

ESSAYS IN INTERNATIONAL FINANCE

No. 40, October 1962

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THE NATURE AND EFFICIENCY  
OF THE  
FOREIGN EXCHANGE MARKET

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INTERNATIONAL FINANCE SECTION

DEPARTMENT OF ECONOMICS

PRINCETON UNIVERSITY

Princeton, New Jersey

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*International Finance Section*

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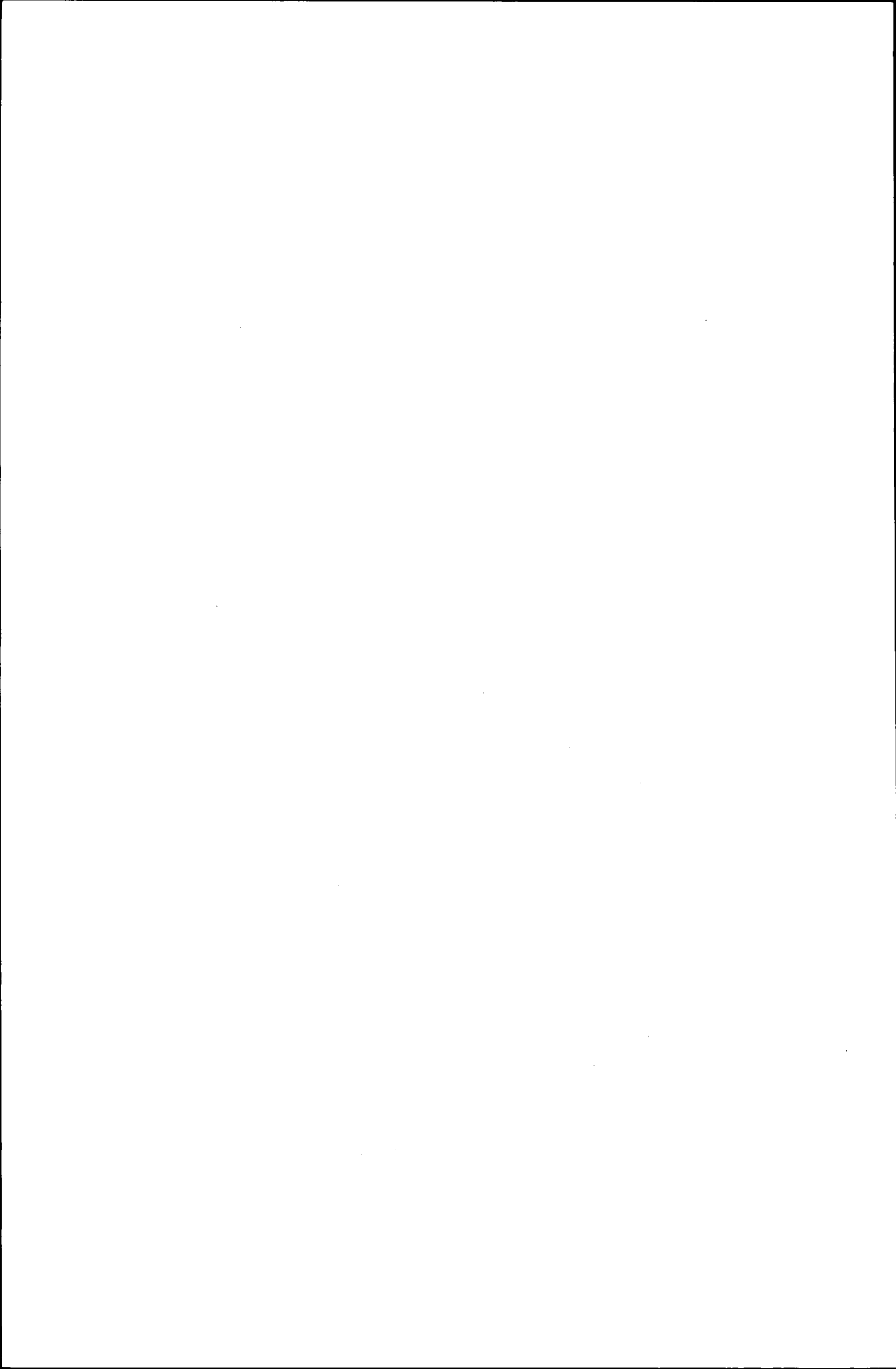


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# THE NATURE AND EFFICIENCY OF THE FOREIGN EXCHANGE MARKET

## I. THE SCOPE AND SIGNIFICANCE OF THIS STUDY

ONE of the most important and least understood markets is the foreign-exchange market. Through this institution, residents of different currency areas are enabled to trade with one another, and invest in one another's assets. Despite Great Britain's dependence upon international trade and London's historic role as banker for the world, the Radcliffe Committee hearings indicated that many economists and bankers do not fully understand the nature of the foreign-exchange market. The Committee was led to ask: "How well organized is the forward-exchange market? Can we hear more about who is engaged in the market? Whom does it comprise?" The answers to these questions left much to be desired.

The Bank of England has varied the Bank Rate to affect, among other things, movements of short-term capital. Nevertheless, the Committee discovered that the Bank does not know the impact of Bank Rate policy upon the foreign-exchange market and upon the international movement of short-term capital.\*

Concern is being shown over the adequacy of the international monetary reserves of the United States relative to its short-term liabilities. As a result of gold outflows, the gold reserves of the United States are \$16.5 billion (as of the end of May 1962), whereas its short-term liabilities to foreign countries exceed \$18.9 billion. Since the dollar is a key-currency, the low ratio of gold to short-term liabilities has been viewed with apprehension. Were a downward trend in this ratio to continue, many believe that foreign confidence in the dollar would be weakened and a serious financial crisis would occur.

One method of coping with the problem of international reserves would be to eliminate the need for official reserves, by leaving the foreign-exchange market free to equilibrate the demand and supply of foreign exchange. Central banks and official stabilization funds would abdicate in favor of private enterprise.

\* Committee on the Working of the Monetary System, Minutes of Evidence (London: HMSO, 1960) para. 3215-19 and 1479-90.

This proposal has found little favor with economists, and still less with members of the New York financial community. While the latter called a system of floating rates "a trader's paradise," many thought that such a system was socially undesirable. They maintain that a foreign-exchange market completely free from government stabilization cannot be relied upon as the sole source of cushioning for current-account disequilibria. The Radcliffe Committee considered that experience between 1914 and 1925, and again between 1931 and 1939, had been sufficient to demonstrate the "inconvenience of a fluctuating pound." Many claim that the recent Canadian experience is inconclusive as a demonstration of the successful operation of a completely free market, since the central bank was in the market constantly to absorb the excess supplies and demands of U.S. dollars. On the other hand, there was little intervention in the Canadian-sterling market, for this rate was highly volatile. For example, the price of sterling ranged from C \$2.71-11/16 to C \$2.75½ during the period January 27, 1959 to February 13, 1959. From March 28, 1959 to May 26, 1959 the price ranged from C \$2.69-15/6 to C \$2.72-5/8. Numerous other similar instances can be cited. These marked price fluctuations suggest that more evidence is required before one may assert that a completely free exchange market is superior to a stabilized exchange market.

The small group of economists who favor a free exchange market adduce *a priori* reasoning to support their claim that a free market would efficiently cushion temporary current-account disequilibria. This group claims that "positive speculators' profits imply that they have stabilized the price."\* Destabilizing actions by speculators are said to imply that they have lost money. Insofar as their operations are profitable, it is claimed that they have been a stabilizing influence. No evidence has been adduced by this group to show whether or not "speculators" did in fact make money. Moreover, the argument concerning the relation between stability and profitability has been shown to be incorrect, in the institutional context of the contemporary exchange market. When there is trading in both spot and forward exchange, and only the spot price is stabilized by the exchange authority, speculators can destabilize the price and yet make money.

Although little is known about the nature of the foreign-exchange market, each group in the dispute holds its position with great confidence. The members of the first group glanced at economic history casually, and found large price movements during a period of free exchange

\* Lester G. Telser, "A Theory of Speculation Relating Profitability and Stability," *The Review of Economics and Statistics*, Vol. XLI (August 1959); Milton Friedman, "The Case for Flexible Exchange Rates," in *Essays in Positive Economics* (Chicago 1953), pp. 157-203.

markets. But these financial experts and economists failed to examine the question of cause and effect. Did the free exchange market unsettle an otherwise stable system; or did the era of a free market coincide with a period of great instability in the balance of payments? If the exchange markets had been stabilized during this period, what would have happened to the international reserves of the various countries? Could stabilized rates have been held at their prewar levels during the period 1919-1925? None of these questions has even been raised by the opponents of free exchange markets. On the other hand, the members of the second group failed to adduce any evidence that the activity of risk-bearers in a free exchange market is such as to avoid excessively large price fluctuations that result from random variations in the balance of payments, i.e., that result when the market has confidence in the stability of the current set of exchange rates. This is an empirical question, and the proponents of free markets have neglected to examine it adequately.

Recently, the U.S. Treasury, acting through the Federal Reserve Bank of New York, has intervened in the forward-exchange market. With the cooperation of the Bundesbank, it has sold D-mark futures, and with the cooperation of the Swiss National Bank it has sold Swiss francs forward, to reduce the forward premia. At the time, the President of the New York Federal Reserve Bank said operations in other European currencies were being considered in order to further strengthen central bank defenses against speculative capital movements.

Efficient intervention presupposes a thorough knowledge of the system of interrelationships known as the foreign-exchange market. Otherwise, the indirect effects of a given policy may run counter to the objectives of the policymakers.

The present essay is devoted to a study of the interrelationships among the participants in the foreign-exchange market. In Section II, we discuss the functions of the foreign-exchange market, and present a general view of the roles of professional risk-bearers, interest-arbitrageurs, borrowers who hedge their foreign-exchange liabilities and speculators. Section III gives a detailed examination of the methods of operation of professional risk-bearers and interest-arbitrageurs in the contemporary foreign-exchange market; the complexities of the market are explicitly considered in this section. Section IV explains the reactions of the foreign-exchange market to current and to anticipated disturbances. There is one pattern of price behavior that results from random variations in the balance of payments; and a different pattern of price behavior that results when the market thinks that changes in the exchange rates will occur in the near future. An examination of the

data enables us to infer the nature of the disturbance: whether it was based upon random or anticipated fluctuations in the balance of payments. Finally, the price relationships that prevailed during recent speculative periods are shown to be compatible with the analysis developed in Section IV. The appendix utilizes the techniques developed in the previous section to answer the question: can professional risk-bearers forecast price in an exchange market which is completely free from central-bank intervention? For this purpose, the free sterling-dollar market from 1921-1925 is examined. We conclude that they were, indeed, able to forecast price and succeeded in making profits.



## II. THE FUNCTIONS OF A FOREIGN-EXCHANGE MARKET

### A. *The Efficiency of a Foreign-Exchange Market*

**A**LTHOUGH the basic balance of payments may be in equilibrium\* over the year as a whole, at a given exchange rate, it is unlikely that the balance will be in equilibrium every day, week or month. The balance on current account varies during the year from a surplus to a deficit, particularly in countries producing primary products. In the United States, for example, the balance on current account during 1959 was \$172 million; but there were surpluses in the first and last quarters, and deficits in the second and third quarters, of the year. A foreign-exchange market which results in a situation whereby the basic balance is in equilibrium at every quarter, month, week, or day is an inefficient market. An analogy can be made between the fluctuations in the net supply of wheat and in the net supply of foreign exchange. Wheat is harvested a few times during the year. It is socially desirable that the consumption of wheat, or foreign exchange which is simply a command over imports, be spread out over the year. This spreading (or smoothing) out can only occur if there are institutions willing to sell foreign exchange during periods of shortage and buy foreign exchange during periods of surplus. A period of shortage occurs when our basic balance tends to be negative; and a period of surplus occurs when our basic balance tends to be positive. An efficient market exists if there are institutions willing to buy and sell foreign exchange for, and from, inventory during these periods. In effect, these institutions invest in foreign exchange during periods of surplus and disinvest during periods of shortage. Through variations in the inventories of these private institutions, i.e., the short-term capital account,† the supply and demand for foreign exchange will be equal every day, although the basic balance may be in equilibrium only over the year as a whole.

A year is an arbitrary period of time. At a given exchange rate, the

\* The basic balance of payments is the sum of the current-account balance plus the long-term capital account plus unilateral transfers. The term equilibrium has many meanings, especially in the balance-of-payments literature. In the present chapter it is used to mean that the sum of surpluses and deficits over a given period of time is equal to zero.

† The short-term capital account refers to the *private* sector's *net* change in short-term claims against foreigners. The sum of the short-term capital account plus the net change in *official* claims against foreigners is identically equal to the basic balance. Since the analysis here is devoted exclusively to the private sectors, variations in the official or government claims against foreigners are excluded from the present analysis of how the foreign-exchange market operates.

basic balance may be in equilibrium over the current year. Suppose that a shortage or a surplus of foreign exchange is anticipated for the following year. An efficient exchange market should induce the economy to prepare for future shortages or surpluses. If a shortage is anticipated, the economy should be induced to accumulate foreign exchange at present: i.e., to export short-term capital. On the other hand, if a surplus is foreseen, the economy should be induced to borrow (import) short-term capital during the current period. Again, an analogy can be made with wheat production. If a wheat shortage is expected, the economy should be induced to accumulate wheat inventories. That is, current production should exceed current consumption. On the other hand, if a surplus of wheat is expected, current consumption should exceed current production and wheat inventories (if they exist) should be reduced.

An efficient foreign-exchange market cannot exist unless there are institutions which can be induced to accumulate foreign exchange during periods when there is a surplus in our basic balance, and decumulate stocks of foreign exchange during periods when there is a shortage in our basic balance. The terms "surplus period" and "shortage period" refer to a longer period of time, over which the basic balance is zero.

The institutions which can be induced to import or export short-term capital occupy a crucial role in determining the efficiency of the foreign-exchange market. A general and simplified discussion of the variables which influence their behavior is the subject of this section. The phenomena of interest arbitrage, the switching of finance with the exchange risk covered, speculation in foreign exchange and the necessity of a set of professional risk-bearers are explained. The simple rules and conclusions presented here are modified in the next section to correspond more accurately to the complex world of our experience.

