolonged periods.

Is there a basis for confidence among speculators and interest-rate arbitrageurs that the foreign nation will not raise the par value of its currency in terms of gold? If the foreign country enjoys a balance-of-payments surplus, devaluation of its currency is out of the question.

[40] See Appendix B.

Even if that nation is suffering a basic deficit, the inflow of arbitrage capital from some chronically troubled nation, such as the United States, may create a surplus in the foreign capital account, tending to offset any deficit on current trade account. Thus the foreign nation has scant cause to devalue.

A revaluation of the home currency would operate against the speculators and uncovered arbitrageurs, but this is ruled out by the predicament of the economy whose currency is under attack. Devaluation of the domestic currency—an aid to arbitrageurs—might occur if it is not a key currency in world markets.

Although the current gold-exchange system was predicated upon timely adjustments in the par values of currencies, the position of the key-currency nation seems to dictate against following the provisions of the Bretton Woods Agreement with regard to "fundamental disequilibrium." While the United States in recent years has been suffering a chronic balance-of-payments deficit, official government policy has ruled out devaluation of the dollar as an acceptable policy alternative. Under Secretary of the Treasury Robert V. Roosa, official spokesman on balance-of-payments policy during the Kennedy-Johnson administration, indicated that with devaluation "the world would be left without a major currency, generally acceptable as a supplement to gold."[41]

Thus, the speculator and arbitrageur in the weaker-currency nation rest easy in the best of all possible worlds, with very little risk of loss due to changes in currency values. Rather, if they are not betting against a key currency, it is likely that the holders of foreign currency will experience windfalls resulting from the devaluation of the depreciating home currency.

If the price of the U. S. dollar is threatened in exchange markets through speculation or oversupply, foreign central banks purchase the "surplus" dollars. This is a result of the evolution of the dollar as a major currency. As Charles A. Coombs, Foreign Department Vice President at the New York Federal Reserve Bank, states, "foreign official intervention in the exchanges is generally conducted through purchases and sales of U. S. dollars, the principal reserve currency."[42] Given this relatively assured lower limit to the international value of

[41] Robert V. Roosa, "Assuring the Free World's Liquidity," *Factors Affecting the United States Balance of Payments,* compilation of studies prepared for the Subcommittee on International Exchange and Payments, Joint Economic Committee, 87th Cong., 2nd Sess., 1962, p. 343.

[42] *Factors Affecting the United States Balance of Payments, op. cit.,* p. 356.

the dollar, institutions or exchange dealers will invest or borrow *without* cover if the maximum potential decline in the spot price of foreign exchange is less than the interest-rate spread. This "uncovering" of transactions yields much larger potential profits. Intervention in spot exchanges, in this instance, causes passive speculation to be profitable.

As spot foreign exchange appreciates to its upper limit, the most volatile short-term capital moves abroad, and covered interest-rate arbitrage is slowed by the institutional constraints imposed by both the diminishing liquidity of arbitrageurs and rising alternative returns. But the more foreign exchange appreciates, the less likely is it that the foreign currency will be devalued. If, then, devaluation by the foreign nation is presumed improbable and pressures in exchanges favor the continuation of support policies near the lower level for the domestic currency, *uncovered* interest-rate abritrage by nonfinancial firms will continue to be profitable. Moreover, such arbitrage will occur at a time when a rising spot rate for foreign exchange and, consequently, probably a higher intrinsic discount are discouraging ordinary interest-rate arbitrage. Thus, prospects are bright for uncovered arbitrage near either the upper *or* lower support limits.

Writers on foreign exchange usually speak of speculation being the consequence of the *anticipation* of devaluation (by agreement of the IMF or otherwise) of the weak currency. The preceding argument pictures speculation as the effect of the expectation of *no* devaluation of the strong currency. But this process does not preclude classical speculation and, at the same time, may be more disruptive. Indeed, from the standpoint of interest-rate arbitrageurs and exchange speculators, the probability of given profits is higher from comparatively assured, continued appreciation of the strong currency *relative* to the weak than from considerable uncertainty regarding devaluation of the latter.

D. SUMMARY

The idea of an interest-rate parity is a useful and usable benchmark, but its maintenance requires the outward flow of covered arbitrage funds and its stability is endangered by speculative forces. Equilibrating capital movements are threatened by exchange controls, other imperfections in world capital markets, and the monetary authorities. Consequently, while the tendency toward equilibrium is assured by the original premises of this concept, parity is challenged by the absence of some of these assumptions in the real world.

IV. A DYNAMIC THEORY OF FOREIGN EXCHANGE

Thus far the motivations for capital movements have been examined and the concept of interest-rate parity re-examined. The failings of the latter have been corrected by qualifying its assumptions, in the light of recent events. Now we can proceed to formulate a more realistic theory of the foreign-exchange market.

This presentation is not an idle academic exercise. At the outset it was noted that the Federal Reserve System in 1961, 1962, and early 1963 had relied on a higher-interest-rate policy to slow capital flows from the United States. But the only type of capital outflow which the authorities could hope to alter would be that seeking profits from interest-rate arbitrage. Speculation against a currency stems from an expected rate of return much greater than could be gained from interest arbitrage. Indeed, if it did not, the speculator would engage in riskless covered arbitrage instead. Thus a domestic interest-rate rise aimed at reducing speculation would have to be large enough to restore the confidence of exchange speculators in the home currency. As A. E. Jasay concludes, the Bank Rate "works partly by determining the interest parity of the forward exchange rate, and partly by affecting (foreign) confidence in the currency." He suggests further that "the latter effect is unpredictable and may swing either way."[43]

If arbitrage funds, however, are not sufficient to bring about interest-rate parity and there also is *uncovered* arbitrage and pure speculation, the forward exchange rate is likely to rise to a premium. In these circumstances, covered interest arbitrage would again be profitable even if the spread between foreign and domestic interest rates were reduced by central-bank actions to zero. Consequently, the incentive for outward capital flows continues to exist. This is the dilemma of the monetary authorities. The reasons why it comes about are explained by the theory of exchange developed below.

Clearly, the concept of interest-rate parity explains capital movements only under the assumptions of an adequate supply of arbitrage funds, absence of exchange restrictions, no speculation, and stable political climates. By definition, these are the conditions which prevail during a "normal" period. But there are severe restrictions on the sup-

[43] A. E. Jasay, "Bank Rate or Forward Exchange Policy," *Banca Nazionale del Lavoro Quarterly Review,* Vol. XLIV (March 1958), p. 71.

ply of arbitrage capital, exchange controls are omnipresent, and speculation is sometimes rampant. Indeed, as noted, under current International Monetary Fund regulations one form of "speculation" becomes such a safe transaction that it seems to stretch the usual definition. Recent exchange-rate data suggest that "normal" periods are so scarce as to be exceptional.

A. INTEREST-RATE ARBITRAGE AND SPECULATIVE CONFIDENCE

Let us retain the traditional assumptions which have been deemed acceptable and reasonable. Only two nations are involved, the Treasury-bill rate is the proxy variable for all interest rates, transactions cost is negligible or canceling, initially there are no exchange restrictions, and political conditions are stable. In this analysis, the spot exchange rate is allowed to move between its upper and lower support limits. However, the implications of this will be judged somewhat differently than in the available theories. Two major assumptions are dropped entirely and become notable exceptions. Institutional constraints impose a limit on the level of arbitrage reserves, and the speculative motive is introduced. Speculation regarding the future value of foreign exchange (either through expected appreciation or revaluation) takes place, and the supply of funds for arbitage is reduced even more.

