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THE EURO-DOLLAR MARKET:
AN INTERPRETATION

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INTERNATIONAL FINANCE SECTION

DEPARTMENT OF ECONOMICS

PRINCETON UNIVERSITY

Princeton, New Jersey

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I. INTRODUCTION

This essay sketches a possible and hopefully plausible interpretation of the development of the Euro-dollar market within the broader context of the international monetary system. It does not contribute any new statistical or institutional material to the growing body of literature dealing with this most fashionable of international financial topics, but attempts to focus attention on some of the features of the Euro-dollar market most relevant to economic theory and policy.

The Euro-Dollar Market

Though most readers will be familiar with the operation of the Euro-dollar market, a very brief survey of some of its features may serve as a useful introduction to the issues raised in this paper.

The Euro-dollar market is part of the Euro-currency market. At least three features characterize Euro-currency operations: institutions operating in the market acquire claims and issue liabilities in a currency other than that of their country of residence; these assets and liabilities are usually short-term in nature; and all transactions involve the intermediation of banks. The main currencies which banks operating in the market accept (borrow) and place (lend) are the United States dollar, the British pound sterling, the Swiss franc, the German mark, the Dutch guilder, the French franc, and the Italian lire. The market area extends farther than the Euro-currency label implies, though the main centers—such as London, Zurich, or Frankfurt—are located in Europe. The Euro-dollar instrument is a foreign-currency deposit at a bank. Rates on call, seven-day, one-, three-, and six-month deposits are usually quoted.

For our purposes, it will be sufficient to define a Euro-dollar deposit as any dollar deposit at a non-American bank. The source of this deposit can be (1) a claim previously held on the United States, (2) an asset denominated in a foreign currency, or (3) a Euro-dollar deposit received by another bank. "Original lenders" can be defined as those institutions, both financial and nonfinancial, which make a Euro-dollar deposit by transferring a dollar deposit held in the United States to the Euro-dollar market or by exchanging foreign currency for dollars in the foreign-exchange market. "Intermediaries" are commercial banks that relend to another commercial bank the dollars they have received on

deposit from an original lender. "Final borrowers" can be defined as those economic agents who receive a dollar loan from a Euro-dollar intermediary but do not relend it to another intermediary. Under this definition, a commercial bank which receives a Euro-dollar deposit and uses it to make a nondollar loan or to increase its reserves acts as a final borrower; so does a nonbank borrower who receives a dollar loan from a non-American bank and does not redeposit it in the Euro-dollar market.

These definitions suggest that Euro-dollar transactions can be viewed as a series of chains along which the deposit of an original lender is transferred to a final borrower via the intermediation of commercial banks. Original lenders in the Euro-dollar market are usually large corporations—especially international corporations—commercial banks, and central banks. Intermediaries are of course mainly commercial banks, while final borrowers of every economic and institutional hue borrow in the market.

As an example, suppose a German exporter transfers a dollar deposit in New York to a German bank. The latter may relend the deposit to an Italian bank, which, in turn, lends it to an Italian importer who uses it to settle a debt to an American exporter. The German exporter is the original lender; the German and Italian banks as intermediaries have accepted and placed the dollar deposit; and the Italian importer is the final borrower.

The Euro-currency market has developed at a rapid pace since the 1958 return to convertibility of the major Western currencies. The Bank for International Settlements has estimated the net size of the Euro-dollar market (the net stock of Euro-dollars) at approximately \$13 billion at the end of 1966. Since Euro-dollar transactions represent fully 80 to 85 per cent of total Euro-currency transactions, one would guess the net size of the Euro-currency market to have stood at \$15 to \$16 billion at the end of 1966.

Two examples will suffice to indicate the market's importance for individual countries. At the end of March 1963, the liabilities of Italian banks in convertible foreign currencies to nonresidents amounted to \$1,947 million, while their foreign-currency claims on nonresidents stood at \$1,420 million. In other words, the Italian banking system had borrowed \$527 million in the Euro-currency market on a net basis and converted this amount into lire assets. Other things equal, the reserve base of the Italian banking system would have been \$527 million smaller had the banks not had access to the Euro-currency market.

In the United Kingdom, at the end of March 1965, foreign-currency liabilities represented some 36 per cent of total current accounts and deposits of accepting houses and overseas banks, and some 14 per cent of the banking system's total current accounts and deposits. Though

most of these liabilities were matched by foreign-currency assets, the *net* (foreign-currency) liability position of the British banking system (to nonresidents) stood at its highest level, increasing by £147 million over the previous quarter, an amount more than sufficient to finance a £96 million deficit on the current and long-term capital accounts of the balance of payments.

Outline of the Essay

So much for background. Two questions need to be asked: first, what general phenomena does the Euro-dollar market reflect; and, second, what is the significance of the market, broadly viewed, for economic theory and policy?