## *B. Short-Term Investment and Borrowing*

I. RISK-AVOIDING SHORT-TERM INVESTORS. Many institutions which invest in domestic Treasury bills and other domestic short-term securities can be induced to invest in foreign Treasury bills and other foreign short-term securities, and vice-versa. A comparison of the relative rates of return on domestic and foreign assets is one of the key considerations involved in the selection of an efficient portfolio. Suppose that the investor firmly expects to hold the bill until its maturity three months later. The expected return on an investment of \$1 in U.S. Treasury bills is \$1 multiplied by the Treasury-bill rate. The expected return on \$1 invested in U. K. Treasury bills is not necessarily \$1 multiplied by the U. K. Treasury-bill rate. There is no certainty that the American investor will be able to sell his sterling for the same price at

which it was purchased. Whenever there is uncertainty concerning the rate of exchange, the expected return on foreign investment is not necessarily the same as the foreign-interest rate.

Whenever forward markets exist, the risks of exchange-rate fluctuations can be reduced by shifting them to the professional risk-bearers. The investor in U. K. Treasury bills can get a quotation on a *swap* from a professional risk-bearer. The *swap* is a simultaneous purchase and sale of foreign exchange of different maturities, entered into with a given party. Thus the investor may be told, on March 28, 1962, that he can buy pounds for \$2.81-3/4 and that he can sell his pounds three months later for \$2.80-1/8. The investor could contract a current (spot) purchase and a forward sale of pounds, on that date, at a cost of 2.307 per cent per annum. A potential short-term investor would compare the Treasury-bill rates in the two countries with the cost of the swap, to determine relative returns on comparable assets. His expected return on a U. K. Treasury bill held to maturity would be equal to the U. K. Treasury-bill rate less the cost of the swap (2.307 per cent). It is this rate of return, with the exchange risk covered, that can properly be compared with the rate of return on a U.S. Treasury bill. Whenever the foreign-interest differential (i.e., the foreign rate less the U.S. rate) exceeds the cost of the swap, the rate of return on a foreign asset held to maturity exceeds the rate of return on a domestic asset held to maturity. Thereby an outflow of short-term capital is induced; that is, Americans are induced to accumulate interest-yielding foreign exchange.

On the other hand, when the foreign-interest differential is less than the cost of the swap, an inflow of short-term capital is induced. For example, if on March 28, 1962, the U. K. Treasury-bill rate was 4.5 per cent and the U. S. Treasury-bill rate was 2.7 per cent, the expected return on a U. S. Treasury bill to maturity exceeded the return on a U. K. Treasury bill held to maturity, with the exchange risk covered. An institution which owns, or has access to, pounds could do the following on March 28, 1962: (i) buy dollars for pounds; (ii) invest in U. S. Treasury bills; and (iii) sell the dollars forward for pounds, to be delivered in three months. It would earn 2.7 per cent on the Treasury bills and 2.307 per cent on the swap, for a total of 5.007 per cent. This exceeds the 4.5 per cent return that it could earn on U. K. Treasury bills held to maturity; and it would have pounds at the end of three months for use in its main business. In this situation, an English branch of the American concern is induced to decumulate pounds, and an English concern is induced to supply pounds in the present.

Interest arbitrage is the phenomenon whereby firms tend to invest

abroad with the exchange risk covered with a forward sale of the currency. The institutions engaged in this form of investment, the interest-arbitrageurs, are risk-avoiders.

2. RISK-AVOIDING SHORT-TERM BORROWERS. The same variables which induce short-term investors to invest in (say) New York, rather than in London, induce certain firms to borrow short-term funds in London rather than in New York. The choice among alternative sources of finance, with the exchange risk covered, is the dual to interest arbitrage discussed above. Its effects are exactly the same as those of interest arbitrage.

An American concern in need of funds for (say) three months may command such an outstanding international reputation that it can borrow as easily in London as it can in New York. Most likely, it will have branches in all major money markets. The prime-commercial-paper rate in New York may be 3.25 per cent per annum, and in London it may be 4.63 per cent per annum. If the concern in question borrows in London, its expected cost in dollars is uncertain if it sells the borrowed sterling for dollars, and fails to protect itself against the exchange risk. When the loan has to be repaid, the price of sterling may have risen above, or have fallen below, the price at which the borrowed sterling was originally purchased. The borrowing concern, if it chooses, can reduce the exchange risk by comparing the costs of borrowing in London and in New York with the exchange risks covered.

To borrow in London the firm must pay 4.63 per cent per annum. If the sterling is sold for dollars and simultaneously repurchased for delivery in three months, the firm will make 2.307 per cent per annum (given the rates quoted in section A above). Its net borrowing cost would be 2.323 per cent ( $4.63 - 2.307$  per cent) per annum. On the other hand, if it borrowed in New York its cost would be 3.25 per cent per annum. The foreign-interest differential of 1.38 per cent ( $4.63 - 3.25$  per cent) is less than the discount on the forward pound of 2.307 per cent. Hence, if the debt will be repaid at maturity, it is cheaper to borrow abroad with the exchange risk covered than it is to borrow at home. Thereby a supply of pounds is produced in the foreign-exchange market.

Whenever an inflow of funds into the United States is induced as a result of interest arbitrage, American firms are induced to borrow abroad rather than at home. This increases the supply of (spot) foreign exchange offered in the market. Foreign firms are discouraged from borrowing in New York and, as a result, the demand for foreign exchange is reduced. Conversely, whenever an outflow of funds from

the United States is induced by interest arbitrage, foreign firms are induced to borrow in New York rather than in their own countries and, as a result, the demand for (spot) foreign exchange is increased. American firms are discouraged from borrowing abroad, and the supply of foreign exchange is reduced.

3. UNCOVERED POSITIONS. Institutions may invest in foreign short-term securities, or incur liabilities denominated in foreign currency, without protecting themselves against exchange-rate fluctuations. Suppose that the maximum decline in the price of foreign exchange, within its stabilization limits, is less than the foreign-interest-rate differential. Then an institution which thinks that devaluation is improbable within three months may not bother to sell forward exchange at a discount, when it purchases a foreign Treasury bill or Bank bill. Thereby it saves the cost of the swap, which is the cost of an insurance premium, on an asset which will be held to maturity. Similarly the firm which borrows in the low-interest-rate money market need not purchase forward exchange, if it is at a premium, provided that the maximum rise in the price of foreign exchange is expected to be less than the interest differential. An institution which fails to secure forward cover (i.e., to offset its foreign-exchange asset with a forward sale, or to offset its foreign-exchange liability with a forward purchase) is not necessarily speculating. In the pre-1914 gold-standard era, short-term capital flowed among countries without forward covering, because the spread between the gold points was often narrower than the interest differentials and devaluation was considered most improbable. Speculation was not responsible for the failure to cover. The investors or borrowers did not consider the insurance worth the cost.

### *C. Risk-Bearing*

I. PROFESSIONAL RISK-BEARERS. The risk-avoiders are the investors in foreign assets who want to protect themselves against the decline in the price of foreign exchange, and the institutions which have incurred liabilities in foreign currency and want to protect themselves against a rise in the price of foreign exchange. If there were no institutions willing to buy and sell forward exchange, then the risks of exchange-rate fluctuations would deter many from investing or borrowing abroad. An efficient foreign-exchange market requires that there be short-term capital exports when our basic balance *tends* to be in surplus, and short-term capital imports when our basic balance *tends* to be in deficit. Over the entire period the basic balance should be in equilibrium; but, as already noted, it is inefficient to restrict monthly

or quarterly imports to be exactly equal to the corresponding value of exports. If the risks of foreign investment and borrowing are great, there will be few institutions willing to accumulate foreign exchange during periods of surplus and sell foreign exchange during periods of shortage. The market would then be forced to restrict its imports of goods and services to the value of exports of goods and services. For primary-products producers, imports would be cheap and lavishly consumed shortly after the harvests, and imports would be scarce during the rest of the year.

Insofar as investors and borrowers can shift the exchange risks onto a set of professional risk-bearers, there will be a more abundant flow of short-term capital among countries. The professional risk-bearers quote prices for forward exchange and for spot exchange. For the reasons explained in section IV, sometimes the forward exchange is at a premium and at other times it is at a discount relative to the spot exchange. In the example cited on page 9, the forward pound was at a discount (or the forward dollar was at a premium) of 2.307 per cent per annum. An investor in sterling short-term assets who protects himself against the exchange risk pays an insurance premium of 2.307 per cent per annum to the risk-bearer. On the other hand, the firm which borrows in London and protects itself against the exchange risk by selling forward dollars to (i.e., by purchasing forward pounds from) the professional risk-bearers, finds that it will gain 2.307 per cent per annum by "purchasing" this insurance. The insurance cost, in a sense, is negative. (Cost here is defined to mean the difference between the forward price at which the foreign exchange is purchased and the spot price at which the borrowed foreign exchange is initially sold.)

In a world of exchange-rate uncertainty, the professional risk-bearers facilitate the international flows of short-term capital. In so doing they contribute to the efficiency of the foreign-exchange market.

Moreover, their willingness to bear risk stimulates international trade and leads to more efficient international distribution and production of goods and services. Exporters may quote prices either in terms of domestic currency or in terms of the currency of the importers. In either case, one of the parties to the transaction incurs an exchange risk. By shifting the exchange risk to professional risk-bearers, the volume of trade can be increased. A vivid example of how the existence of risk-bearers can stimulate trade concerns German-Russian trade in the last quarter of the nineteenth century. The British exporters "never quoted in terms of a fluctuating currency," and Russian importers would have had to bear the entire exchange risk. German exporters were willing to quote in terms of rubles since a well developed forward market existed in

Berlin. The German exporters were able to shift the exchange risks to the professional risk-bearers who purchased forward rubles. I think that partly as a result of this ability, of German exporters and importers to shift the risks to a group specializing in risk-bearing, one-third of Russia's foreign trade was with Germany. The inducement to engage in international trade and profit from international differences in price, is increased by the presence of professional risk-bearers who make markets in forward exchange.

2. SPECULATORS. Theoretically, the exchange market could be efficient if speculators were willing to purchase foreign exchange when the basic balance tended to be in surplus, and were willing to sell foreign exchange when the basic balance tended to be in deficit. Then the existence of the forward market would not be necessary to induce inflows and outflows of short-term capital. The speculators would perform the functions of foreign investors, borrowers and risk-bearers. To revert to the wheat analogy, the speculators would be the purchasers and stors of wheat in the post-harvest season, and the sellers of wheat out of stocks during the pre-harvest season.

The main body of speculators in foreign exchange are the exporters and importers who have claims or liabilities denominated in foreign currencies. Their main method of speculation is via the leads and lags in international payments. When there is an excess supply of foreign exchange the price tends to fall. If the speculators think that this decline is temporary, the importers who must make payments in foreign currency accelerate their purchases of foreign exchange. Thereby, they accumulate foreign-exchange inventories in anticipation of a rise in price. They are both foreign investors and speculators. Similarly, the exporters who have received payment in foreign currency may lag their sales of foreign-exchange receipts. They will continue to hold these foreign assets in anticipation of a price rise. The net effect of the leads and lags is to produce a short-term capital outflow, when a period of shortage is expected to follow the current period of surplus. The economy thereby stores foreign exchange for the anticipated period of shortage.

When a surplus in the basic balance is anticipated, the leads and lags operate in reverse and produce a capital inflow. Importers who have incurred liabilities in foreign currency speculate by lagging, or delaying, their payments. An attempt is made to maintain their foreign-exchange liabilities in the anticipation of a decline in the price of foreign currency. This lag reduces the demand for foreign exchange. Importers who lag their payments are similar to the firms which borrow abroad and expect to repurchase the foreign exchange at a lower price than it was sold

originally. Exporters speculate against a currency by accelerating the sales of their export receipts before the price falls. This increases the supply of foreign exchange prior to the appearance of the surplus. The net effect of the leads and lags, in this example, is to produce a capital inflow in anticipation of a surplus in our basic balance. Thereby the economy is induced to increase its present rate of import consumption in view of an expected increase in foreign-exchange receipts.

Although speculators are substitutes for interest-arbitrageurs, for borrowers who cover themselves against exchange risks, and for professional risk-bearers who make (*inter alia*) markets in forward exchange, they are imperfect substitutes. First, the total supply of international short-term capital would be reduced if potential investors could not shift the exchange risks to the professional risk-bearers. On the other hand, the existence of forward markets and professional risk-bearers does not reduce the supply of *speculative* capital. Second, when there is exchange-rate uncertainty, the existence of a forward market increases the volume of international trade. A contraction of international trade, which would occur if forward markets were reduced in scope by official restrictions and therefore made more risky, would reduce world national income and welfare. Hence speculators are not perfect substitutes for professional risk-bearers.



### III. PROFESSIONAL RISK-BEARERS AND SHORT-TERM INVESTORS

The efficiency of the foreign-exchange market is profoundly influenced by the activities of the professional risk-bearers and short-term investors. In this section, the professional risk-bearers and short-term investors are described in detail.

#### *A. Professional Risk-Bearers*

The large banks which buy and sell foreign exchange are the professional risk-bearers in the foreign-exchange market. This responsibility is the function of the senior exchange trader, who is usually a vice-president of his bank. Exchange traders make primary markets. They quote "bid and ask" prices, and act as principals in almost all transactions. In "exotic" currencies—those which are infrequently traded—or in currencies of nations with highly unstable or capricious governments, the risks of acting as principals are too great. Then the traders act as brokers: they buy if they can find a customer and sell if they can find someone who has that currency to offer. There are brokers who are used in inter-bank dealings in the New York market, but they are quite distinct from the traders who work for the banks with foreign-exchange departments. In the New York market, banks do not deal directly with each other but use the services of brokers. A two-point ( $2/100$  of a cent) commission is charged for these services. Moreover, brokers keep traders informed of the prices in the market. There are many misconceptions concerning the source of profits for exchange traders. Their profits, when they exist, do not arise mainly from the spread between their bid and ask prices. When a trader makes a market, by quoting a bid and an ask price, he does not necessarily buy at the bid and sell at the ask. Position-taking involves risk. This is illustrated by the following incident.