It is necessary to suggest several hypotheses. While the exact quantities of exchange moving for purposes of arbitrage or speculation cannot be determined, an approximation is yielded by hypotheses regarding the coefficients of elasticities between price changes and advances of arbitrage and speculation funds. These coefficients are estimates based on the preceding discussions. It is assumed, quite realistically, that the monetary authorities in the respective nations have considerable control over Treasury-bill rates.

An abnormal period, as indicated, is one in which the market believes the payments deficit to be chronic, a situation not unlike that prevailing in the United States during the early 1960's. But a distinction is made between an abnormal period with passive speculation and an abnormal period of pure speculation.[44] In order for an abnormal price period to become speculative, the rejection of perfect certainty concerning revaluation is necessary, but not the acceptance of perfect uncertainty. The only specification regarding expectations is that devaluation of the currency purchased (in terms of gold) is not probable within 90 days.

[44] See Glossary of Foreign-Exchange Terms.

Uncovered arbitrage is likely to accompany pure speculation if the arbitrageurs are fairly certain that the exchange rate will not move against them *within the next 90 days*.[45] Such arbitrage, which has in part a speculative motive, is more destabilizing to the exchange market than is pure speculation to the spot market. Because of the forward market, a sudden reversal in the usual covering process causes the forward rate to jump sharply upward.

B. THE MATHEMATICS OF SPECULATION AND INTEREST-RATE ARBITRAGE

Before uncovered arbitrage and speculation can take place, some action must change expectations regarding the future price of foreign exchange. Suppose that because of foreign-aid and defense grants abroad the home country's payments to the foreign country exceed its receipts. At the same time the dollar volumes of private exports (X) and imports (M) remain constant. The foreign spot exchange rate rises. Since the level of exports (X) is held constant, this rise in the exchange rate results in an excess supply of foreign exchange available for speculation and arbitrage.

Returning to equation II.1, this excess supply in the spot market equals $X_t[\Delta(1/x_{t-1})]$. This expression can be generalized to read, $\beta[\Delta(1/x_{t-1})]$, with $\beta > 1$. Once again, the beta constant is used.

It is believed that the elasticity of speculative demand to given changes in price expectations is very high under the condition of increased confidence regarding a fixed relation between gold and the major currencies. In view of the institutional restraints, the elasticity of interest-rate arbitrage to changes in the covered interest-rate differential is fairly low. On the other hand, the demand elasticity for *uncovered* arbitrage, with its attendant risks for ordinarily conservative arbitrageurs and the imposed 90-day commitment for pure speculators, is even lower. Consequently, the constants adopted in expressing these relations are summarized in Table 2, along with a restatement of previously used symbols. In making theoretical judgments from the new equations, it is hypothesized that $\rho > \alpha > \Sigma > 0$. Traders' leading and lagging is ignored at this juncture.

Spot Equations

The speculative demand (D_s) is a function of the expected future price of spot exchange and the "opportunity cost," or alternative

[45] This hypothesis is recognized as a slight modification of the original interest-rate-parity assumption of no devaluation or revaluation, and is based on the concept of speculative confidence formulated in the preceding chapter.

TABLE 2

MATHEMATICAL SYMBOLS

Variables		*Constants*	
X =	Dollar volume of domestic exports	$\beta > 1$	—Excess-supply coefficient
M =	Dollar volume of domestic imports	$\rho > 0$	—Pure-speculative-demand coefficient
u =	Domestic 90-day Treasury-bill rate per annum	$\rho > \alpha > 0$	—Covered-interest-rate-arbitrage coefficient
v =	Foreign 90-day Treasury-bill rate per annum	$\alpha > \Sigma > 0$	—Uncovered-interest-rate-arbitrage coefficient
x =	Spot foreign-exchange rate		
y =	Forward foreign-exchange rate		
m =	Uncovered interest-rate spread ($m = v - u$)		
r =	Covered interest-rate differential ($r = y - x + m$)		
$t + i$ =	Unknown unit of time, less than 90 days		

return. A proxy variable for opportunity cost is the domestic bill rate (u).

$$D_s = \rho(x^*_{t+1} - x_t - u_t) \tag{IV.1}$$

Interest-rate-arbitrage demand (D_i) is a function of the covered-interest-rate differential (r), after accounting for price expectations. If the expected price change is sufficient and deemed lasting (for at least 90 days), uncovered arbitrage takes place.

$$D_i = \alpha(y_t - x_t + m) + \Sigma(x^*_{t+1} - x_t) \tag{IV.2}$$

Assuming that the quantities of maturing contracts (M_{t-3} and X_{t-3}) are equal and canceling, D_s and D_i can be combined with current imports (M_t), so that total exchange demand (Q_d) becomes, $Q_d = M_t + D_s + D_i$. Given the supply (Q_s), $Q_s = X_t + \beta[\Delta(1/x_{t-1})]$, the expanded equilibrium ($Q_d = Q_s$) becomes:

$$M_t + \rho(x^*_{t+1} - x_t - u_t) + \alpha(y_t - x_t + m) + \Sigma(x^*_{t+1} - x_t) = X_t + \beta\left(\Delta \frac{1}{x_{t-1}}\right). \tag{IV.3}$$

Simplifying, the equilibrium condition is:

$$M_t + (\rho + \Sigma)(x^*_{t+1} - x_t) - \rho u_t + \alpha r_t = X_t + \beta\left(\Delta \frac{1}{x_{t-1}}\right). \tag{IV.4}$$

The Forward Market

The excess forward foreign-exchange supply (Q_e) is a function of covering by interest-rate arbitrageurs.[46] Letting

$$Q_e = \alpha(y_t - x_t + m_t) - \Sigma(x^*_{t+1} - x_t) \tag{IV.5}$$

X_{t+3} equal the demand for cover by foreign importers, as in the earlier equations, this forward equation can be reduced to,

$$M_{t+3} = X_{t+3} + \alpha r_t - \Sigma(x^*_{t+1} - x_t). \tag{IV.6}$$

Presuming that current private imports equal current private exports, and future scheduled imports equal future scheduled exports, the spot and forward equations (IV.3 and IV.6) can be solved simultaneously for that current domestic Treasury-bill rate (u_t), which will yield equilibrium.

$$u_t = \frac{(\rho + 2\Sigma)(x^*_{t+1} - x_t) - \beta(\Delta x_{t-1})}{\rho} \tag{IV.7}$$

For compactness, this solution can be simplified further with another assumption. Letting $\rho = 1$ and $(\rho + 2\Sigma) = k$, then,

$$u_t = k(x^*_{t+1} - x_t) - \beta(\Delta x_{t-1}). \tag{IV.8}$$

In short, the domestic Treasury-bill rate necessary to achieve simultaneous equilibrium of the spot and forward markets is primarily dependent upon the future expected price of foreign exchange, whereas classical interest-rate parity is achieved when, $(u_t - v_t) = (y_t - x_t)$.