The essay's approach to these questions is to analyze, first, some of the salient features of recent international movements of short-term capital in general, and of Euro-dollar transactions in particular: the widespread use of third currencies in financial transactions among countries; the predominance of certain currencies, such as the dollar, in these transactions; the predominance of certain types of assets (in particular, claims on banks) as international credit instruments; and the very high interest elasticity that international demand and supply functions of short-term capital have exhibited in recent years. Institutional descriptions of—and attempts at measuring—these phenomena have been offered in the literature. This essay's approach is more analytical. It discusses, first, the nature of currency preferences (beyond preferences for certain patterns of risk and return on asset portfolios); second, the concentration of such preferences on one or two particular currencies; third, the gains that accrue to a country from the "vehicle" use of its currency; and, fourth, the relation between third-currency denomination of claims and debts and capital mobility.

This first part of the analysis will be carried out in the next two sections of the essay. Thus, section II will examine the nature of currency preferences and the economic rationale for the use of vehicle currencies; Euro-dollar transactions will be viewed as but one example of such vehicle-currency use. Section II will also argue that gains accrue to both the government and private residents of a country which issues a vehicle currency. Section III will discuss the link between capital mobility and the existence of certain types of assets—for instance, Euro-dollar deposits—which make better vehicles for international movements of capital than others. At the same time, section III will argue that the issue of such international vehicle assets by several countries makes it possible for the gains accruing to the country whose currency is used as vehicle in international transactions to be distributed more widely.

While sections II and III will present a broad interpretation of the Euro-dollar market, the subsequent sections will deal with some of its implications. Section IV will attempt to disentangle some of the issues involved in assessing the impact of the Euro-dollar market on the balance of payments of the United States. Section V will analyze the market's potential contribution to credit creation. The concluding section will sketch some of the implications of the analysis for the conduct of economic policy in both the United States and individual "outer" countries.

II. VEHICLE CURRENCIES

Our first task is to account for third-currency denomination of transactions among countries and for the predominance of the dollar and a few other currencies in such transactions. To understand the rationale of these transactions, of which Euro-dollar operations are a special case, it is necessary to ask, first, why an economic agent should ever want to hold assets or incur liabilities in a foreign currency; and, second, why he should show a preference for a few out of all available foreign currencies.

Currency Preferences

Traditional foreign-exchange theory does not offer an answer to these questions. True, it states that an investor will hold foreign rather than domestic assets if the return net of risk on the former is larger—or, strictly speaking, if the expected utility of holding the former is greater, where the argument of the utility function is limited to the probability distribution of monetary returns on the asset. This theory, however, does not explain why an economic agent should decide to hold his wealth in assets denominated in, say, dollars rather than in lire, if risk and interest rates on dollar and lire assets are equal and if there is absolute confidence in the maintenance of prevailing exchange rates. That is, particular assets are not held because of their currency denomination *per se*, according to traditional theory—except that lip service is occasionally paid to the fact that economic agents do keep working balances in various currencies. This theory, therefore, cannot explain the fact that private investors (as well as monetary authorities) display a preference for holding foreign assets denominated in major currencies—sterling in the past, dollars at present. Neither can it explain why the Euro-dollar market looms so large in Euro-currency markets.

To explain such specific currency preferences it is necessary to examine the place of assets denominated in foreign currency in wealth owners' portfolios, examine it independently of considerations of risk and return on the assets themselves.

The simplest approach to this issue is to ask what economic reasons there are for any individual or private institution to hold inventories of foreign currency even under severely simplified assumptions. That is, suppose that the only interest-bearing assets the residents of a country are allowed to hold are denominated in domestic currency (the only foreign-currency assets they can hold are *cash* assets). Suppose also that it is known with perfect certainty that exchange rates and prices will remain fixed at present levels for all future time periods. Under these assumptions there exists no economic reason for the holding of foreign

cash in the absence of asset-exchange costs. However, when transactions costs—broker's fees, bank charges, bookkeeping costs, psychological inconvenience, and so forth—are involved in the exchange of one asset for another, it becomes profitable for those agents whose receipt and expenditure streams are at least partly denominated in foreign currencies to hold cash balances in foreign currency even though the interest return on the latter is zero.

To illustrate, suppose that the foreign trade of a country is invoiced in foreign currency. Then, an importer's expenditure stream is denominated in foreign currency and his income stream in domestic currency, while the opposite pattern holds for an exporter. The importer accumulates domestic currency when his receipts exceed his expenditures, that is, as his net worth expands, and must pay out foreign currency as his net worth contracts. Were there no fixed costs of converting domestic cash into foreign cash, the importer would sell domestic interest-bearing assets and acquire foreign currency continuously as his net worth contracts, pay foreign suppliers immediately, and never accumulate any significant amount of foreign cash. A fixed cost per conversion, however, incites him to make lump-sum conversions and therefore to maintain, on the average, positive balances of foreign cash.