On the Friday prior to the revaluation of the D-mark in 1961 (from 4.2 to 4.0 marks to the U.S. dollar) several banks found themselves oversold on D-marks. During the day, their customers and other banks purchased more D-marks than they sold to the banks in question. The bank traders expected to cover their sales by purchasing D-marks in Germany on Saturday morning. If they sold dollars at the Bundesbank's buying price for dollars (i.e., selling price for D-marks), they would have made profits on the transactions. Revaluation was "in the air": it had been expected for months. But *traditionally*, exchange-rate changes had been made after the close of business on Saturdays. So, they were confident that they could buy their marks on Saturday morning.

Moreover, a high authority in the Bundesbank said, in a speech to a small group of bankers on Thursday, that revaluation would not occur. On Saturday morning, the traders placed buy orders with the German commercial banks. The German commercial banks went to the Bundesbank, which was the only buyer of dollars at that time. Contrary to previous practice, the Bundesbank refused to sell; and it revalued the mark. Instead of a trading profit, a loss was made on an uncovered short position.

1. LINES, POSITIONS AND INVENTORIES. A trader has a *running position sheet* in each currency. This sheet contains the purchases and sales for a series of dates, and the sum of the net purchases over the entire series of dates. The bank's *position* is the sum of its net purchases and sales for the set of dates in its running position sheet. A position may be *long* or *short*, depending upon whether the bank is a net buyer or seller of foreign exchange over the set of dates.

Most traders have *lines*, which are the maximum long and short positions they can have in various currencies. The lines given to the trader depend upon (1) the capital of the bank: its ability to withstand losses. An intrepid trader can embarrass his bank financially. Positions are checked regularly by the senior trader, who usually is a vice-president, and by the executive vice-president, to prevent the trading department from assuming more risk than senior management deems prudent. The lines also depend upon (2) the volume of business in a given currency. The lines in sterling and the Canadian dollar will normally exceed the lines in the lira and the D-mark, because the volume of business in the first two currencies is so great. Moreover, as the volume of business in sterling has grown since 1958, sterling lines have also increased.

Every bank which maintains a market in a given currency has an inventory of that currency, or has to maintain at least one account in a bank in the country of that currency. Even when a bank has a short position in a currency, it will probably have an inventory of that currency. On a certain day, say January 9, a bank may have £ 1 million. But in the sterling position sheet of that date, there may be more future commitments to sell sterling than to buy sterling. Over the entire set of commitments, the bank may be a short-seller, although it currently owns £ 1 million of balances.

Balances or inventories are held for the convenience of doing business with customers, just as the retail merchant, manufacturer or wholesaler holds an inventory of goods.

2. THE MANAGEMENT OF POSITIONS. A position is held to anticipate the requirements of customers and to anticipate the movements of the

market, in such manner that profits will be made. For example, in 1957 the major traders did not share the customers' views that sterling would be devalued, or that the D-mark would be revalued. They did expect their customers and other banks (e.g., foreign banks) to offer sterling and demand D-marks. Consequently, they assumed long positions in D-marks and short positions in sterling to anticipate the customers' requirements. By purchasing D-marks for a series of dates and selling sterling for a series of dates, (i) they were able to sell D-marks spot, near future and far future without being short and, (ii) they were able to buy sterling spot, near-future and far-future without being overloaded. If they had not assumed a short sterling position, the bank traders would not have been able to make attractive bids on the customers' offers to sell, or they would have been forced to unload quickly before the price of sterling fell in the market. The New York banks are in active competition with each other; and are anxious to offer the highest bid and lowest ask to secure the customer's business, and still make a profit. If a banker allowed his position to be thrust upon him, he would not have been able to compete actively for his customers' business. Each trader attempts to impress upon his customers his ability to give them the best prices in the market.

Positions are also taken to anticipate the market's reaction to future events. If a trader believes that, when the U.K. gold-reserves figures are published in the next few days, they will show a significant decline, he will take a short position in sterling. He expects the prices of spot and future sterling to decline when the market sees the published figures. Then, he could even out his short position at a profit.

Positions have to be managed, for the banks' customers and other banks are constantly thrusting positions upon them. The trader must decide what position he wants to take, in each currency, and must react accordingly.

3. LONG POSITIONS. Suppose that a bank is offered foreign exchange, for spot and future delivery, over a period of days. Several choices are open to the bank trader. (1) He may sell the exchange outright. (2) He may take a long uncovered position. (3) He may hedge the spot and near-futures by deliberately taking a short position in far-futures.

All banks cannot even out their spot positions, if they have been net buyers of foreign exchange as a result of a balance-of-payments surplus. Attempts by some banks to even out their positions will result in declines in the prices, and hence in trading losses for the selling banks. The bank trader will decide whether it is more advantageous for him to

sell out at a loss or to adopt some combination of alternatives (2) and (3) above.

As the price of foreign exchange falls under the selling pressure, a trader who thinks that the price decline will only be temporary may consider maintaining a long position. His expected profit would be equal to the expected capital gain from the rise in the price, less any costs of tying up his working capital in foreign-exchange balances. There is no unanimity among traders in price expectations, and there are significant differences among traders in the opportunity cost of tying up funds. These two considerations, plus the attitudes toward risk, account for differences in bank-trader behavior.

The position that a trader wants to assume, as reflected in his running position sheet, involves a whole series of dates. If spot is undervalued, the trader must compare the expected appreciation that is likely to occur with the opportunity cost of tying up bank reserves in foreign balances. There are two components of the opportunity cost of tying up funds: the domestic costs and the trading costs. If there is a brisk demand for funds in the New York money market, funds tied up in foreign-exchange balances imply a loss of reserves. A loss of reserves means that the bank foregoes lending to customers at the prime rate, which in turn entails a loss of current income and customer confidence. Recourse can always be made to the Federal Funds market or to the discount window at the Federal Reserve Bank. However, commercial banks are reluctant to be in debt to the Federal Reserve Bank. At times, the discount rate is high: it was 4 per cent in 1959 and 1960. Moreover, the Federal Reserve Bank may request that the bank repay its debt by selling off investments (at a loss) during a period of rising rates, or that it call in loans. When a rising demand for loans to domestic customers is expected, the opportunity cost of having reserves tied up in foreign-exchange balances may offset the expected appreciation in the spot price.

Another deterrent to building up spot balances occurs when a trader has a limited amount of working capital. Then, he can only augment his balances in one currency by depleting his balances in another. Since a minimum inventory is often needed in each of the major trading currencies, he will be reluctant to deplete his inventories in another major currency for the sake of an expected capital gain. There are more efficient ways of making capital gains than by depleting inventories (see below).

Other bank traders (or the same trader at another time) may have lower opportunity costs of funds, so that the expected appreciation in the spot price exceeds the profit that can be made in alternative uses. For example, a commercial bank may have net free reserves and may be

willing to take a risk of tying up its funds for a couple of weeks or months. Or, the bank trader may be employed by a "merchant bank" which does not accept deposits from the public; its main business is the acceptance of bills, foreign-exchange transactions and underwriting. At a given time, this merchant bank may not be utilizing all of its capital in underwriting, and hence may be eager to earn money on an expected appreciation of the spot exchange. These traders would then be more willing to build up their foreign-exchange balances.

If the trader believes that the cost of tying up funds in additional balances exceeds the expected appreciation in price, he has several alternative courses of action. It is assumed that banks have been net buyers of foreign exchange.

First, the trader could even out his spot position by selling the foreign exchange purchased. In a period of selling pressure, such a course of action leads to trading losses but it does not tie up his working capital. Second, if the prices of futures (futures and forward are synonyms in the New York market) have been falling at greater rates than have spot prices, the trader might find it advantageous to swap. A swap, as explained earlier, is a contract for a spot and a forward transaction in the opposite directions. It could also be a contract for the simultaneous purchase and sale of a near-future for a far-future (or vice versa). The trader may contract, for example, to sell spot for delivery in three days and purchase the same amount for delivery in ten days. Profit will be made on the swap if futures are at a discount. As a result of this swap the trader achieves several objectives.

- (1) He does not tie up his working capital in foreign-exchange balances.
- (2) He nevertheless maintains a long position, in anticipation of the price rise.
- (3) He realizes some trading profits from the swap.

The large banks, with active domestic-loan business, do *not* absorb the variations in the spot exchange that arise from the daily, weekly, monthly or quarterly surpluses (or deficits) in the balance of payments. Unless the spot exchange is considerably undervalued, their opportunity costs of funds are too high to induce them to build up their balances. When they have a position, it is in the futures market, not in the spot market.

If futures are at a premium, the bank trader may be deterred from taking a long position. The loss on the swap, of spot for futures, may offset the expected rise in price of the foreign exchange. In such an event, he might sell his spot outright and take a trading loss. The bank trader will simultaneously determine his desired position and the ma-

turity of his position, i.e., the distribution of his net purchases among spot, near-futures and far-futures. The maturity of his position will depend upon the relation of current to expected prices. For example, during the month of July 1961, the major banks were not bearish on sterling. Their customers and foreign banks, however, expected a devaluation; and spot sterling fell to \$2.78-7/16. Without the intervention of the Central Bank, it would have fallen lower. The discount on three-month sterling was as high as 3-1/8 cents; on July 12, 1961 future pounds could be purchased for \$2.75-5/16. The senior traders expected drastic domestic measures to be undertaken within the United Kingdom and large-scale international support for the pound. A trader holding such views would take a long position, concentrated in near- and far-futures.

If the trader's timing were correct, he would come into possession of pounds at the time that the pound would be rising as result of these disinflationary measures. On July 25, 1961 the Bank Rate was increased; and sterling rose from \$2.78-7/16 to \$2.80-5/8 at the end of October.

A long position in far-futures would also have been profitable, and was, in fact, taken by those who were not bearish. Traders who purchased three-month-futures in July would have sold out at a 6-5/16 cent profit in October, without having any funds tied up in the interim.

There are risks inherent in the purchase of foreign exchange. Not only is there a risk of a possible default by the seller of exchange, but there is a risk that the price will fall rather than rise. The first risk is reduced by purchasing forward exchange only from institutions which have accounts with the bank, or whose financial integrity is above question. Thereby, the bank reduces the probability that the seller may be unable to deliver the exchange. Similarly the bank does not sell forward exchange to non-customers, or to those whose financial standing is questionable. The risk of a price fall cannot be eliminated except through the maintenance of an even position in each maturity. But it can be reduced through an appropriate hedge.

A hedge is the assumption of a selling (buying) commitment to offset a buying (selling) commitment. It is a method of bounding (i.e., limiting) possible losses. For example, suppose the bank sold a currency three-months forward. Assume further that the market believes that this currency will be revalued within six months and that consequently people want to buy futures. If the trader does not share this view, but does not want to maintain a short position, he may hedge. He would buy a near-futures contract to cover his sale of the three-month-futures. Since the market expects a revaluation within six months, the far-fu-

tures will be at a premium over the near-futures, regardless of interest rates in the two markets. The covering operation: the purchase of near-futures and the sale of far-futures will, therefore, be profitable.

If the currency is, in fact, revalued, the trader does not lose. His asset (near-futures) will appreciate just as his liability (sale of far-futures) will rise in terms of domestic currency. Moreover, he will probably profit from a revaluation which the market considers to be adequate. Prior to the revaluation, the forward premium will exceed the short-term interest differential in the two markets. The supply of forward exchange arising from interest arbitrage will be unable to cope with the speculative purchases. There will be, therefore, an "intrinsic premium"—which arises whenever the forward premium, on a percentage basis, exceeds the difference between the foreign and domestic short-term money rates. After an adequate revaluation, the forward-spot relationship will approximate the interest differential more closely. It is likely that interest rates will be higher in the country which has just revalued its currency. Hence, the forward will go to a discount under spot. If the trader reverses his position upon revaluation, by selling his near-futures and buying far-futures, he will emerge with a profit. His total profit will be the initial premium on far-forward plus the final discount on far-forward. No working capital has been tied up in this transaction.

These points are clearly illustrated by the events which occurred during the period of the revaluation of the D-mark (March 1961). In February and March short-term interest rates were higher in Germany than in the United States. In March the market yield on 3-month Treasury bills was 2.327 per cent in New York, and 60-90-day Treasury bills were yielding 2.50 per cent in Germany. Nevertheless, the forward mark was at a premium (i.e., the forward dollar was at a discount). The spot dollar was at 4.170-4.171 DM during the first few days of March, whereas the forward dollar was at 4.169 DM. Speculative bull pressure on the forward D-mark counterbalanced the sale of forward marks arising out of interest arbitrage. After revaluation, the forward mark went to a discount momentarily. On March 6, 1961 the spot dollar was 3.99 DM and the forward dollar was 4.00 DM. However, the market felt that the revaluation did not proceed far enough, and that the mark would appreciate again. The premium on forward marks reappeared and persisted certainly through the month of March. Since the revaluation was not considered adequate by the market, speculative buying of forward marks counterbalanced the sales of forward marks by the interest-arbitrageurs.

4. SHORT POSITIONS. Positions are sometimes assumed consciously, in anticipation of customers' needs or of the state of the market. At other times, positions are thrust upon banks by the unexpected actions of their customers and of other banks. Then the ingenuity of the trader is required to adjust his present position to his desired position.

When banks are short, they have contracted to sell more than they have contracted to purchase. Let us assume that a bank trader is bearish on a currency and wants to maintain a short position. How does he do it? The *least* common method of covering a short position in spot exchange is by borrowing from a foreign bank at the overdraft rate. There are three reasons why this method of covering is hardly ever used. First, there are restrictions (in force at the date of this writing—April 1962) upon the granting of overdrafts for this purpose in the United Kingdom and in France: the maximum overdraft period is 48 hours to cover commercial items in transit. Second, the overdraft rate is a penalty rate: it is "too high." In England this rate is between  $1/2$  and 1 per cent above the Bank Rate (6 per cent on November 4, 1961). In Canada, where there are no restrictions, the overdraft rate is high:  $5-3/4$  per cent in October 1961. Third, banks are reluctant to be in debt to their foreign correspondents.