The higher the expected future price, the greater the domestic Treasury bill must be to curb capital flights. A bill rate sufficient to equal some function of the expected future price differential $(x^*_{t+1} - x_t)$ must be extremely high during a period of speculation (rising expected

[46] Excess supply in the spot market is transferred, in effect, to the forward market.

* Expected future price. As before, to be precise $(x^*_{t+1} - x_t)$ is converted to per cent per annum terms, or

$$365\left(\frac{x_{t+1} - x_t}{x_t}\right).$$

The "expected future price of exchange" is not as evasive as it might sound. When the spot exchange rate rises above its lower support level on several successive days, foreign-exchange-department heads expect the advance to continue. But as the spot price approaches the *upper* support level, it is expected that the price advance will not be sustained. In interviews during the early days of this study, it was discovered that foreign-exchange-department heads are able to formulate specific and definite ranges of probable price changes.

price) against the domestic currency. This is a goal much more difficult to achieve than the one necessary simply to equate the foreign Treasury-bill spread with the discount on forward exchanges. And once this more difficult objective is met, capital outflows will cease only if movements in the other variables, possibly prompted by the Treasury-bill rise, do not favor further outflows.

C. PRICE DETERMINATION IN THE EXCHANGE MARKET

The foregoing will be useful in describing price behavior in both the spot and forward markets. While these symbols are intriguing, it is the logic behind them that must not escape us. It was assumed at the outset that, given fairly fixed exchange rates, the price of exchange is set initially by the ratio between the dollar volume of merchandise and nonfinancial service imports and exports (M/X).[47] We abstracted from this in order to generate an artificial excess supply of foreign exchange. This was informative. But exchange supply and demand have been complicated by two major forces, the leading and lagging in payments by traders plus speculative-arbitrage demand in the spot market and excess foreign-exchange supply in the forward.

Giving the original quantities of exchange needed for trade, these forces yield the subsequent equations for exchange demand (Q_d) and supply (Q_s).[48]

(IV.9) *Spot Market*

$$Q_d(t) = M_t + (\rho + \beta + \Sigma)(x^*_{t+1} - x_t) - \rho u_t + \alpha r_t$$

$$Q_s(t) = X_t - \beta(x^*_{t+1} - x_t), \quad \text{with} \quad (\rho + \beta + \Sigma) > 1$$

(IV.10) *Forward Market*

$$Q_d(t) = M_{t+3} - \beta(x^*_{t+1} - x_t)$$

$$Q_s(t) = X_{t-3} + (\beta - \Sigma)(x^*_{t+1} - x_t) + \alpha r_t \ ,$$

with $(\beta - \Sigma) > 0$, since $\beta > \Sigma$.

[47] Again, if the U. S. dollar and the British pound had the same par values and U. S. exports to and imports from Great Britain were equal, the foreign-exchange rate would equal $1.

[48] Although $(t + i)$ is an unknown, discrete time period, for convenience we again use the symbols, M_{t+3} and X_{t+3}, to express the dollar volume of imports and exports for future delivery.

It should be understood that these are net relationships. In the case of interest-rate arbitrage (D_t), for instance, $\alpha(y_t - x_t + m) + \Sigma(x^*_{t+1} - x_t)$ will result in either a net inflow or outflow of funds, depending on whether the differentials favor the home economy or the foreign.

If $M_t = X_t$ and $M_{t+3} = X_{t+3}$, the spot and forward equations can be solved simultaneously for u_t.

$$u_t = \frac{(x^*_{t+1} - x_t)(\rho + 2\Sigma)}{\rho} \tag{IV.11}$$

Again using a simplifying technique, let $\rho = 1$ and $(\rho + 2\Sigma) = k$.

$$u_t = k(x^*_{t+1} - x_t) \tag{IV.12}$$

This merely confirms an earlier solution. But the market price of exchange is determined by the ratio of exchange demand to supply. This ratio (Q_d/Q_s) yields the following price equations.

$$x_t = \frac{M_{t-1} + (\rho + \beta + \Sigma)(x^*_t - x_{t-1}) - \rho u_{t-1} + \alpha r_{t-1}}{X_{t-1} - \beta(x^*_t - x_{t-1})} \tag{IV.13}$$

$$y_t = \frac{M_{t+3} - \beta(x^*_t - x_{t-1})}{X_{t+3} + (\beta - \Sigma)(x^*_t - x_{t-1}) + \alpha r_{t-1}} \tag{IV.14}$$

These equations do not encompass every possible influence on these prices, as we shall see. None the less, the manipulation of these variables can be carried quite far. For instance, once the direction of the current prices (x_t and y_t) is gauged, the probable direction of movement toward another set of exchange rates can be determined by substituting x_t and y_t for x_{t-1} and y_{t-1} in the equations.

Several general observations are prompted at this point, which will later prove to be crucial. While a rise in the expected future price (x^*_t) tends to exert an upward pressure on the spot price and a downward one on the forward, in a normal period this movement will continue only until the spot price has been pushed nearly to its upper support level. The turning point will occur when the expected price becomes equal to the current rate. At that time the leads and lags will be reversed and, *ceteris paribus*, the old equilibrium price re-established.

The behavior of the covered interest-rate variable (r) is of special interest. With the thinner forward market, forward covered-arbitrage sales (which are equal to covered spot interest-rate-arbitrage purchases) will cause a greater decline in the forward rate than rise in the spot. The process of covered interest arbitrage transmits excess supply from the spot to the forward market. Again, as the reduction of the covered-interest-rate differential discourages further outflows of capital, this relative price movement is propitious.

In terms of achievement of interest-rate parity, the most favorable

relative price move is a slight increase in the spot rate and a substantial decrease in the forward rate. The leading and lagging of importers-exporters is usually self-equilibrating, in the absence of other forces. Uncovered arbitrage, which is in part speculative, would advance the spot rate, while not directly affecting the forward. But covered interest-rate arbitrage would have the advantage of lowering the forward rate considerably more than raising the spot price.

But speculation often exerts an upward pressure in exchange rates of various maturities. If the speculative attack is against the home currency in the spot market only, the forward discount will widen. However, this gap will be closed rapidly if speculators begin purchasing forward contracts as well. In the more elastic forward market, the forward price will move closer to the spot, reducing the forward discount.

Speculators purchase forward contracts when they expect the future spot price to exceed the current forward rate. The "futures" contract then can, upon its delivery, be sold spot at a profit. Letting ρ equal also the *forward-speculative-demand coefficient*, foreign-exchange demand for this purpose would equal $\rho(x_t^* - y_{t-1} - u_{t-1})$. Assuming that no forward speculation has occurred in the recent past, this would not alter immediately the spot exchange rate.[49] But the forward-rate equation would take a modified form.

$$\text{(IV.15)} \qquad y_t = \frac{M_{t+3} - \beta(x_t^* - x_{t-1}) + \rho(x_t^* - y_{t-1} - u_t)}{X_{t+3} + (\beta - \Sigma)(x_t^* - x_{t-1}) + \alpha r_{t-1}}$$

The observation of relative spot and forward exchange-rate movements during a given time span can, with the aid of these equations, indicate the probable nature of dominant short-term flows. If the relationship between exports and imports is stable and short-term interest rates are set by the monetary authorities, several hypotheses can be stated.

Suppose both the spot and forward rates are declining at the same pace, leaving the forward premium unchanged. The dominant force is probably speculation against the foreign currency, with a greater volume of transactions taking place in the spot than in the forward market. If the more rapid descent is in the forward rate, some speculators are shifting to "futures." Conversely, a simultaneous rise in the exchange rates suggests the attack is on the home currency. This speculation may take both the "classic" form and that of uncovered arbi-

[49] In the case of prior forward speculation, the supply of foreign exchange in the spot market would be augmented by $\rho(x_{t-1}^* - y_{t-2})$.

trage. Even though the value of the domestic currency may have reached its lower support limit, uncovered arbitrage can continue so long as devaluation of the foreign currency is presumed unlikely for 90 days. Thus the flow of capital out of the deficit nation may be uninterrupted even in the absence of expected appreciation of foreign exchange.

If the forward rate is rising at a faster rate than the spot price is falling, inward covered arbitrage most likely is the main force. On the other hand, a spot rate which is climbing more slowly than the "futures" price is falling is evidence of outward covered interest arbitrage. A slower rate of change in the forward rate in either case is indicative of some uncovered transactions. In all cases, the relative movements will vary according to the mixture of these various elements.

The Normal Period

Retaining these equations as a working model, the actual process whereby these prices change is considered next. This analysis hopefully will embellish the theoretical skeleton. Suppose the spot exchange rate rises during a balance-of-payments deficit that is expected to be temporary. The domestic commercial banks with large foreign-exchange departments develop shorter positions in the foreign currency, for they expect the price advance to be reversed soon. At about the same time, leads and lags are reversed as importers reduce their purchases of spot and exporters increase their sales of foreign exchange, each expecting the price to fall back to the given set of "normal" prices. These actions yield a net decline in the demand for spot exchange.

When the spot price initially rises relative to the forward, the discount on forward exchange (y—x) widens. If relevant interest rates between the two nations are equal and held stable by the monetary authorities, the profitability of active, outward interest-rate arbitrage diminishes, whereas inward arbitrage increases. In effect, the arbitrageurs sell spot exchange (buying the domestic currency) and purchase forward foreign exchange (selling domestic currency). In addition to yielding another net reduction in demand in the spot market, these actions advance demand in the forward. Most likely, since the conditions giving rise to the deficit are transitory, foreign branch factories or offices will not borrow the domestic currency and sell it at a profit, as they can expect to repay the loan in the domestic currency at a higher cost. It is equally unlikely that foreign affiliates of large for-

eign non-bank firms will accumulate liquid reserves of the temporarily higher-valued foreign currency.

Hence in the course of a relatively brief time span, the leads and lags of exporters plus the sales by foreign interest-rate arbitrageurs reduce the excessive price of spot. In the forward market, the purchases of arbitrageurs tend to nudge the forward premium downward, in a direction opposite that of the original spot-price rise. (This movement is supplemented by increased covering among foreign exporters.) Equilibrium is soon restored.

The Abnormal Period

But let us consider a time when the market believes the payments deficit to be chronic. The transactions during such a period are summarized in the accompanying table (3). It is assumed that foreign short-term interest rates exceed corresponding domestic rates, and these rates are held constant. The time notation $(t + i)$ is an unknown, discrete time period. These operations are probably completed within a few weeks, certainly in less than 90 days.

In the first stage (t) the increasing price of foreign exchange causes importers to *accelerate* purchases of spot and exporters to *lag* sales of exchange because both expect the price rise to continue. Domestic banks develop "long" positions in the foreign currency and exchange dealers raise their ask prices. Foreign importers' sales forward usually will be rising, and foreign exporters will either not cover (or do so at a lesser maturity).[50] Judging from the behavior of these variables (X, M, M_{t+3}, X_{t+3}), the net effect of the covering transactions is a rise in the spot rate and an even sharper rise in the forward, augmenting the forward premium or lessening even more the forward discount.

In the second stage $(t + 1)$ foreign branch factories or offices will engage in indirect interest-rate arbitrage, adding to the cost of spot. Both direct, active interest-rate arbitrage and passive exchange arbitrage will be very profitable. But such arbitrage, often decried as a "hot money flow," is the main pressure toward normalcy. The forward sales are, first, the main source of downward pressure on the price of forward exchange, and, second, a major source of future supply of exchange.[51] While importers' exchange flows abroad and does not neces-

[50] It will help the reader to understand these covering operations if he remembers that foreign imports are, for instance, American *exports* and foreign exports are American *imports*.

[51] Equations II.1 and II.2, the original supply and demand identities, contain quantities of maturing futures (X_{t-3} and M_{t-3}).

TABLE 3

FOREIGN-EXCHANGE-MARKET ADJUSTMENTS DURING BALANCE-OF-PAYMENTS DEFICIT AND HIGH FOREIGN INTEREST RATES, ABNORMAL PERIOD

	Spot Market		*Forward Market*	
Time Interval	*Purchases*	*Sales*	*Purchases*	*Sales*
t	(1) Deficit in payments results in rise in spot & forward prices. There is a relative shortage of foreign exchange.			
	Importer-Exporter Leads and Lags (Hedging)			
	(2) Importers accelerate purchases of spot, exporters lag sales of exchange (expect deficit to be lasting).	(2) Domestic banks with large foreign departments will be selling exchange to importers at higher ask prices.	(2) Domestic banks with large foreign departments develop "long" positions in foreign currency. Volume of purchases depends upon amount of discount and banks' willingness to supply funds to importers at loss of reserves. (2) Foreign importers' sales forward rise, foreign exporters will either not cover or do so at decreasing maturity. Net effect is increase in forward rate.	
	Indirect Interest-Rate Arbitrage (Active)			
$t + 1$	(3) Foreign branch factory in deficit country sells the domestic currency that it has borrowed in the money market of deficit country (at exchange profit).			

TABLE 3 (Continued)

Time Interval	Spot Market: Purchases	Spot Market: Sales	Forward Market: Purchases	Forward Market: Sales
		Direct Interest-Rate Arbitrage (Active)		
$t + 1$	(4) Large domestic nonfinancial firms purchase foreign exchange for investment in foreign Treasury bills.	Investment Swap Transaction		(4) Large domestic nonfinancial firms sell equal amount of foreign exchange as cover.
	(5) Large foreign nonfinancial firms that borrow from deficit country purchase spot exchange.	Borrowing Swap Transaction		(5) Large foreign nonfinancial firms buy an equal sum of the deficit currency forward.
		Passive Exchange Arbitrage		
	(6) Foreign affiliates or branches of large world-wide deficit-currency-country firms accumulate liquid reserves of higher-valued foreign currency.	Swap Transaction		(6) Foreign affiliates sell equal sum of foreign currency as cover.

sarily return, purchases by arbitrageurs are not a total loss of foreign exchange unless all the investments and loans are renewed. And even these renewals cannot go on forever.

Interest-rate parity can only be returned in this abnormal period through considerable (or what some government officials might term "excessive") capital flows abroad. When and if arbitrage funds are sufficient to push the forward discount as high as the interest-rate spread, capital flows through interest-rate arbitrage will cease.