Suppose that a trader has sold spot exchange, for delivery in three days, and does not have it. What will he usually do, if he is bearish? First, he may use his foreign-currency accounts to cover. The major banks hold considerable amounts of foreign-currency balances for their customers. These deposits arise when a customer has foreign exchange which he will need in a short period of time. He signs a waiver releasing the bank from any exchange-rate or restrictions liability; and has on deposit a certain amount of foreign currency. It is agreed that he cannot write checks on this sum without going through the bank. Thereby, the bank has a sum of foreign exchange to cover short positions. When, and if, the trader's prognosis materializes, he can replenish at a profit the exchange that he sold.

Second, he has three days to deliver the exchange, and can buy it back on the second day. In this manner, he can cover his sale at a profit, if the rate falls very soon after his sale.

Third, he may enter into a swap. He can buy exchange for delivery in three days and simultaneously sell (to the same party) exchange to be delivered in 3 plus  $x$  days. If forward exchange is at a premium, he will make profit on the swap while he maintains his short position. Even if forward is at a discount, the swap is almost invariably cheaper than an overdraft. In recent years, the maximum swap cost for sterling has been



6½ per cent on an annual basis; whereas the overdraft rate has usually been substantially higher.

When a trader assumes a bearish position in a currency, his position will be in the near- and far-forward maturities. Then there is no need to cover until the contract matures; and there has been no cost involved in carrying the short position. When the contract matures, the trader can maintain his short position by entering into swaps, or by using his foreign-currency accounts.

### *B. Short-Term Investors*

Under this heading, the complexities of the contemporary foreign-exchange market are explicitly introduced to present more realistically the phenomena of interest arbitrage and its dual: financing in various money markets with the exchange risk covered.

I. CONSIDERATIONS INVOLVED IN INTEREST ARBITRAGE. There is a floating money supply, estimated by some bankers at between one and two billion dollars, available to profit from differences in interest rates among centers. This supply comes from the large non-financial concerns which maintain foreign branches and foreign deposits, and from foreign (Swiss, German and French) banks. In recent years, there has been a greater participation in this market by American non-financial concerns.

Interest arbitrage is not devoid of risk, for there is the possibility that the funds may be needed before the maturity date of the short-term obligation. A non-financial corporation may encounter an unexpected opportunity for an advantageous purchase for cash, or some contingency may arise requiring a sudden expenditure. The 3-per cent net earned on a Treasury bill or a bank bill may not compensate the corporation for its inability to liquidate its investment, except at a substantial loss. The breadth of the foreign center's short-term money market—the ability of the market to absorb large amounts of money without significant changes in the prices of bills—is as important a consideration as the reputation of the debtor. Only London, Montreal-Toronto, and New York possess such broad markets. Interest differentials in other countries do not exert the same attractions as interest differentials among the three centers cited above.

A second risk that the interest-arbitrageur incurs concerns the probability that an exchange loss will occur, or an exchange gain will not be realized, if the investment is liquidated prior to maturity. For example, in June 1961 the U. K. Treasury-bill rate was 4.50 per cent, and the U.S. Treasury-bill rate was 2.33 per cent, per annum. A 2.17-per cent

differential existed in favor of London. However, on June 15, 1961 the three-month forward dollar was at a premium of  $1\text{-}3/4$  cents on a price of  $\$2.79\text{-}1/8$  per pound. On a per annum basis, the premium on the forward dollar was 2.51 per cent. An investor with sterling balances who (i) purchased dollars on June 15, (ii) invested his dollars in U.S. Treasury bills, and (iii) sold his dollars forward (for pounds) for delivery on September 15, could have made 4.837 per cent *if he held his asset to maturity*. If he kept his funds in U. K. Treasury bills he would have only made 4.50 per cent.

But suppose the party in question needed pounds in August to meet some contingency. The U.S. Treasury bills would have to be sold at a slight loss, since the August rate was 2.39 per cent. The three-month forward contract, calling for the delivery of dollars on September 15, would have to be repurchased; and spot pounds would have to be purchased with the spot dollars received from the sale of the Treasury bills. On August 15, 1961, one-month forward dollars were at a premium of  $1\text{-}3/16$  cents. This meant that he would have repurchased his forward dollars at a higher price than he would have sold his spot dollars. His *net* gain on swaps would have been equal to: (a)  $1\text{-}3/4$  cent profit on the swap on June 15, less (b)  $1\text{-}3/16$  cents loss on the swap on August 15, for a net gain of  $9/16$  cent per pound for two months, which is equivalent to a gain of 3.38 cents for a year on a purchase price of  $\$2.79\text{-}1/8$ . This amounts to 1.21 per cent per annum. Over the entire transaction, therefore, he would have made an *exchange gain* of 1.21 per cent per annum plus an *interest return* of less than 2.33 per cent per annum, for a total return of 3.54 per cent per annum. This is less than the 4.50 per cent that he could have earned had he kept his funds in U.K. Treasury bills. Interest arbitrage would have been profitable had he kept his funds invested for the entire three months. Insofar as he was forced to liquidate at the end of two months, he suffered a net loss. Risk is not absent from interest arbitrage.

Third, the interest-arbitrageur runs a risk—even if he is certain that he will not be forced to liquidate his investment prior to maturity—if the foreign currency is under pressure. This serious element of risk has been succinctly described by H.M. Treasury:

(b) if sterling is under pressure and the pound is suspect, inward interest arbitrage would be unlikely to take place, irrespective of how profitable it might be. The reason is that the Exchange Control Act enables the Government to determine how foreign-held balances may be dealt with. Consequently, foreigners who are content in the ordinary course to hold funds in London, are less willing

to do so when sterling is weak, when the reserves are falling and when defensive measures of some kind are expected. Under such circumstances foreigners are disposed to withdraw funds from London even if that may involve them at times in quite considerable cost. It is therefore quite unrealistic to suppose for one moment that the opportunity of a relatively small interest advantage would persuade them at such times to bring more money in.\*

The phenomenon of borrowing abroad, with the exchange risk covered, is the dual to interest arbitrage. The risks involved in hedged foreign investment apply equally to hedged foreign borrowing. Neither one is an *automatic* response to international differences in interest rates.

The phenomenon of interest arbitrage extends to interbank borrowing as well as to financial investment by non-financial concerns. The Euro-Dollar market, for example, is concerned with this type of arbitrage. An institution borrows in a low-interest-rate market and lends in a high-interest-rate market. Usually, the exchange risk is covered.

For example, in the fall of 1960, there was a shortage of loan money in Japan. A penalty rate of 6.94 per cent was charged by the Central Bank to banks borrowing in excess of their quotas. In New York, however, the Treasury-bill rate was 2.48 per cent, approximately equal to the maximum interest rate on three-month time deposits. At the same time, private foreign institutions held \$7.55 billion on deposit with United States banks.

The Euro-Dollar market developed to take advantage of such opportunities. For approximately 5-1/4 per cent, a Japanese bank could borrow dollar deposits, owned by foreigners, for three months. It would sell the dollars spot and simultaneously buy them forward for three-months delivery. The yen proceeds would then be loaned out in Tokyo at a rate more than sufficient to pay the 5-1/4 per cent and the cost of the swap. Not only was this transaction profitable for the Japanese; it was also profitable for the owner of the Euro-Dollars who made 2-3/4 per cent more than the time-deposit rate in New York. In this way, interest arbitrage *tended* to equalize interest rates among countries.

2. THE FORWARD RATE AND THE INTEREST PARITY. The interest parities (i.e., the interest differentials on short-term securities between two countries) do not *independently* determine the forward rate (i.e., the per cent premium or discount on forward exchange). First, the forward rate affects the international movements of short-term capital among

\* Committee on the Working of the Monetary System, *Principal Memoranda of Evidence*, Vol. 1, H. M. Treasury, p. 121.

countries and thereby affects the interest parities. For example, foreign official and non-official institutions owned \$9.45 billion of U.S. Treasury bills and certificates in August 1961. This was almost 20 per cent of the total value of Treasury bills and certificates owned by the public *and* by the Government agencies and trust funds. Changes in the forward rate, which affect the relative profitability of foreign investment in Treasury bills, can produce a sizeable change in the bill rate. Second, in view of the risks cited above, the supply of funds available for interest arbitrage may be inadequate to equate the forward rate with the interest parity.

Concerns engaged in interest arbitrage consider three types of investment: internal investment (i.e., within their own business), domestic-portfolio investment (bills, commercial paper, etc.) and foreign-portfolio investment. Funds will be allocated among these alternative uses, on the basis of expected rates of return—net of risk. Sometimes the profit opportunities for internal investment by a firm are so great that there is little remaining for portfolio investment. At other times, e.g., in the interim between the flotation of a new issue and the internal investment of the funds, there is a surplus available for portfolio investment.

Funds for interest arbitrage by non-financial concerns are competitive with funds for domestic-portfolio investment. It is a mistake, however, to think of foreign investment as a perfect substitute for domestic-portfolio investment. To be sure, the ratio of foreign to domestic securities desired will increase as the profit on covered interest arbitrage increases. But, there is a maximum ratio of foreign to domestic securities that a non-financial corporation desires to hold. As this ratio is approached, firms are less eager to substitute foreign for lower-yielding domestic securities. There is always the fear that restrictions could be imposed upon the repatriation of foreign capital, if a crisis should develop. If the concern is large, it may fear that a sudden withdrawal of funds may upset the foreign-money or forward-exchange market. Finally, the stockholders and Board of Directors may be disturbed by a large ratio of foreign to domestic securities.

Consequently, there is not always a perfectly elastic supply of funds to eliminate any differential that may appear between the forward rate and the interest parity. The greater the distrust of the foreign currency, the smaller the supply of funds available for covered interest arbitrage. One should also remember that official restrictions on the flow of short-term capital may prevent the elimination of profits on covered interest arbitrage.

Two examples illustrate the failure of the market to equilibrate the

forward rate with the interest parities. The first example concerns the United States and Canada, where the investment risks consisted entirely of the probability that the investments would have to be sold prior to maturity. The second example concerns the United States and England, where the presence of exchange restrictions accounted for the yield discrepancies.

During much of the time between 1952 and 1958 it was possible to make a profit of 1 to 2½ per cent over the Canadian Treasury bill rate by buying U.S. dollars spot to invest in U.S. Treasury bills and covering by selling U.S. dollars forward. The failure of the market to eliminate this profit was attributable to a principle of increasing risk. Canadian banks and non-financial concerns did substitute some U.S. Treasury bills for Canadian Treasury bills, in view of the interest differentials and cost of the swap. However, Canadian and U.S. Treasury bills are not perfect substitutes. If a Canadian bank or non-financial concern must liquidate a U.S. Treasury bill prior to maturity, it incurs the *additional* risk that it will have to repurchase its original sale of forward U.S. dollars at a higher price than it sells its spot U.S. dollars. Since U.S. Treasury bills are riskier than Canadian bills, for Canadian concerns, there is a limit to the extent that they will substitute higher-yielding U.S. bills for lower-yielding Canadian bills. Hence the supply of funds for interest arbitrage is not perfectly elastic.

When there are exchange restrictions, the forward rate can exceed the interest parity. During the period July to September 1957, the forward dollar was at a 6-7-per cent premium relative to the pound; whereas the London rate exceeded the New York rate by 1 per cent. Even when the increase in the Bank Rate raised the interest differential to 3 per cent in favor of London, it was still less than the premium on the forward dollar. Had there been no exchange restrictions, the outflow of short-term funds from England might have forced a devaluation.

It has therefore been demonstrated that the interest parities (i.e., the interest-rate differentials on short-term securities between two countries) do not independently determine the forward premium or discount. The determination of the forward rate is reached in a more complicated manner, as will be explained in the next section.

#### IV. MARKET ADJUSTMENTS DURING NORMAL AND SPECULATIVE PERIODS\*

A *normal* period may be defined as one when there is confidence in the stability of a given set of spot and forward rates. When there is a difference between current and the normal set of prices, the market expects this difference to be eliminated within a short period of time. On the other hand, we define a *speculative* period as one when the market expects a change to occur in the normal set of prices, within a short period of time.

A normal period prevails when the balance-of-payments surplus or deficit is expected to be ephemeral at the given set of exchange rates. On the other hand, in a speculative period the balance-of-payments deficit or surplus is not expected to be temporary at the existing set of rates.

There is a different pattern of market reactions during a normal period than during a speculative period. Examination of price movements will reveal whether the period was basically normal or basically speculative. With this information, it is possible to evaluate the efficiency of the foreign-exchange market.

##### *A. Price Regularities during a Normal Period*

During a normal period, there will be an inverse relationship between the spot price of a foreign currency and its forward premium (a discount is a negative premium). When the spot price rises, the forward premium will fall (or the discount will widen). When the spot price falls, the forward premium will rise (or the discount will narrow).

During a normal period, variations are constantly occurring in (a) relative interest rates between countries, (b) the current-account balance, (c) the long-term capital-account balance, and (d) the volume of unilateral transfers. The market then adjusts to these variations.

Market adjustment to these variations must be such as to (1) equate the supply and demand for spot exchange, and (2) equate the supply and demand for forward exchange. Interdependence between these two markets is so great that if one market is in disequilibrium, the other market cannot remain in equilibrium. Tables 1-6 below, are constructed to summarize these equilibrium adjustments.

\* This section is an application to the foreign-exchange market of a theory of commodity markets developed in my article, "The Simultaneous Determination of Spot and Futures Prices," *American Economic Review*, Vol. 51 (December 1961). The foreign-exchange market deals with a storable commodity: claims on foreigners.

I. THE SUPPLY AND DEMAND FOR SPOT EXCHANGE. Suppose that there is a surplus in our balance of payments: item 1, Table I. This surplus could have been produced in many ways: through a decrease in unilateral transfers, a rise in the long-term capital-account balance or in the current-account balance. Regardless of the way in which it was produced, an excess supply of spot exchange is generated, which the market believes to be ephemeral.

TABLE 1

SPOT PURCHASES AND SALES DURING A NORMAL PERIOD:  
SURPLUS IN THE BALANCE OF PAYMENTS

<i>Purchases:</i>	<i>Sales</i>
<p>(2) Leads and lags: importers accelerate purchases of exchange and exporters lag their sales of exchange in anticipation of a rise in the spot price.</p> <p>(3) Interest-arbitrageurs buy spot as forward premium rises, or forward discount falls.</p> <p>(4) Foreign concerns borrow in New York, and sell dollars for foreign currency. They cover the exchange risk.</p> <p>(5) Some institutions may take long uncovered positions.</p> <p>(6) The decline in the spot price tends to reduce (1).</p>	<p>(1) Surplus in the balance of payments (produces a decline in the spot price).</p>

The spot price falls as a result of this surplus. As the market sells exchange to the large banks, which make the market, the traders bid lower prices. These lower bids are made with the anticipation that the traders will even out their spot positions. Their opportunity costs are too high to induce them to build up their foreign-exchange balances in any significant degree.

As the spot price falls, relative to a set of normal prices, the leads and lags in payments develop. The importers accelerate their payments in foreign currency, before the price recovers to its normal level. Thus, some of the spot exchange is absorbed. Similarly, the exporters lag their

sales of foreign exchange, and wait until the price recovers to its normal level. This reduces some of the excess supply of foreign exchange. A net demand for spot exchange is produced by the leads and lags (item 2, Table 1).

Interest-arbitrageurs provide a large demand for spot exchange (item 3, Table 1). As the spot price falls relative to the forward price, the forward premium rises or the forward discount falls. Given the money-market rates of interest in two countries,\* the profitability of outward interest arbitrage increases with a rise in the forward premium, or with a decline in the forward discount. Interest-arbitrageurs then purchase spot exchange and invest their proceeds abroad with the exchange risk covered.

It is not true that the supply of funds available for interest arbitrage is always sufficiently (elastic) great to bring the forward premium (or discount) into equality with the Treasury bill-rate differential. From July 1960 to November 1961 the yield differential on three-month Treasury bills between London and New York, allowing for forward-exchange cover, ranged from 1.5 per cent per annum in favor of London to 2 per cent per annum in favor of New York. Moreover, the interest-rate differential is not an *independent* variable which determines the forward premium or discount. The sizeable flows of funds among the large money markets affect short-term interest rates. One reason why the New York Federal Reserve Bank seeks to hold foreign deposits in competition with the commercial banks, is the desire to synchronize its open-market operations with the investment activities of foreign central banks in the New York market. The latter are sufficiently great to influence the prevailing short-term money rates, and negate the effects of Federal Reserve operations.

For these reasons, and those given above, we consider the forward premium (or discount) a dependent variable. During normal periods the forward premium is inversely related to the spot price.

There is reason to believe that the interest-arbitrageurs absorb a great fraction of the variations in the quantities of spot exchange. Although this outward flow of funds is extremely important in cushioning the effect of a balance-of-payments surplus, it has been accorded the derogatory title of a "hot-money movement."

As the forward premium rises on the foreign currency, the forward dollar goes to a discount. It becomes less costly to borrow in New York,

\* For expositional simplicity, we are considering two "countries": the United States and the rest of the world. If there is a balance-of-payments surplus, our currency will tend to appreciate relative to all other currencies. Otherwise, there will be opportunities for arbitrage. Hence the inducements to outward interest arbitrage will apply to all the other foreign money markets.



with the exchange risk covered, than it was prior to the decline in the spot price of the foreign currency. Foreign firms can borrow in New York, sell the dollars for foreign currency, and simultaneously repurchase forward dollars. Since the discount on the forward dollar has increased (or the premium on the forward dollar has decreased), the net cost of this borrowing operation is decreased. Similarly, American firms will find it more expensive to borrow abroad, with the exchange risk covered, than before. The reason is that the premium on the forward foreign currency, i.e., the "insurance cost" of the hedge, has increased. The net effect is to increase the net demand for foreign exchange (Table 1, item 4).

A smaller source of absorption for the balance-of-payments surplus comes from the medium-sized banks. Insofar as they may have low opportunity costs of their funds, they may increase their foreign-exchange inventories when the spot price declines (Table 1, item 5).

For the reasons mentioned in Part B below, the decline in the price of foreign currency may affect our basic balance of payments in the very short run. Some export sales may be cancelled, or some long-term foreign investments may be accelerated, as a result of the decline in the price of foreign exchange. This phenomenon (Table 1, item 6) tends to offset item 1.

Equilibrium in the spot market occurs when the quantity of foreign exchange offered as a result of a balance-of-payments surplus is equal to the quantity absorbed by the purchasers (items 2 through 6). The same procedure applies, *mutatis mutandis*, when a deficit occurs.

2. THE SUPPLY AND DEMAND FOR FORWARD EXCHANGE. Transactions (3) and (4) above have duals in the forward market. Interest-arbitrageurs, who invest their funds abroad, or firms, which switch their borrowing to New York, not only purchase spot exchange, but simultaneously sell forward exchange to the same party. These are items 3 and 4, in Table 2. If they invest in an asset, or incur a liability, with a

TABLE 2

FORWARD PURCHASES AND SALES DURING A NORMAL PERIOD:  
SURPLUS IN THE BALANCE OF PAYMENTS

<i>Purchases</i>	<i>Sales</i>
(6) Professional risk-bearers.	(3) Interest-arbitrageurs.
	(4) Firms which borrowed in New York and covered themselves against the exchange risk.

maturity of  $h$  days, they simultaneously sell their exchange forward for  $h$  days. As a result, a supply of forward exchange is produced. The selling pressure in the spot market is transmitted to the forward market.

As interest-arbitrageurs and borrowers in New York sell futures, the price falls. Large banks, which are the professional risk-bearers in the foreign-exchange market, seldom take positions mainly by augmenting their foreign-exchange balances. When they take a position, it is in the futures market. An investment is made in futures, without tying up valuable reserves, in anticipation of a price rise. They are represented by item 6, Table 2. Their position is taken as a result of the difference between the current price of futures and the price that is expected to prevail at a later date. Long positions are taken if the price expected to prevail at a later date exceeds the current price of futures. Short positions are taken if the price expected to prevail at a later date is below the current price of futures.

Equilibrium exists when the spot price has fallen and the forward premium has increased (or the discount has been decreased). As a result, (1) there is a greater amount of investment abroad by interest-arbitrageurs, and (2) a greater volume of claims against foreigners is held by other hedgers and by institutions with uncovered spot positions. Moreover, the price of futures falls to induce the large banks to assume the risks of accommodating the interest-arbitrageurs and other hedgers. The decline in the price of futures is an integral part of the process whereby risk is shifted to the risk-bearers. Since the forward premium has increased (or discount has decreased), the future price falls by less than the spot price.

### *B. Variations in Interest Rates during Normal Periods*

A change in the interest-rate differential may be viewed by the market in several ways. First, it may not be accompanied by any strong expectations that there will be a change in the normal set of exchange rates. In this case, the change in the interest differential is a normal disturbance. That is, it occurs during a normal period. Second, the change in the interest differential may be heralded as a decision to alter the exchange rates, relative to its current levels. In such a case, the disturbance is speculative: it occurs during a speculative period. There are many situations when both views are held by different components of the market. Then the resulting price reactions will be the weighted sum of the reactions of the various components.

The reactions of the market to a change in interest rates during a normal period are developed here. In the movement to the new equilib-

rium, the movements of the spot price and forward premium will be in opposite directions.

I. THE SUPPLY AND DEMAND FOR SPOT EXCHANGE. Assume that interest rates abroad rise relative to domestic interest rates, but that no significant changes are expected in the normal rates of exchange. Tables 3 and 4 summarize the equilibrium adjustments in the spot and forward markets.

TABLE 3

SPOT PURCHASES AND SALES DURING A NORMAL PERIOD:  
RISE IN FOREIGN INTEREST RATES

<i>Purchases</i>	<i>Sales</i>
<p>(1) Interest-arbitrageurs purchase spot exchange and invest their funds abroad. Price tends to rise. (Some of the outflow of short-term capital could be uncovered.) Borrowing shifts to New York with the exchange risk covered. Spot foreign exchange is purchased with the borrowed dollars.</p>	<p>(2) Leads and lags: importers lag their foreign-exchange purchases and exporters accelerate their foreign-exchange sales.</p> <p>(3) Short positions may be taken by some institutions.</p> <p>(4) Current-account or long-term capital-account surplus may rise.</p>

An outflow of funds will result as foreign interest rates are increased. Owners of U.S. Treasury bills and time deposits will switch their funds to foreign bills and time-deposit accounts. Similarly, borrowing will shift to New York. Spot foreign exchange will be purchased with the borrowed dollars. The exchange risk will be covered. The attempts to buy foreign exchange will drive the price up, for the bank traders will raise their ask prices to obviate covering these sales at a loss. This phase of the process is illustrated by item 1, Table 3. As the spot price increases, the profitability of interest arbitrage decreases. Thereby, the net increase in demand for foreign exchange is reduced.

As the price rises, relative to the expected normal price, the leads and lags in international payments develop (item 2, Table 3). Exporters accelerate the sales of their foreign-exchange receipts before the price reverts to its former level. Similarly, importers lag their purchases of foreign exchange in anticipation of a subsequent decline in price. The net effect is to increase the quantity of foreign exchange offered in the market.

It is possible that the rise in price may increase our current-account surplus in the very short run. When exchange-rate movements are

great, import purchases may be cancelled by those who failed to secure forward cover. This would increase the net supply of foreign exchange (item 4, Table 3). Such incidents did occur during the period of floating rates, 1919-1925. During 1919, for example, the monthly average price of sterling ranged from \$3.91 to \$4.76; and during 1920 it ranged from \$3.30 to \$3.95.

... In July 1919, the decline in the sterling-dollar rate, which had until then been gradual, was sharply accelerated. The extraordinary levels at which money on call was being lent in New York, coupled with heavy offers of cotton bills, combined to weaken sterling in that month and in the absence of support the rate fell 20 points in one week, reaching 4.28 on July 17. Cables were almost immediately after received in London to the effect that an actual cancellation of an important export order in cereals had taken place in Philadelphia as a direct result of the decline in the exchange. Acute apprehension was felt that export orders would be greatly reduced and confusion reigned among American exporters.\*

When exchange-rate movements are "sufficiently great," the long-term capital-account or the invisible current-account balance may also be affected with a negligible lag. A concern contemplating a sizeable long-term investment abroad may delay making the investment if the price of foreign exchange rises above its expected normal level. A half cent saved per unit of foreign exchange mounts up to a significant amount on a multi-million-dollar foreign investment. Hence, the long-term capital account could be affected in the very short run by exchange-rate variations. Along similar lines, the timing of corporate dividends from foreign branches of American concerns may be influenced by the current exchange rate. Consequently, the invisible current-account balance may be influenced, with a short lag, by the difference between the current and expected normal exchange rates.

Some institutions may take short uncovered positions in foreign exchange, as a result of this price rise. They would (i) reduce their foreign balances, (ii) swap spot for a future maturity, or (iii) use their foreign-customer accounts to make delivery. They expect to repurchase the foreign exchange when the price reverts to its lower level.

The price of foreign exchange will rise until item 1 is counterbalanced by items 2-4. In the final equilibrium the spot price will, of course, be higher than initially.

\* William Adams Brown, Jr., *England and the New Gold Standard 1919-1926*. (London: P. S. King and Son, Ltd., 1929), pp. 57-58. W. A. Brown uses points synonymous with cents.

2. THE SUPPLY AND DEMAND FOR FORWARD EXCHANGE. Transaction 1, Table 3 has a counterpart in the forward-exchange market. Interest-arbitrageurs simultaneously sell forward when spot is purchased. In this manner they attempt to shift the risks of exchange-rate fluctuations onto the institutions which purchase futures. The major risk-bearing institutions in the futures market are the large banks which make the markets in all maturities. The price of futures must fall below the normal expected price, in order to induce the banks to purchase these futures. Table 4 describes the equilibrium in this market.

TABLE 4

FORWARD PURCHASES AND SALES DURING A NORMAL PERIOD:  
RISE IN FOREIGN INTEREST RATES

<i>Purchases</i>	<i>Sales</i>
(5) Large banks, which take positions in futures, lower bid prices.	(1) Interest-arbitrageurs and foreigners who borrowed in New York sell forward exchange to cover spot purchases.

The equilibrium adjustment produces a rise in the spot price and a decline in the forward premium (or rise in the forward discount). Thereby, (i) the rate of capital outflow is reduced, (ii) a demand for forward exchange is produced, and (iii) institutions increase their sales of spot exchange. *Mutatis mutandis*, the same argument applies for a decline in foreign interest rates during a normal period.

### C. *Speculative Periods*

I. PRICE REGULARITIES. The market consists of a variety of institutions with different price expectations or aversions to risk. During a speculative period, several important segments of the market expect prices to change and react accordingly. It is shown that, during a speculative period, the spot price moves in the same direction as the forward premium (or in a direction opposite to the forward discount). Equilibrium adjustments in the spot and forward markets, when the price of foreign exchange is expected to decline, are summarized in Tables 5 and 6.

Suppose that the traders in the large banks expect large-scale selling of a foreign currency by their customers and foreign banks. Such selling may be motivated by fears of devaluation. The traders who make the market will then sell the foreign currency short, to avoid long positions or market losses when the selling orders materialize. Their actions are

listed in item 1, Table 5 and item 1, Table 6, when they sell forward and spot, respectively.

TABLE 5

FORWARD PURCHASES AND SALES DURING A SPECULATIVE PERIOD :  
EXPECT PRICE OF FOREIGN CURRENCY TO FALL

<i>Purchases</i>	<i>Sales</i>
(2) Interest-arbitrageurs purchase forward exchange as forward premium declines or discount rises.	(1) Large banks sell in anticipation of the state of the market or of customers' requirements.
(3) Some institutions buy spot dollars and sell forward <i>dollars</i> , to profit from the price differential.	