One cannot avoid observing the irony in the predicament of the deficit nation. When faced with a chronic payments deficit, the government is fearful of losses through capital outflows and may take drastic actions to forestall them. Its monetary and fiscal authorities may impose restrictions on capital movements or arbitrarily raise short-term interest rates. Yet, the successful curbing of capital outflows produces a situation in which the incentive for such movements is

strengthened. This is an argument contrary to that ordinarily proposed by central banks and treasuries.

The Speculative Abnormal Period

Speculation can come about in the traditional manner, or it can develop as a result of uncovered interest-rate arbitrage and "speculative confidence." Earlier we described in detail how expectations can become favorable for speculation, a time when arbitrageurs and speculators believe that there will be *no devaluation* or depreciation of the strong currency. Actually, when the currency under attack is a key currency, it is *depreciation* rather than expected devaluation which triggers this movement.[52]

As the probability of appreciation of foreign exchange rises, professional traders begin to speculate in stage $(t + 1)$. In effect, this group will join the growing numbers of foreign exporters who are (by conducting uncovered transactions in many cases) speculating against the value of the deficit currency. A few commercial banks will expand this total by taking speculative positions either during the course of the business day or by failing to balance exchange accounts at the end of the day. If we assume that future contracts for more than 90 days are available, professional speculators will purchase further and further into the future.

The spot and forward prices continue to move in the same direction. Indeed, it is likely that forward exchange is at a premium. With a possible premium on forward transactions, domestic and foreign commercial banks, which ordinarily do not conduct arbitrage operations, may find the profit margin sufficient inducement $(t + 2)$. These banks are unlikely to take open positions and will begin to exercise the classic interest-arbitrage role. Passive arbitrage also will become more significant, but most likely will also be covered as insurance against the political uncertainty involved when offices are located in the foreign nation. Thus, covered arbitrage by commercial banks may be the only strong force tending to move the forward premium (or small discount) to a (greater) discount, and toward restoration of capital-flow stability. In practice, it is extremely unlikely that all the holdings of nonbank firms will be uncovered. But, at the same time, the domestic monetary authorities may try to discourage arbitrage through both moral suasion and attempts to reduce the liquidity of domestic commercial banks.

[52] This process is outlined in Table 4.

TABLE 4

FOREIGN-EXCHANGE-MARKET ADJUSTMENTS DURING BALANCE-OF-PAYMENTS DEFICIT, WITH UNCERTAINTY REDUCED, SPECULATIVE PERIOD

	Spot Market		*Forward Market*	
Time Interval	*Purchases*	*Sales*	*Purchases*	*Sales*
t	(4) Uncovered, devaluation of foreign currency or revaluation of domestic assumed improbable for 90 days.			
	(5) Uncovered, devaluation of foreign currency or revaluation of domestic assumed improbable for 90 days.			
$t + 1$			Forward premium rises because of lack of forward sales.	
	(2) Same as before, but leads and lags become in part a speculative function.		(2) Same as before, except a few banks will assume speculative positions.	
	(3) Indirect active arbitrage increases.			
	(7) Professional traders speculate with purchases of uncovered exchange (or sell domestic currency short).		(7) Professional speculators also purchase exchange in "futures," anticipating higher spot price.	
$t + 2$	(4) (5) With the much higher premium forward, it is profitable for domestic and foreign banks to play interest-rate-arbitrage role formerly exercised by the large nonfinancial firms.			(4) (5) Commercial banks are not likely to take uncovered position. Thus they exercise classic interest-rate-arbitrage role.
	(6) Passive arbitrage may become more pronounced.			(6) Because of political risks, foreign affiliates are likely to continue to cover.

While this may seem a special foreign-exchange concept in which certain institutional constraints are introduced, its possibility dramatizes the danger of speculation becoming a comparatively safe transaction. Recent experience suggests that this may offer a more general explanation of short-term capital flows than provided by accepted theories. Moreover, it does not negate the more straightforward case in which speculation against the possibility of devaluation of the home currency or revaluation of the foreign currency occurs. In either situation, domestic gold and other reserves are lost in the process of supporting the lowest feasible price limit of the home currency. What is more uncomfortably relevant, it bears close resemblance to the dilemma of a key-currency nation such as the United States.

These findings have very specific policy connotations. Monetary policy is confronted with capital outflows stemming from various motives; these movements are witnessed as trade finance, pure speculation, uncovered interest arbitrage (passive speculation), and relatively riskless interest arbitrage (covered). Trade finance responds to domestic exports; higher interest rates can do little here. To terminate all forms of speculation, including uncovered arbitrage, a government must bring about very sharp advances in domestic short-term rates—in effect committing itself to sacrificing the home economy on the altar of international equilibrium. At the same time, uncovered arbitrage is being stimulated by the adamant refusal of officials in key-currency nations to change the price of gold.

The last hope of the monetary authorities, then, is to aim at the highly technical goal of reducing covered interest-rate arbitrage. But because of the interrelation of the spot and forward exchange markets, the authorities should not be oblivious to the behavior of the forward price of exchange. If this tandem motion is not fully understood, the price of ignorance may be a decline in domestic production and employment.

V. MONETARY POLICY VERSUS THE FORWARD RATE

While it is clear that domestic short-term interest rates cannot be pushed upward without influencing the forward exchange rate, the Federal Reserve System did not intervene in the forward exchange market prior to February 1962. This was about 19 months after the System initiated its "pegging" policy in an attempt to stem short-term capital outflows. Moreover, these exchange transactions were, in great part, quite moderate.[53]

This raises several questions for policy. Is the net effect of raising the domestic bill rate to diminish the incentive for moving funds abroad? If the impact of such a policy is offset by a rising forward exchange rate, would it be more appropriate to confine monetary policy to conducting operations in the forward market in order to discourage covered interest-rate arbitrage? And what is the net response of *uncovered* arbitrage to monetary policy? If, indeed, speculation is based on a rate of return vastly exceeding the current interest-rate spread, would a rise in short-term rates stop this segment of the "capital flight"? In the following section some guidelines are provided for answering these perplexing questions.

A. THE UNITED STATES AND A PRACTICAL POLICY DEMONSTRATION

The reduction of old assumptions to a new reality is not only a worth-while intellectual exercise; it can also have unexpected policy implications. In brief, what are now realistic amendments will be incorporated into the analysis of the chronic balance-of-payments deficit suffered by the United States in the first half-decade of the sixties. The relevant variables and unknown parameters are summarized anew in Table 5.

Interest-rate parity, defined as the capital-flow equilibrium in the home country, is determined by $v - u = -z$ when $v > u$. A now familiar problem is posed wherein a low discount (or slight premium) on forward exchange develops as a result of a payments deficit. While any particular nation may experience a payments problem relative to one other country, a nation experiencing a long-term deficit usually is faced with reserve losses to the major money markets of the world,

[53] Complete details of Federal Reserve spot and forward transactions by currency type appear in the March and September issues of the *Federal Reserve Bulletin*, beginning September 1962.

TABLE 5

MATHEMATICAL SYMBOLS

x—spot foreign-exchange rate
y—forward foreign-exchange rate
z—forward premium (+) or discount (−), annual rate
u—domestic Treasury-bill annual rate
v—foreign Treasury-bill annual rate
w—domestic lending annual rate
q—foreign lending annual rate
r—covered Treasury-bill interest-rate differential, annual rate
r' = covered lending interest-rate differential, annual rate
D_1 = demand for forward exchange by domestic nonfinancial firms
D_2 = demand for forward exchange by foreign nonfinancial firms
λ = coefficient relating a change in the covered-interest-rate differential (r) and a shift in the demand function for domestic Treasury bills (D_1).
θ = coefficient relating a change in the covered borrowing rate (r') and a shift in the demand function for domestic loans by foreigners (D_2).

either directly or indirectly through the London sterling market. As a consequence, relationships between the troubled nation and any other region with a developed foreign-exchange market would be quite similar.

The traditional assumptions which still apply are those relating to the Treasury-bill rate as the proxy variable, the uniformity of forward contracts, the political stability of the involved nations, the "pegging" of spot exchange, and those minor qualifications regarding the immediacy of the spot market and the canceling of transactions costs. At the outset several additional conditions are imposed; others will be introduced at appropriate junctures.

1. The relationships described are those between the United States dollar and any one of the five or six major exchange currencies, or all combined as one.
2. The money market of the home country is free of all direct exchange restrictions, not unlike that of the United States in the early 1960's.
3. The total time period, extending from t through $t + 2$ does not exceed 90 days. Hence, the impact of current forward contracts upon the spot market at the 90-day delivery date is not a matter of concern.
4. There is considerable uncertainty regarding devaluation or revaluation of both the home and the foreign currency.

The reintroduction of uncertainty demands some explanation. The purpose here is to create the most favorable possible conditions for

using a higher-interest-rate policy for curbing the outflow of U. S. short-term capital. If there is little possibility for pure speculation,[54] short-term movements will be essentially a function of interest-rate arbitrage. Traditionally, it has been the task of the central bank to stop such flows.

With the exception of uncertainty, the immedate reaction to these forthright statements is that, from the standpoint of the United States, they are not assumptions at all. Even the time period is realistic, for only the most clairvoyant could hope to forecast specific foreign-exchange behavior beyond a quarter of a year.

The greatest benefit from this discussion is to demonstrate the interaction between the domestic short-term interest rate and the forward exchange rate, a segment of the foreign-exchange mechanism which remains virtually untouched by human hypothesis. But this interplay presents a formidable conflict for the monetary authorities.

Initially, it is assumed again, the domestic Treasury-bill rate (u) and the foreign Treasury-bill rate (v) are determined by the official monetary authorities in any two developed nations. The forward premium or discount, however, is a function of forces dominating the spot market plus short-term capital flows, which are in part the result of the initial covered-interest-rate differential.

The prospect for interest-rate parity between the United States and another nation with a large, active exchange market turns upon the determinants of short-term capital movements. As the United States is experiencing a chronic balance-of-payments deficit, at first the greatest pressure on the spot rate will be exerted by the leads and lags of commercial traders. There will be active interest-rate arbitrage of considerably less quantitative significance by foreign branches of domestic firms in the deficit country. The only forces tending to push the forward rate to a lesser premium or a greater discount will be active, direct interest-rate arbitrage by non-bank firms and passive arbitrage by foreign affiliates or branches of domestic firms. The latter is so minor in empirical significance that it can safely be ignored.

The achievement of interest-rate equilibrium then turns upon the behavior of the forward rate, which is allowed to move freely. Upward pressure on the forward rate results through purchases of forward exchange by the risk-takers and forward covering by foreign importers. The net effect is for exchange dealers (and, in turn, commercial banks)

[54] Pure speculation is distinguished from importer-exporter open positions resulting from leading and lagging, or other types of passive speculation.

to raise their ask price for sales either spot or forward, and both sets of prices tend to move upward together. We shall surmise, quite reasonably, that the forward rate moves near the spot rate, probably edging above it, as most foreign exporters will not be covering. Many foreign exporters-importers will be speculating that their currency will become even dearer in the future.

The problem then is to trace the behavior of the forward premium (z). The net increase in demand for spot and forward foreign exchange presumably is caused by importers and exporters during the first time period (t), leaving a slight premium on forward contracts in the subsequent period ($t + 1$). Whereas interest-rate parity exists when the interest-rate spread equals the forward premium, i.e., $z = u - v$, it is assumed here that the interest-rate spread favors slightly the foreign nation. As respective interest rates are held constant by the authorities,

$$z_{t+1} \neq u_t - v_t \,. \tag{V.1}$$

Thus the premium on forward exchange prevents the establishment of equilibrium between the two nations.

Up to this point the only force affecting the forward rate has been that exerted by export-import transactions. To simplify the mathematics, it will be assumed further that this is the only source of pressure on the forward price of exchange until the spot rate has reached its upper support limit. Furthermore, the spot rate is pushed to its upper level, as allowed by the exchange-stabilization funds of the respective areas, in period $t + 1$.

Initially, then, it is assumed that the forward rate (y) in period $t + 1$ is equal to the forward rate in the immediately preceding period, t. This forward rate, however, still exceeds the pegged spot rate (x_{t+1}). As the forward premium equals the differential between the forward and spot rates, in per cent per year terms,[55]

$$z_t = y_t - x_t \quad \text{and} \quad z_{t+1} = y_{t+1} - x_{t+1}. \tag{V.2}$$

Substituting y_t for y_{t+1}, the new forward premium is,

$$z_{t+1} = y_t - x_{t+1} \,, \quad \text{with} \quad x_{t+1} > x_t. \tag{V.3}$$

[55] The difference, $y_t - x_{t+1}$, is assumed to be in per cent per annum terms, as are the other exchange-rate differentials. To express this term as

$$365\left(\frac{y_t - x_{t+1}}{x_{t+1}}\right)$$

would complicate the equations without changing the final results.

The problem then is simplified to a consideration of the effect of two forces upon the forward market—direct, active interest-rate arbitrage by large domestic non-bank firms and direct interest-rate arbitrage through borrowing by large foreign nonfinancial firms.

Since x_{t+1} places a ceiling on the spot price (x), further changes in the forward price (y) determine changes in z, and vice-versa.

(V.4) $$z_{t+2} = z_{t+1} + \Delta z_{t+1}$$

Given the importer-exporter versus domestic-banks stalemate, further movements in the forward premium or discount will be a function of the change in demand for interest-rate-arbitrage funds by large foreign and domestic nonfinancial firms.

(V.5) $$\Delta z = f(\Delta D_1 + \Delta D_2),$$

where

$$\Delta D_1 = \lambda(\Delta r),\ \Delta D_2 = \theta(\Delta r').$$

(V.6) $$\Delta z = \lambda(\Delta r) + \theta(\Delta r')$$

As the covered-interest-rate differential is the interest-rate spread adjusted for forward exchange (covering) costs,

(V.7) $$r = v_t - u_t + z_t\ ,\ r' = q_t - w_t + z_t.$$

Substituting in equation V.6,

(V.8) $$\Delta z_{t+1} = \lambda[(v_t - u_t + z_{t+1}) - (v_t - u_t + z_t)] + \theta[(q_t - w_t + z_{t+1}) - (q_t - w_t + z_t)].$$

Both λ and θ are positive since any increase in r or r' augments the demand for forward exchange (D_1 and D_2). It is hypothesized that λ and θ are also each greater than one.