TABLE 6

SPOT PURCHASES AND SALES DURING A SPECULATIVE PERIOD :  
EXPECT PRICE OF FOREIGN CURRENCY TO FALL

<i>Purchases</i>	<i>Sales</i>
(4) Leads and lags by those who think the price decline has proceeded "too far."	(1) Sales of spot by bears. Initial leads and lags also enter here.
(5) The current and long-term capital account will decline as a result of the fall in the spot price.	(2) Interest-arbitrageurs who sell spot foreign exchange and invest proceeds in United States.
	(3) The institutions which buy spot <i>dollars</i> with foreign exchange and simultaneously sell forward dollars.

Their short position occurs in the forward market predominantly, for the reasons explained in section III. Initially, the major pressure is exerted upon the forward market; and the premium on the forward foreign currency declines or the discount rises. This means that the premium on the forward dollar rises, or the discount on the forward dollar declines. As a result, inward interest arbitrage is encouraged. Foreigners, or American concerns which maintain foreign balances, are induced to redirect their short-term investments from the foreign center to New York. The net yield on investments in New York, with the exchange risk covered, has been increased by the rise in the premium (or fall in the discount) on the forward dollar. Interest-arbitrageurs then sell spot foreign exchange (item 2, Table 6) and simultaneously pur-

chase forward foreign exchange (item 2, Table 5) from the large banks. Similarly, American concerns are induced to finance themselves abroad with the exchange risks covered. They are subsumed under item 2.

In addition to the interest-arbitrageurs, some institutions may seize an opportunity to make profits by swapping. They would buy spot dollars and sell forward dollars (i.e., sell foreign exchange spot and repurchase futures) when the forward premium on the dollar exceeds their costs of carrying larger dollar balances. These institutions, so similar to the interest-arbitrageurs, are cited in item 3 in Tables 5 and 6.

Restrictions on the outward flow of short-term capital from foreign countries may reduce the importance of the above items in equilibrating the forward market. Were outward interest arbitrage prohibited effectively, item 2 would disappear in Tables 5 and 6. The forward price would continue to decline under the selling pressure. On the other hand, a large source of supply in the spot market would be eliminated. Insofar as the central bank supports the spot market, the drain on its reserves would be mitigated.

During speculative periods, the Bank of England has not supported the forward market. Its failure to intervene is motivated by a desire to let the bears suffer when the pound is *not* devalued. Bears who sold sterling futures, in a market with few buyers, sell at very low prices. If sterling is not devalued, they are forced to cover at considerably higher prices. Thereby, they "have been taught a lesson."

Such a policy is fraught with danger. The greater the forward discount, the more profitable is interest arbitrage out of the United Kingdom. Unless the restrictions on a capital outflow are highly effective, the substantial forward discount on sterling will make a covered short-term capital outflow highly profitable. The three-month Treasury-bill rate differential was in favor of New York by 5-6 per cent per annum in July-September 1957—with the exchange risk covered. If capital does escape, the reserves will be depleted; and devaluation could be forced upon the exchange authorities.

Transmission of the bear pressure from the futures market to the spot market occurs via the activities of the interest-arbitrageurs. Another great source of selling pressure in the spot market arises from the leads and lags in international payments. This source of supply is subsumed under item 1, Table 6. During the third quarter of 1957, the leads and lags were estimated to have caused a reduction of £ 90-100 million in the United Kingdom's reserves.

Offsetting these selling pressures in the spot market are two factors. As the price of foreign exchange declines, expectations tend to be revised. The greater the decline in price, the more institutions change from bears to bulls. Each institution has initially expected the price of foreign

exchange to fall to a certain price. When the current price declines below this price, the institution will accelerate its payments, and lag its receipts, in foreign currency. The initial leads and lags tend to be reversed as the price falls. Thereby, the initial supply of spot tends to be absorbed. This phenomenon is stated in item 4, Table 6.

Another offset to the initial bear pressure upon the spot market is the balance of payments (item 5, Table 6). For the reasons explained above, the current and long-term capital accounts may react rapidly to substantial changes in the exchange rate.

The price of spot exchange will decline, in a free market, until items 4 and 5 offset items 1, 2, and 3 in Table 6. When the spot market is being supported, the drain on reserves will continue until equilibrium is attained.

At the final equilibrium, the spot price and forward premium will be less than they were prior to the bear pressure. A lower forward premium (or higher forward discount) is necessary to equilibrate the forward market. A lower spot price is necessary to equilibrate the spot market. A similar argument explains why the spot price and forward premium will rise together during a bull speculative period.

2. SUPPORTING EVIDENCE FROM THE RECENT PAST. During 1961, there was a revaluation of the D-mark which the market considered to be inadequate. Later in the year, there was a run on sterling in anticipation of a devaluation. This run was reversed when the Bank Rate was raised and large stand-by credits were obtained from the International Monetary Fund. If the theories developed above are correct explanations of the workings of the foreign-exchange market, then the positive relationship between the spot price and the forward premium should have occurred during the speculative periods.\* This relation did in fact hold, as will be shown presently.

#### (i) The German Revaluation

After four years of debate, the Germans revalued the mark. On March 3, 1961, the official parity was 11 marks 76 pfennig to the pound, with effective stabilization limits  $11.59-1/4$ — $11.92-3/4$ . By Monday, March 6, the new parity was 11 marks 20 pfennig to the pound, with effective stabilization limits 11.0366—11.3646.

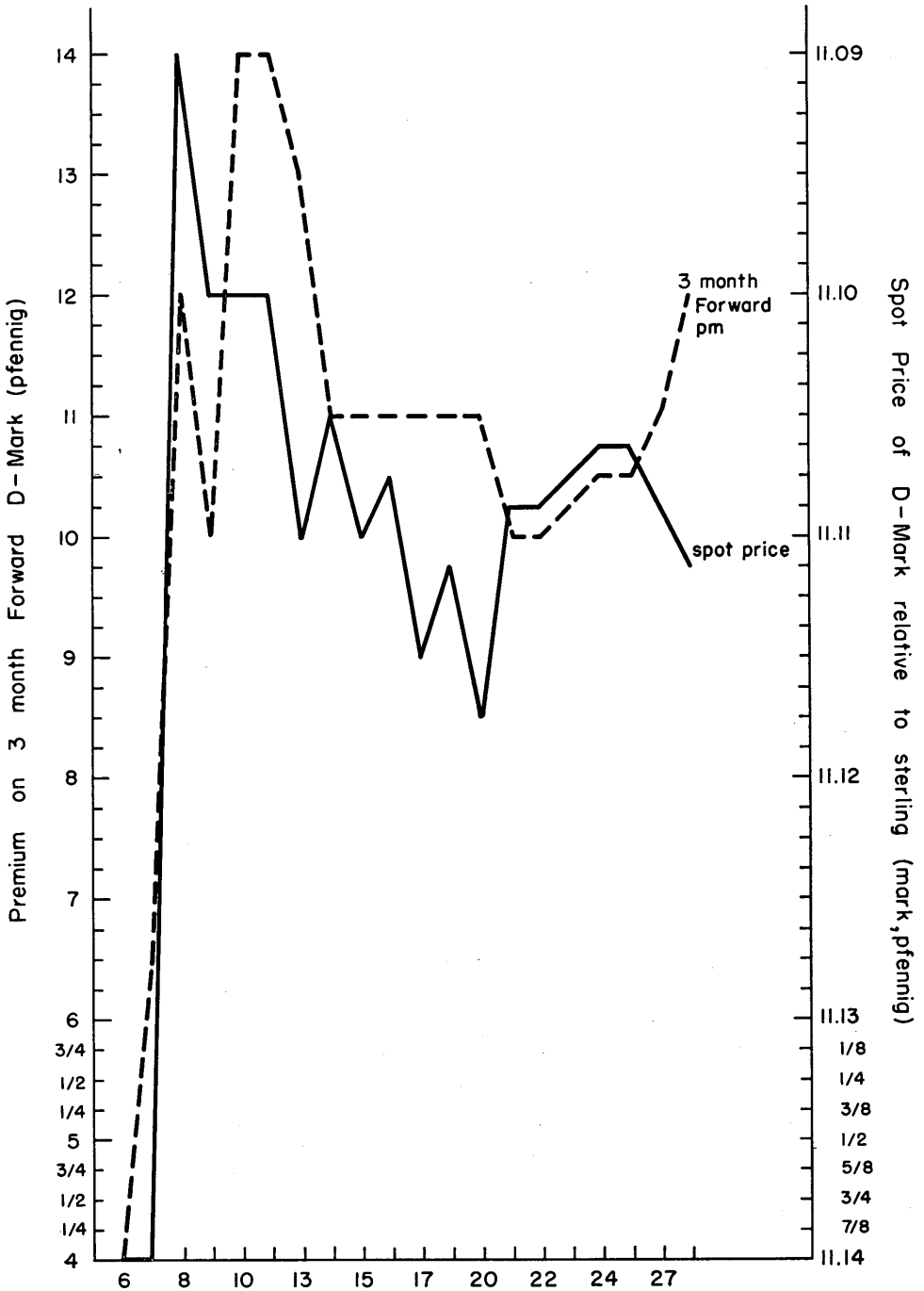
Quotations from *The Economist* (March 11, 1961) describe the speculative nature of the immediate post-revaluation period, which is graphed in Chart 1.

\* The positive relationship between the forward premium and the spot price exists both when the former is measured as a per cent of the spot price and in absolute terms.



Chart 1

Spot Price and Forward Premium on D-Mark  
Relative to Sterling, March 1961



Saturday's announcement came as a universal surprise in the markets. The Dutch decision followed in the early hours of last Monday; and later that day one European government after another, including some of the unlikeliest ones, proclaimed solemnly that they had no intention of revaluing their currency. Yet uncertainty remains, stemming in part from the limited extent of the German revaluation. Will it be enough? Is it the first and final, or just first? Doubts about this are being voiced in every financial centre in Europe. They cannot be set at rest by even the most awesome statements of intent—these have been as effectively devalued by Herr Blessing as they were by Sir Stafford Cripps in 1949. (p. 981)

Sterling has been under heavy pressure, particularly on Wednesday [March 8], when the flood of speculation that has swamped the exchange markets concentrated its full force against the pound, provoked by a suggestion in a German newspaper that it might be devalued, so to say, to meet the mark half way. (p. 985)

This bear pressure on the pound, or bull pressure on the mark, coincided with the substantial increases in the spot price of the mark and its forward premium, from March 6 through March 8.

According to the theory summarized in Tables 5 and 6, the bear speculation against the pound (i.e., the bull speculation in favor of the mark) (a) should have induced interest arbitrage from England to Germany and (b) should have induced German firms to borrow in London. Thereby interest arbitrageurs, and Germans who borrowed in London, should have demanded the forward pounds supplied by the professional risk-bearers or their customers. This must have occurred. At the end of February, U.K. Treasury bills yielded 1.31 per cent per annum more than German Treasury bills; and day-to-day money yielded 0.38 per cent per annum more in England. In March, U.K. Treasury bills yielded 1.98 per cent more, and day-to-day money yielded 0.36 per cent more, than they did in Germany. From March 6 to March 11, the forward-mark premium rose from 1.44 per cent per annum to 5.05 per cent per annum. Covered short-term investment in Germany was more profitable than investment in England. By the same token, a German firm borrowing in England, could save 5.05 per cent per annum by hedging its sterling liability with a purchase of forward sterling. Not only was the flow of funds, from England to Germany, profitable but it seemed to have occurred on a large scale. There was a rise of \$125 million in the Bundesbank's gold and foreign-exchange holdings during the week ended March 7, and \$206 million the following week. It may

be assumed that a large part of the funds that moved to Germany was obtained by conversions from sterling and by transfers of dollar deposits from England.

Subsequently the fierce speculative attack on sterling abated. *The Economist* (March 19, 1961, p. 1091) wrote:

It is possible that the relief is no more than momentary, but the great thing is that speculative activity has been prevented from snowballing.

One possible reason for the temporary reversal of the heavy speculative pressure was the statement issued by the governors of the leading European central banks after their monthly meeting at the Bank for International Settlements during the week ending March 18.

... A statement from the BIS is something of an event. This haven for central bankers (where, it is reputed, no Treasury official has set foot, and certainly no public relations officer) normally gets through its monthly weekend meeting without the public being aware that the governors have met at all. But last Monday [March 13] representatives of the central banks of Belgium, Britain, France, Germany, Italy, the Netherlands, Sweden and Switzerland said this to the world:

The governors are satisfied that the rumours which circulated last week in the market about possible further currency adjustments have no foundation and they wish it to be known that the central banks concerned are co-operating closely in the exchange markets.

One can picture quiet satisfaction among the central bankers over the elliptical second half of that statement.

During that week, there were clear downward trends in both the spot price and forward premium on the D-mark. Trends were not monotonic, for the markets were on edge. Operators in the London foreign-exchange market estimated the week's turnover to be the heaviest since the days of speculative frenzy in the early 1920's.

As the speculative attack abated, the premium on the forward mark declined from 5.05 per cent to 3.60 per cent per annum from March 11 to March 22, 1961. The data are therefore consistent with the theory summarized by Tables 5 and 6.

## (ii) The Decline and Rise of The Pound

Towards the end of June, 1961 a sterling crisis was portended. "The fate of the pound, therefore of world exchange arrangements as a whole," wrote *The Economist* (July 8, 1961), "is likely to be decided

before the August holidays." The period June 26 to August 9, described in Chart 2, has three phases. During the first phase, June 26 to July 11, there was general speculative pressure against the pound. Many were most reluctant to hold sterling over the weekends: they would go short on Friday or Saturday and cover on Mondays. The Bank of England was in the market supporting the declining pound. Speculative pressure was concentrated in the forward market, where the dollar rose to a 4.49 per cent premium on an annual basis. The selling of sterling futures started in Germany and was followed by sales from New York. Gold and foreign-exchange reserves of the United Kingdom declined by \$132 million during June. During this speculative period, the positive relationship between the spot price of the dollar and its forward premium are apparent from Chart 2.

The supply of forward pounds was absorbed by the interest-arbitrageurs who invested in U. S. Treasury bills, and by American concerns which were induced to borrow in London with the exchange risk covered. In June, Treasury bills yielded 2.17 per cent more in London than in New York. This differential was 2.86 per cent in July. On bankers' acceptances, the differential in favor of London was 1.89 per cent in June and 1.97 per cent in July. During phase I, from June 26 to July 12, the premium on the forward dollar rose from 3.495 per cent to 4.489 per cent. Outward interest arbitrage from London to New York was profitable. Thereby, a demand for the forward pounds was generated. This is precisely the mechanism described in Tables 5 and 6.