The above equation (V.8) can be solved by substitution. Since $z_t = y_t - x_t$, and $z_{t+1} = y_t - x_{t+1}$,

(V.9) $$\Delta z_{t+1} = (\lambda + \theta)(x_t - x_{t+1}).$$

Since $|x_{t+1}| > |x_t|$, Δz_{t+1} will be negative. Let $(x_t - x_{t+1}) = -g$ and $K > 2$, then

(V.10) $$\Delta z_{t+1} = -Kg.$$

(V.11) $$z_{t+2} = z_{t+1} - Kg$$

And the forward premium (z) declines during the period, $t + 2$, by Kg. If forward exchange had been at a discount, the forward discount

would have widened by Kg. The drop in the forward premium, in either case, would tend to discourage further outflows of short-term capital.

But suppose the monetary authorities decide to follow a policy of arbitrarily raising the short-term Treasury-bill rate early in the transition from period t to period $t + 2$.

Let the new rate, $u_{t+1} = u_t + 1$ percentage point, and the new lending rate, $w_{t+1} = w_t + 1$ percentage point.

$$\Delta z_{t+1} = \lambda[(v_t - u_t + 1 - x_{t+1} + y_t) - (v_t - u_t - x_t + y_t)] + \theta[(q_t + 1 - w_t - x_{t+1} + y_t) - (q_t - w_t - x_t + u_t)] \tag{V.12}$$

$$\Delta z_{t+1} = K(1 - g) \tag{V.13}$$

$$z_{t+2} = z_{t+1} - Kg + K \tag{V.14}$$

Subtracting the pre-monetary-policy equation, we have:

$$z_{t+1} - Kg + K - (z_{t+1} - Kg) = K. \tag{V.15}$$

Any decline in the forward premium or rise in the forward discount will be offset by $K > 2$ per cent per annum, which is sufficient to leave $|u - v| > |z_{t+2}|$, and there still is an incentive to move short-term capital abroad.

B. THE POLICY DILEMMA

The conclusion that interest-rate parity under these conditions cannot be sustained by pushing up the short-term domestic Treasury-bill and lending rates is precisely the opposite of the view commonly held. Many writers on foreign exchange, such as J. Sproas and Paul Einzig, have suggested that the interest-rate-parity theory is applicable only if "arbitrage funds are not exhausted." But each has fallen into the trap of recommending higher short-term interest rates to curb the outflow of capital.

First, arbitrarily raising rates tends to affect the forward exchange rate in an opposite direction to that desired. The logic behind this is inescapable: the forward premium will be lessened only if short-term capital *is allowed to flow out of the United States*. Second, the process whereby interest rates are adjusted by the Federal Reserve Open Market Committee usually requires a tightening of credit and/or money conditions, which in turn might reduce the reserves available

for arbitrage, particularly those of commercial banks. Thus, when the foreign spot rate is forced to its upper limit, the Federal Reserve System faces the dilemma either of allowing short-term capital to flow out in order to curb the rising forward premium, or of attempting to prevent the outflow while allowing the incentive for it to grow.

Some defenders of these Federal Reserve actions might argue that *uncovered* arbitrage is characteristic of a time when the foreign spot rate has reached its stabilization peak. The elimination of uncertainty would facilitate such arbitrage. If pure speculation also is rampant, the forward rate may rise to a substantial premium. But, since uncovered arbitrage is based on an expected rate of return vastly exceeding that of covered interest arbitrage, the height of the domestic short-term bill rate necessary to end such movements might exceed the acceptable policy range.

In short, the central bank is faced with a dilemma in which the choice is between raising interest rates too much or too little. If the objective is to dampen speculative flows, the interest-rate swing must be quite wide. But the implementation of a high-interest-rate policy may widen the covered interest differential via the forward rate and further encourage covered interest arbitrage.

An alternative to using an arbitrary advance in the short-term interest rate as the policy tool to stem capital outflows is intervention in the forward market to push the forward rate to a large discount. This would be facilitated by the higher price elasticity of the forward rate. But, applying the above analysis, to push the short-term interest rate upward and simultaneously intervene in the forward market is to work at cross-purposes. On the one hand, the monetary authorities, by discouraging covered arbitrage, are contributing to the premium on forward exchange. On the other hand, the Federal Reserve must expend currency reserves in attempting to reduce the forward premium. To follow a policy of forward intervention and at the same time one which makes such reserve losses even more certain hardly seems reasonable.

All this takes place in a virtual state of euphoria, in which foreign treasuries and central banks adopt such a kindly attitude toward one another that *retaliation* is ruled out. But let us at least review the possibility of retaliatory reaction from the point of view of our own national interest. In early 1964 a flurry of central-bank-rate increases by Japan, the United Kingdom, and Western European nations raised the prospect of substantial changes in United States interest rates.

Finally, in November the sterling crisis and British Bank-Rate rise prompted the Federal Reserve to hike its discount rate, too. Although Federal Reserve officials sagely did not announce a public policy of retaliation against foreign interest-rate advances, they did in fact retaliate. Such a policy of competitive interest-rate changes, customarily deplored by the United States Treasury and the Federal Reserve System, really is no different from the type of policy often practiced by nations other than ourselves. Thus, if the United States, whose trade as a share of GNP is very low relative to that of its trading allies, willingly attempts to defend itself, by such measures, against short-term capital movements, how much more likely are nations heavily dependent on exports to do so?[56] Many of these nations are experiencing balance-of-payments deficits themselves.

[56] For the period 1959-1961, U. S. exports averaged 5.1 per cent of its GNP, while Japanese exports were 12.0 per cent, French 15.8 per cent, Canadian 19.7 per cent, British 23.5 per cent, Belgium 35.0 per cent, and Dutch 51.9 per cent.

VI. CONCLUSION

There is an ironic parallelism between U. S. monetary policy since the turn of the decade and the overall American attack on the payments deficit. The objective of the United States has been to retain the key-currency role of supplying dollars to the Free World by restricting their outflow. This, however, is a flagrant contradiction of ends and means. As under the discarded gold standard, it was hoped that all nations would receive the benefits of the international monetary system without having to meet all of its obligations. Appropriately, a "timely re-structuring" of exchange rates, which was the key to the proper functioning of the new gold-exchange system, was ruled out for the United States. Exchange rates were not to be altered, but neither were domestic production and employment to be sacrificed. These too are conflicting aims.

So long as a substantial deflation was ruled out, monetary policy could not be geared directly to improving the trade balance of the United States in the short run. At the same time, if Federal Reserve policy was to stop speculative capital flights, it had to be sufficiently restrictive to convince speculators that the Government was willing and able to depress domestic economic activity to the necessary degree.

The monetary authorities did not accept this challenge head-on. Rather, they turned to a highly technical policy of pegging and nudging short-term interest rates. While the securities-trading experience of the Federal Reserve System was undoubtedly broadened, the foregoing discussion casts considerable doubt upon its substantive value in curing the payments deficit. In this more specific respect the dilemma of the dollar returns to haunt us. Interest-rate actions to reduce interest-rate arbitrage may in fact increase the incentive for further arbitrage, as the result of an ill-behaved forward exchange rate. Indeed, though the official policy goal was to curb the capital outflow while keeping it sufficient to fulfill the dollar role of key currency, the result of applying the monetary-policy remedies indicated by traditional theory was really to accentuate the potential dollar loss.

Hence the monetary authorities may have raised interest rates too high for the purpose of domestic growth but not high enough for the purpose of reversing short-term capital movements. Such a policy comes dangerously close to doing both too much and too little. In

short, domestic monetary policy appears to have been *unnecessarily* constrained by Federal Reserve-Treasury actions designed to give artificial support to short-term interest rates between late 1960 and early 1965.

APPENDIX A

GLOSSARY OF FOREIGN-EXCHANGE TERMS

Foreign Exchange—is a means of payment or instrument of short-term credit of other countries with different monetary units, from the point of view of persons engaged in purchases or sales against the national currency. The term is normally employed with reference to telegraphic or telephonic transfers from one currency into another.

Specifically, the monetary instruments include notes, checks, bills of exchange, and bank balances and deposits in foreign currencies.

Forward Exchange—is foreign exchange bought or sold for future delivery (hence the term "futures" sometimes used in American literature) against payment in home currency on delivery. Such transactions are confined almost exclusively to transfers, the purchase and sale of bank balances in terms of a foreign currency.

Spot Exchange—is foreign exchange bought and sold for delivery two days after conclusion of the exchange and paid for upon delivery. Some analysts would say that such transactions are really forward deals for two days.

Forward Rate—is the unit price in domestic currency of foreign exchange sold for future delivery.

Forward Premium (or discount when negative)—is the difference between the forward and spot rates expressed as a per cent of the spot exchange rate. When forward exchanges are worth more than the corresponding spot exchanges they are at a premium; if they are worth less they are at a discount.

Interest-Rate Differential (or sometimes "interest-rate spread")—is the difference between uncovered short-term interest rates prevailing in two money centers at a given moment.

Intrinsic Premium (or discount)—is the discrepancy between interest spreads and forward rates. When the forward discount is less (perhaps at a premium itself) than the interest-rate spread, the difference constitutes an intrinsic premium. When the discount is more than the interest differential, the difference is an intrinsic discount. This is sometimes expressed as an overvaluation or undervaluation of forward exchanges. Normally, the premium or discount is expressed in terms of per cent per annum.

Swap Transaction—is the purchase or sale of spot exchanges against the sale or purchase of forward exchanges. In recent years this has taken on a more technical meaning. While swap used to mean the simultaneous covering of a sale or purchase of currency, today it ordinarily refers to the simultaneous purchase and sale of currencies of varying maturities by a central bank.

Outright Transaction—is a transaction in which the purchase or sale of forward exchange is not linked with a spot transaction.

Covering—by means of forward exchange transactions is an arrangement to safeguard against the exchange risk on a payment of a definite amount to be made or received on a definite date in connection with a self-liquidating commercial or financial transaction.

Hedging—by means of forward exchange transactions is an arrangement to safeguard against an indefinite and indirect exchange risk arising from the existence of assets or liabilities, the value of which is subject to changes via spot rates. The entire amount of the asset or liability need not be hedged.

Hedging also is sometimes defined as deliberately taking a speculative risk in order to offset a bigger speculative risk in the opposite direction.

Interest Arbitrage—is the international transfer of funds to a foreign center, or the maintenance of funds in a foreign center, instead of repatriating them, for the sake of benefiting by the higher yield on its short-term investment in that center. Strict interest arbitrage is covered. The cost of the covering operation is deducted from the interest differential or the profit derived from it is added to the interest spread to determine the net profit from the transaction.

Open Position—constitutes the difference between the total of a foreign currency owned or receivable and the total of the same currency payable under definite contracts. If the amount held and receivable exceeds the amount payable, the difference represents a *long* position. If the amount held or receivable is less than the amount payable, it constitutes a *short* position.

Speculation (defined in a broad sense)—is the deliberate assumption or retention of a net open (long or short) position in foreign exchange in consideration of the expected future spot rate (or sometimes expected forward rate). This constitutes an uncovered exchange risk, and can take either an active or passive form.

Pure (Active) Speculation—is the deliberate assumption or retention of a net open (long or short) position in foreign exchange in order to make a predicted profit through expected changes in the spot rate.

Passive Speculation—is an uncovered exchange position ancillary to some transaction other than pure speculation. Whenever a net open position results, at some risk, from export-import transactions or interest-rate arbitrage, it is a form of passive speculation.

Exchange Arbitrage—is a simultaneous three-way transaction wherein exchange dealers gain a profit from a temporary difference between two currencies in terms of a third.

Bear and Bull Positions—are short and long positions deliberately created for speculative purposes either by forward exchange operations or by borrowing or lending abroad and selling and buying spot exchange.

APPENDIX B

CAPITAL CONTROLS, SOME MAJOR INDUSTRIAL COUNTRIES

Country	Type of capital movement				
	Convertibility of currency on capital account	Direct investments abroad	Portfolio investments abroad	Commercial credits—5 years and under	Financial loans
Belgium-Luxembourg	External	Control via free market	Control via free market	Control via free market	Control via free market
France	do	Liberalized	Free	Liberalized	Individual licensing and banking laws
Germany	Full	Free	do	Free	Free
Italy	External	Largely liberalized	Generally permitted, with some exceptions	Credits up to 5 years liberalized, all other credits under 1 year liberalized	Loans within the EEC under 5 years, less than $80,000, and with interest less than 6 per cent are free; loans over 1 year liberalized
Netherlands	do	Liberalized	Control via free market	Liberalized	Individual licensing
Switzerland	Full	Large credits controlled under banking laws	Large credits controlled under banking laws	Large credits controlled under banking laws	Large credits controlled under banking laws
United Kingdom	External	Individual licensing and control via free market	Control via free market	Controlled over 6 months	Controlled under both banking and exchange-control laws

Country	Type of capital movement				
	Deposits in foreign banks	Flotation of securities issues by nonresidents	Repatriation of direct investments by nonresidents	Repatriation of portfolio investments by nonresidents	Areas where special regulations apply[a]
Belgium-Luxembourg	Control via free market	Banking laws and free-market exchange rate	Control via free market	Control via free market	None
France	Generally not permitted	Controlled under both banking and exchange-control laws	Liberalized	Free	French franc area
Germany	Free	Free	Free	....do	None
Italy	Generally not permitted	Controlled under both banking and exchange-control laws	Liberalized	Liberalized	OECD; EEC
Netherlands	....do	....do	....do	Control via free market	Guilder area
Switzerland	Free	Controlled under banking laws	Free	Free	None
United Kingdom	Generally not permitted	Controlled under both banking and exchange-control laws	Free on approved investments	Control via free market	Sterling area Uniscan

[a] Payments to bilateral-account countries not listed here are also under special controls.

NOTE.—The notation "liberalized" indicates that prior authorization is required, but is freely given. The notation "control via free market" indicates that transactions are permitted, but that the call for foreign exchange to finance them is restricted by channeling them through a free market, the supply of foreign exchange to which is limited. Tendencies for outflow to increase result in changes in the free-market exchange rate rather than in an increased outflow of foreign exchange.

SOURCE.—U. S. Congress, Joint Economic Committee

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