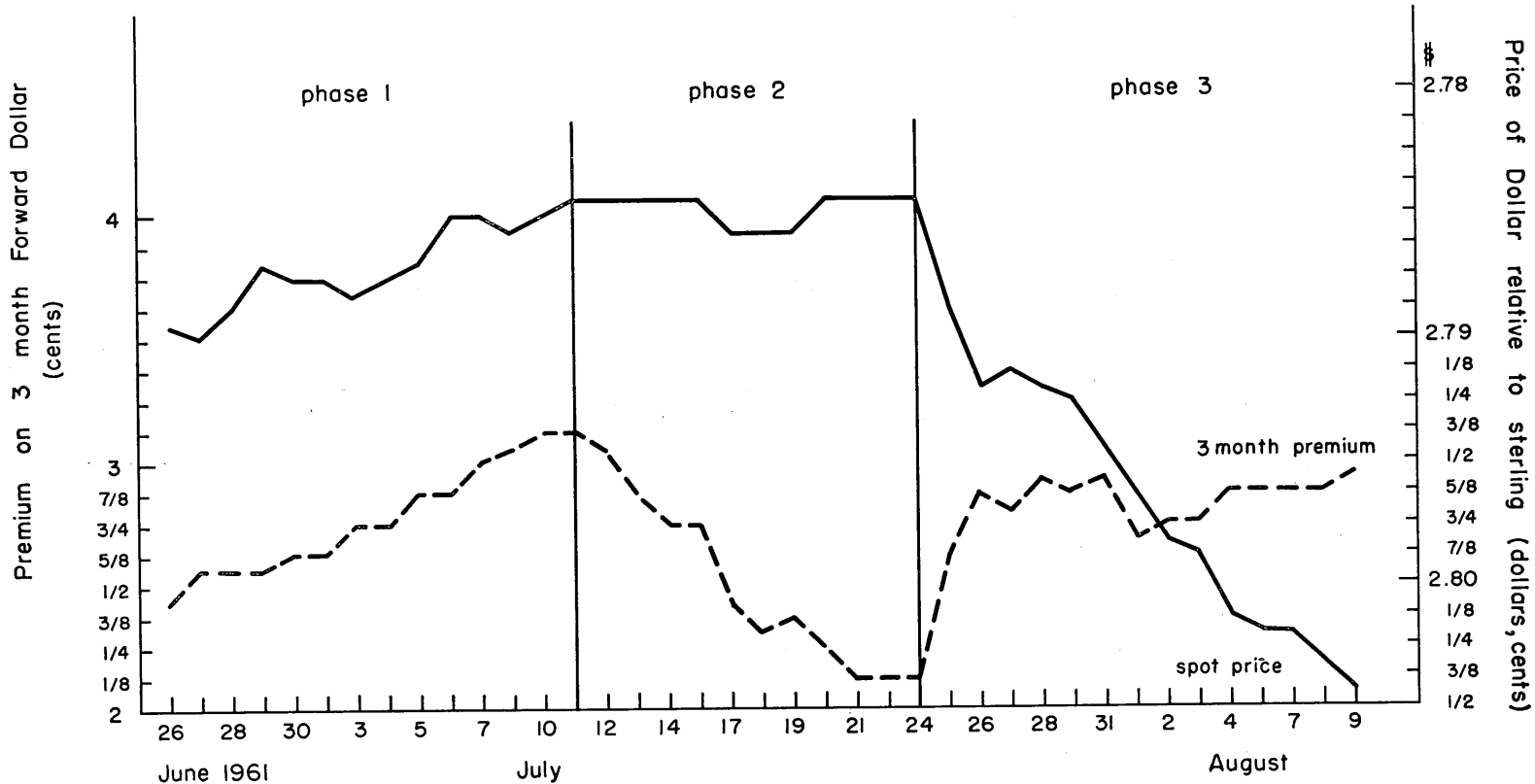
From July 11 to July 25, when the Bank Rate was suddenly increased, another set of events occurred. The large New York banks thought that the market was overly bearish on the pound. They therefore went long pound futures, while their customers and foreigners continued to sell spot pounds and future pounds. Pressure on the spot pound arose out of the leads and lags in international payments. This would explain the decline in the forward premium, while the spot pound was steady at \$2.78-7/16. There was no doubt that The Bank of England was actively supporting the pound at that level; but there was no evidence of official support in the forward market.

Insofar as pound futures were being purchased, the stimulus for outward interest arbitrage from the United Kingdom diminished. The premium on the forward dollar declined from 4.3995 on July 12 to 3.0527 per cent per annum on July 24.

On July 25, 1961, the third phase began. The Bank Rate was raised from 5 to 7 per cent; and the Chancellor fortified the reserves by resorting to the International Monetary Fund. As Chart 2 indicates, spot

Chart 2

Price of U.S. Dollar Relative to Sterling,  
June 29-August 9, 1961



sterling responded immediately to these measures (i.e., the spot dollar declined dramatically and steadily).

The Bank Rate rose from 5 to 7 per cent, the discount rate on (3-month) Bank bills rose from  $4\frac{3}{4}$ — $3\frac{1}{16}$  to  $6\frac{1}{4}$ — $3\frac{3}{4}$ , and Fine trade bills (3-months) rose from  $5\frac{1}{2}$ —6 to  $7\frac{1}{2}$ —8, per cent per annum. Britain's credit from the IMF consisted of an immediate drawing of nine currencies totalling \$1.5 billion, and a stand-by arrangement for an additional \$0.5 billion during the next twelve months.

The speculative bubble was pricked and the attraction of high interest rates produced the price relationships observed during a *normal* period. Since the professional risk-bearers in New York were not short sterling futures on July 25, the supply of interest-arbitrage funds from the United States to London raised the premium on the forward dollar. Informed market opinion realized that the rise in the forward premium on the dollar, during this period, was not a sign of speculation.

Few operators . . . have felt ready to put money into London without covering themselves in the forward market; and as the forward discount works out at an annual rate of  $3\frac{3}{4}$ —4 per cent on New York . . . this virtually wipes out the interest differential. A sharp rise in the interest differential is naturally associated with a widening in the forward margin, and this movement on Wednesday [July 26] could not therefore be attributed to a worsening of confidence. On Thursday forward rates were a little stronger, though dealings were not large.\*

A *speculative* period, phase 1, gave way to a *normal* period, phase 3. In the first phase the spot-dollar and the forward premium on the dollar were positively related. During the final phase, when interest rates were increased in London, the negative relation appears. These incidents are compatible with the regularities predicted by the theory developed above.

\* *The Economist*, July 29, 1961, p. 472.

## APPENDIX

### THE FLOATING STERLING-DOLLAR RATE 1921-25:

#### THE ABILITY OF THE PROFESSIONAL RISK-BEARERS TO FORECAST PRICE

A necessary, though not a sufficient, condition for an efficient free exchange market is that the professional risk-bearers should be able to forecast prices during both speculative and normal periods. If a foreign-exchange surplus will occur in the near future, the economy should be induced to increase its rate of imports at present. But if a foreign-exchange shortage will occur in the near future, the economy should be induced to economize its imports in the present. The activities of the professional risk-bearers, in anticipating future prices, affect the efficiency of the free market.

The experiences of the free sterling-dollar market, from 1921 to 1925, are analyzed here. The questions to be answered are:

1. Were the professional risk-bearers able to forecast price?
2. Were they better able to forecast price during speculative periods than during normal periods?
3. If each transaction is given the same weight, were their activities profitable?
4. Did they make more profit during speculative periods than during normal periods?

Part A contains a brief historical explanation of why the sterling-dollar market was freed during 1919-20 and then stabilized at the prewar parity in 1925. Part B analyzes the profitability of risk-bearing during this period.

#### *A. Why a Free Market Existed from 1919 to 1925\**

No doubts existed concerning the goals of British international monetary policy at the end of World War I. Montagu Norman, Governor of the Bank of England, "was supported by every British government during this period and by a majority of the members in every party in Parliament" in the view that sterling should ultimately be restored to its prewar gold value. This determination to return to the prewar parity was not the result of political expediency or economic analysis. William Adams Brown believed that it was the outgrowth of British banking tradition. "The British paper pound was a promise to

\* See L. V. Chandler, *Benjamin Strong*, Washington, D.C., 1958.

pay a certain weight of gold, and this promise had to be redeemed.”\* The problems concerned the most efficient means of restoring the prewar gold parity.

The purpose of the Brussels Conference of 1920 was to formulate an authoritative analysis of the postwar foreign-exchange problem which would command widespread assent. A. C. Pigou's memorandum to this conference suggested a dichotomy between the policies appropriate to countries whose exchanges had depreciated little, and those whose exchanges had depreciated substantially, relative to the dollar. I quote from this remarkable memorandum, for two reasons. First, his views were accepted by Benjamin Strong and Montagu Norman, the leaders of the international financial community. Second, this memorandum demonstrates that Pigou did not believe in the efficacy of price deflation as an instrument of economic policy:

The decision by any country so to control its currency as to establish a parity, or rather centre of parity, between that currency and gold leaves open a fundamentally important issue. What parity shall be established: shall it be the pre-war parity, or the parity that is found to exist when the process of 'inflation' is brought to an end, or some parity intermediate between the two? The principal relevant conditions are as follows. In favour of a return to pre-war parity it may be urged that the adoption of any lower parity means deliberate government depreciation of the currency, and so lowers general confidence in the financial probity of the country in which it is done: and that it is unfair to all lenders at fixed interest, whose loans were made before the war or during its earlier stages before the currency had greatly depreciated. On the other side it may be urged that in countries where the currency is greatly depreciated, a return to pre-war parity would involve an enormous contraction of currency and fall of prices, that this could only be brought about by a long continued regime of high money rates and a consequent check upon industry; that it would necessitate a more or less corresponding reduction of money wages only attainable through serious friction and many stoppages of work. Moreover, it would involve the payment of interest on war loans in a currency much more valuable than that in which a large part of them were subscribed. Yet again, money incomes being reduced in proportion as currency was appreciated, it would make necessary much higher rates of tax to provide interest and sinking fund on the debt, and this would make more difficult the fiscal problem of balancing the budget.

\* W. A. Brown, *The International Gold Standard Reinterpreted 1919-1934*, New York, 1940, Volume I, p. 178.



In the light of these considerations it is clear that the case for a return to the pre-war parity is stronger—that is to say, the arguments in favour of it have more, and those against it have less force—the nearer to this parity a country's currency is found to be when 'inflation' is finally stayed.\*

Great Britain could not restore convertibility until it knew the current value of the pound relative to \$4.8667: the prewar parity. This was no simple task, for the economic environment had changed radically since the war and sterling was a key-currency. Many foreign countries kept their assets in sterling, which was the main channel for remittances between Europe and the United States. As a result of London's intermediary role, the sterling-dollar exchange was in effect a Europe-New York exchange. When there were continental purchases of dollars, the dollar would appreciate relative to sterling and sterling would appreciate relative to the continental currency. The strength of sterling relative to the dollar did not depend exclusively upon the internal conditions in Britain and the United States.

Benjamin Strong and Montagu Norman agreed that there were certain prerequisites that had to be met before convertibility could be restored. First, British prices would have to fall relative to American prices. Neither was a disciple of the simple purchasing-power-parity theory, which claims that relative prices are the independent variable and the equilibrium rate of exchange is the dependent variable. They explored the possibility that an appreciation of the exchange rate could be used as a deflationary device. Nevertheless, in 1920 the U.K. wholesale-price index was 100 per cent above its prewar level, whereas the U.S. wholesale-price index was 70 per cent above its prewar level. More deflation (or less inflation) had to occur in the United Kingdom than in the United States before convertibility could be restored at the prewar exchange rate. But the Federal Reserve system was unwilling to pursue an inflationary policy as a result of the gold inflows and the Bank of England was reluctant to pursue a deflationary policy.

Second, interest rates in London should exceed those prevailing in New York. Thereby, there would be an increase in the net inflow of capital into Britain and sterling would tend to rise towards its prewar parity. This policy conflicted with the domestic objectives in each country. Widespread unemployment in England made Norman reluctant to raise interest rates or to oppose easier credit conditions. Strong, on the other hand, feared inflation and felt during much of the period that they could not permit lower interest rates in New York, sometimes even raising them.

\* *Ibid.*, pp. 222-223.

Third, the extent of the British war-debt obligations to the United States had to be decided. Otherwise, there would be no way of knowing the volume of payments that Britain would have to make to the United States each year. The appropriate rate of exchange would have to be one which would provide enough foreign-exchange receipts to make payments on both current and on capital account. Could the \$4.8667 rate provide enough foreign-exchange receipts to meet an uncertain amount of debt payments?

Fourth, a solution had to be found to the reparations problem. Since sterling was the European currency, the sterling-dollar rate could not be stable if the exchanges of the former Central Powers were in chaos.

No agreement was reached on the Anglo-American war debts until 1923. In fact, the Debt Funding Act, which created a Commission empowered to negotiate settlements, was not passed until 1922. Moreover, the Dawes Plan, which provided an effective, though temporary, solution to the reparations problem, was not in operation before 1924.

Restoration of convertibility at the prewar rate was irrational, and fraught with danger, before these prerequisites were satisfied. Moreover, it was apparent that several years would have to elapse before these conditions were met. By setting sterling free, its value would be determined; and the authorities would know when convertibility could be resumed at \$4.8667. In the meantime, Great Britain would have a foreign-exchange market. The freeing of the sterling-dollar exchange rate, and the abolition of domestic price controls, were effectively accomplished early in 1920.

By late 1924, sterling was selling in the \$4.70's and the prerequisites for convertibility at \$4.8667 were practically satisfied: U.K. war debts to the United States had been settled, the Dawes Plan was in effect, New York interest rates were lower than London interest rates, there were large capital outflows from the United States, and sterling was rising.

The Bank of England obtained \$300 million of stabilization credits, for two years, from the Federal Reserve Bank of New York and from J. P. Morgan. These credits increased confidence in the future stability of sterling, which became convertible in 1925.

### *B. The Profitability of Risk-Bearing: 1921-1925*

A continuous record of the principal forward rates has been collected by Paul Einzig,\* for the period beginning in 1921. The rates are for the Saturday of each week, except when no Saturday rates were available.

\* Paul Einzig, *The Theory of Forward Exchange* (London: Macmillan and Co., 1937), Appendices I and III were utilized.

In those cases, he used the latest quotation available prior to that Saturday.

I. SPECULATIVE PERIODS. The method used here of calculating the profitability of positions can best be explained with examples drawn from the data. A speculative period is one when the spot price of a currency and its forward premium move in the same direction. The period July 2, 1921 to July 23, 1921 was speculative because the price of the pound and its forward premium both declined. This situation corresponds to the case summarized in Tables 5 and 6.

	July 2, 1921	July 9	July 16	July 23
1. spot price of pound	\$3.73½	\$3.70	\$3.62½	\$3.59
2. pm (+) or dis (—) on the 3-month forward pound*	(1.74%) 1⅝¢	(1.35%) 1¼¢	(1.24%) 1⅛¢	(1.11%) 1¢
3. forward price of pound	\$3.75⅝	\$3.71¼	\$3.63⅝	\$3.60
4. price of pound 3 months later	\$3.73	\$3.79¼	\$3.88¼	\$3.93
5. profit or loss (—) on being short	2⅛¢	—8¢	—24⅝¢	

The risk-bearers sold pounds forward on July 2, July 9, and July 16; and hence produced the declines in the spot price and forward premiums from July 2-9, July 9-16, and July 16-23. Thus they were short three-month futures. On the basis of the theory developed in Section 4, the pound futures were purchased by the interest-arbitrageurs who transferred funds from London to New York. In three months time, the risk-bearers would have had to deliver the pounds.

Assuming that the bearish risk-bearers (as a group) cover their sales by purchasing pounds approximately three months later,† their profit (or loss) is the difference between the selling price and the spot price three months later. The July 2 sale would be covered on October 1 at a 2-1/8-cent profit, the July 9 sale would be covered on October 8 at an 8-cent loss, and the July 16 sale would be covered on October 15 at a 24-5/8-cent loss.

Similarly, when the spot price and the forward premium rise together, the risk-bearers are inferred to have raised the price by taking long positions (primarily) in the futures market. Their profit is the difference between the spot price three months later and the price of three-month

\* The per cent refers to a per annum basis.

† The risk-bearers' behavior induced interest-arbitrageurs to purchase forward pounds. Hence, the risk-bearers as a group must obtain pounds for delivery. Insofar as they will not purchase spot pounds at a time when inward interest arbitrage into the U.S. is profitable, they will purchase pounds approximately at the time the forward contract matures.

futures at the initial date. An example of a bull speculative period in sterling is the following.

	Oct. 8, 1921	Oct. 15	Oct. 22
1. spot price of the pound	\$3.79 $\frac{1}{4}$	\$3.88 $\frac{3}{4}$	\$3.93
2. pm (+) or dis (—) on the 3-month future pound	(0.66%) 5 $\frac{1}{8}$ ¢	(0.77%) 3 $\frac{1}{4}$ ¢	(1.02%) 1 ¢
3. forward price of pound	\$3.79 $\frac{7}{8}$	\$3.89	\$3.94
4. price of pound 3 months later	\$4.20	\$4.23	\$4.21
5. profit or loss (—) on being long	40 $\frac{1}{8}$ ¢	34 ¢	

Risk-bearers are inferred to have raised the price of the pound from October 8 to October 15 by purchasing pound futures. These pounds are assumed to have been sold on January 7, 1922 at a profit of 40-1/8 cents. The price rise from October 15 to October 22 is inferred to have occurred in a similar manner. Risk-bearers purchased three-month futures for \$3.89 on October 15 and sold out at \$4.23 on January 14, 1922. The profit was 34 cents per pound.

Since we do not know the volume of transactions at any one date, the statistics merely refer to the purchase or sale of one pound.

2. NORMAL PERIODS. As noted in Section IV, there are two types of normal periods, when the spot price and forward premium move in opposite directions. Tables 1 and 2 refer to the type of normal period produced by autonomous changes in the "basic balance": the balance on current plus long-term capital plus unilateral transfer account. When the spot price declines, the risk-bearers take long positions in futures (item 6, Table 2); and they take short positions in futures when the spot price rises. Tables 3 and 4 refer to the type of normal period produced by autonomous changes in interest rates at home or abroad. In this case, when the spot price rises, the risk-bearers take long positions in futures (item 5, Table 4); and they take short positions in futures when the spot price falls.

No difficulties arise concerning the identification of normal periods: the movement of the spot price must be compared with the movement of the forward premium. The *basic-balance type* of normal period (e.g., that described in Tables 1 and 2) is distinguished from the *interest-differential type* of normal period (e.g., that described in Tables 3 and 4) in the following way:

If (1) the spot price and forward premium move inversely; (2) the discount-rate parity\* (the London rate less the New York rate) and the

\* The discount rate is the rate of discount for three-months prime bills. Since I am

spot price of the pound move together; and (3) the discount-rate parity changes by more than 10 points (a point is  $1/100$  of 1 per cent), then the period is an interest-rate-differential-normal period. I infer that the exogenous disturbance was a change in the interest parities.

On the other hand, if the spot price and forward premium move inversely, condition (1) prevails but conditions (2) and (3) do not. I infer that the exogenous disturbance occurred in the basic balance. In such a case the change in the interest parities will be a *dependent* variable. The flow of funds, item 3 in Tables 1 and 2, will affect the interest parities, which I arbitrarily assume will change by less than 10 points. When the change in the interest parity is the independent variable, I assume the change exceeds 10 points.

An example of the "basic-balance" normal type of period will be followed by one concerning an "interest-rate-differential" normal period.

	July 30, 1921	August 6	August 13
1. spot price of pound	\$3.56 $\frac{1}{4}$	\$3.60	\$3.66
2. pm (+) or dis (-) on the 3-month forward pound	(1.68%) 1 $\frac{1}{2}$ ¢	(1.53%) 1 $\frac{3}{8}$ ¢	(1.50%) 1 $\frac{3}{8}$ ¢
3. price of forward pound	\$3.57 $\frac{3}{4}$	\$3.61 $\frac{3}{8}$	\$3.61 $\frac{1}{8}$
4. discount-rate parity	July: 47 points in favor of New York August: 44 points in favor of New York		
5. price of pound 3 months later	\$3.92 $\frac{1}{2}$	\$3.94	\$3.94
6. profit or loss to risk-bearers	-34 $\frac{3}{4}$ ¢	-32 $\frac{5}{8}$ ¢	

Over the period July 30, 1921 to August 13, 1921 the spot price of the pound rose and its forward premium fell. The decline in the forward premium was monotonic non-increasing. Hence the period is called normal, even though the absolute amount of the premium remained constant from August 6 to August 13.

The August discount-rate parity increased by 3 points: i.e., the London rate improved relative to the New York rate. However, a 3-point decline in the interest differential in favor of New York is assumed to be an induced rather than an exogenous factor in raising the price of the pound. This is a basic-balance-normal period. The risk-bearers are inferred to have sold three-month pound futures, to interest-arbitrageurs, on July 30 and on August 6. On October 29, they purchase pounds for \$3.92 $\frac{1}{4}$  at a 34- $\frac{3}{4}$ -cent loss; and on November 5 they purchase pounds for \$3.94 at a 32- $\frac{5}{8}$ -cent loss. In this case, they have failed to forecast the price correctly.

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viewing the situation from New York, the discount-rate parity is the London rate minus the New York rate. Einzig, *op. cit.*, Appendix III, provides the *monthly* discount rate parities from the point of view of London.

An interest-rate-differential-normal period occurred from July 29, 1922 to August 19, 1922.

	July 29, 1922	August 5	August 12	August 19
1. spot price of pound	\$4.44¾	\$4.45½	\$4.46¼	\$4.48
2. pm (+) or dis (—) on the 3-month forward pound	(0.84%) 15/16 ¢	(0.67%) ¾ ¢	(0.67%) ¾ ¢	(0.67%) ¾ ¢
3. price of forward pound	\$4.45 11/16	\$4.46¼	\$4.47	\$4.48¾
4. discount-rate parity	July: 113 points in favor of New York August: 86 points in favor of New York			
5. price of pound 3 months later	\$4.46¼	\$4.46¾	\$4.46	\$4.48
6. profit or loss to risk-bearers	9/16 ¢	½ ¢	—1 ¢	

Conditions (1), (2) and (3) are satisfied for the period above. Hence the situation corresponds to the one summarized in Tables 3 and 4. Interest-arbitrageurs invested funds in London and sold sterling futures to the risk-bearers. The July 29 purchase was sold on October 28, the August 5 purchase was sold on November 4, and the August 12 purchase was sold on November 11. The first two transactions were profitable; the third was not.

3. THE ABILITY OF RISK-BEARERS TO FORECAST PRICE. On the basis of this analysis, we can answer the questions posed at the beginning of the appendix. Questions 1 and 2 refer simply to the profit or loss on a given transaction, not the amount involved. There were 194 observations and profits were made in 120 cases. If these observations are considered as Bernoulli trials with a probability of making a profit equal to  $\frac{1}{2}$ , then the expected number of profitable cases is 97. The variance of the binomial distribution is  $(\frac{1}{2})(\frac{1}{2})(194) = 48.5$ . Hence the discrepancy between 120 and 97 is more than three times the standard deviation. We must therefore reject the hypothesis that these observations are Bernoulli trials with a 50-50 chance of making a profit. The professional risk-bearers apparently did better than chance.

Table 7 is a contingency table, summarizing their abilities to predict during speculative, basic-balance-normal and interest-differential-normal periods.

We now seek to answer question 2: whether the risk-bearers were more accurate in one type of period than another. During speculative periods, profits were made in 62 out of 97 cases: namely, 64 per cent of the time. The ratio of profitable to total cases was 79 per cent in the interest-normal period (30 divided by 38); whereas there were only 28 out of 59 profitable cases in the basic-balance-normal period. Can we reject the hypothesis that there was no difference in their forecasting ability among the three periods?

TABLE 7

## THE PROFITABILITY OF RISK-BEARING: 1929-25

	<i>profit</i>		<i>loss</i>	
I. Speculative	62	64%	35	97
	60*		37*	
II. Interest-normal	30	79%	8	38
	23.5*		14.5*	
III. Basic-balance-normal	28	48%	31	59
	36.5*		22.5*	
	120		74	194

If the probability of forecasting correctly is independent of the type of period, then the probability of forecasting correctly should be  $120/194 = 0.618$  in each period. During the speculative period there should have been  $(0.618)(97) = 60$  profitable cases, during the interest-normal period there should have been  $(0.618)(38) = 23.5$  profitable cases, and during the basic-balance-normal period there should have been  $(0.618)(59) = 36.5$  profitable cases. These numbers are starred in Table 7. Using the continuity correction factor, chi-square is significantly different from zero at the  $2\frac{1}{2}$  per cent level. On the basis of these findings, we may reject the hypothesis that the probability of forecasting correctly is independent of period. Roughly speaking, the risk-bearers are able to predict correctly in 4 out of 5 cases during interest-normal periods, in 3 out of 5 cases during speculative periods, and in 2 out of 5 cases during basic-balance-normal periods.

From 1921 to 1925, the price of the pound was rising. Risk-bearers who were long stood a better chance of making profit than did risk-bearers who were short. Is it likely that the risk-bearers predicted better in periods I (speculative) and II (interest-normal) than they did in period III (basic-balance-normal) merely because they tended to be long during the first two periods to a greater extent than they were long during the third period. Table 8 is a new contingency table which subdivides each period, according to whether the risk-bearers were long or short. The starred numbers are the expected frequencies, obtained by multiplying the row total by  $120/194$ .

Although risk-bearers did better when they were long rather than short, they still exhibited a better ability to forecast price during speculative and interest-normal periods than they did during basic-balance-normal periods. Chi-square (using the contingency correction factor) is significantly different from zero at the  $2\frac{1}{2}$  per cent level. Hence the ability to forecast price is not independent of the type of period.

TABLE 8

THE PROFITABILITY OF RISK-BEARING: 1929-25

	<i>profit</i>	<i>loss</i>	
I. Speculative	37	12	49
long	30.3*	18.7*	
short	25	23	48
	29.7*	18.3*	
II. Interest-normal	21	1	22
long	13.6*	8.4*	
short	9	7	16
	9.9*	6.1*	
III. Basic-balance-normal	10	7	17
long	10.5*	6.5*	
short	18	24	42
	26*	16*	
	120	74	194

Table 9 summarizes the material required to answer Questions 3 and 4: were their activities profitable?

TABLE 9

MEAN PROFIT PER TRANSACTION: 1921-25

I. Speculative period	
A. long	11.056 cents per pound
B. short	1.348
II. Interest-normal period	
A. long	12.918
B. short	4.00
III. Basic-balance-normal period	
A. long	1.439
B. short	-3.158
Grand mean	4.364 cents per pound

F = 4.97 significant at 1 per cent level

If each transaction is given an equal weight, the risk-bearers made a 4.364-cent profit per transaction over the entire period. This does not correspond to any specific rate of return because their operations were confined to the futures market where no initial outlay is required. Their



ability to predict price and make a profit was better during speculative and interest-normal periods than during basic-balance-normal periods. Similarly, they made more profit when long than when short—because the price of the pound was rising during the period. One can reject the hypothesis that the six sample means came from the same population. The value of F is statistically significant at the 1-per cent level.

It is concluded that the professional risk-bearers were able to predict price and succeeded in making profits in their activities. They were more successful during speculative and interest-normal periods than they were during basic-balance-normal periods. History fails to prove that the free sterling-dollar market was a chaotic market where the activities of the professional risk-bearers were irrational.\*

\*For a different view see Ragnar Nurkse, League of Nations, *International Currency Experience*, chs. V and IX.

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