Similarly, an exporter accumulates foreign cash as his net worth expands and must pay out domestic cash as his net worth contracts. In the absence of asset-exchange costs, a profit-maximizing exporter will convert, upon receipt, his foreign-exchange earnings into domestic currency and invest them in interest-bearing domestic assets until he needs to make payments. With fixed costs per asset exchange he will let foreign-cash balances accumulate until the cost of conversion falls below the interest return that can be earned by investing the foreign exchange in domestic assets. In other words, exporters as well as importers will keep, on the average, positive balances of foreign cash.

It can be shown, by a similar line of reasoning, that traders who combine the functions of importer and exporter will keep positive balances of foreign cash as long as a discrepancy in the currency denomination of their receipt and expenditure streams exists. It can also be shown that the pooling of separate income and expenditure streams, either directly by an importer-exporter or by specialized intermediaries such as banks or foreign-exchange brokers, usually results in a lowering of the share of both foreign and domestic cash in working balances and in a higher return on over-all working balances. (Working balances, as defined by Professor James Tobin, are those balances which are held for the purpose of meeting seasonal excesses of expenditures over receipts; they can include both cash and interest-bearing assets.)

These conclusions are derived, implicitly, from the inventory approach to the demand for money developed by Professor William Baumol and by Professor Tobin. The appendix gives an explicit proof of the argument for the case of an importer. The essence of that argument can be put verbally.

Consider an importer who must make payments in foreign currency to his suppliers (continuously and at a constant rate) over some relevant planning period. The importer must decide how much cash to keep on hand and how much to invest in domestic interest-bearing assets (bonds for short). How often the importer converts domestic bonds into foreign cash—and hence his average foreign-cash holdings—depends on the domestic rate of interest and on the asset-exchange costs of converting bonds into foreign cash.

In order to maximize the return on his working balances, the importer will seek to convert domestic bonds into foreign cash in those discrete amounts which minimize the cost of holding foreign-cash balances. This cost has two components: the opportunity cost of giving up interest on bond holdings, and the cost of converting domestic bonds into foreign currency. The higher the interest rate, the greater is the opportunity cost of holding foreign cash—and hence the lower will optimum foreign-cash balances be. The higher the fixed costs of asset exchanges, the higher will be the cost of each asset exchange and the lower the optimum number of asset exchanges—hence the greater will average foreign-cash holdings be. More precisely, the appendix shows that foreign-cash balances will be positive as long as fixed asset-exchange costs are positive, that they will vary directly with these costs and the volume of transactions, and inversely with the domestic rate of interest.

The economic basis for the existence of currency preferences can now be summarized: the interaction of discrepancies in the currency denomination of receipts and outlays with asset-exchange costs results in a demand for specific currencies in an open economy. The foreign-currency composition of working balances should be related to the composition of trade, the demand for a specific foreign currency varying directly with the volume of transactions denominated in that currency and inversely with the rate of interest on domestic assets.

The Demand for Vehicle Currencies

The foregoing analysis accounts for the demand for specific currencies; it does not explain, however, why such demand should concentrate on one or a few currencies. For, the foreign exchange which is held in working balances is not a single commodity but is made up of the currencies of the several economies with which the home country trades.

The traders of various countries will carry out transactions predominantly in one vehicle currency only if such practice results in some economic advantage to all parties concerned. The advantages of using a vehicle currency reside, on the one hand, in increased interest income on working balances, and, on the other hand, in the opportunity to accumulate wealth in assets of fairly universal purchasing power.

Consider, first, the gains from the denomination of working balances in a vehicle currency. Reducing the foreign-exchange component of working balances from many currencies to one vehicle currency enables traders to reduce transactions costs and to increase the over-all return on their working balances. For, while it may be difficult to accumulate sufficiently large cash balances in each of a multitude of different currencies to make conversion into interest-bearing assets profitable, no such difficulty is likely to be encountered when all income and expenditure streams arising from foreign transactions are denominated in one and the same currency.

This proposition can be illustrated by considering the gains from reducing the number of foreign currencies in which an importer's expenditure streams are expressed. Assume, again, that only foreign *cash* assets are available and take the case of a German importer who must make payments in each of the currencies of the several countries with which he trades. The importer will hold cash balances in each of these currencies. Should his trade with Italy, for instance, now be settled in dollars rather than lire, his dollar cash balances will increase by less than the amount of lire cash balances (multiplied by the dollar-lire exchange rate) he was previously holding. That is, as the volume of transactions denominated in dollars increases, optimum cash holdings of dollars increase less than proportionately. As a consequence, the proportion of interest-bearing assets in, and hence the interest income on, working balances increases.

These specific results are a reflection of a more general principle: whenever discrepancies exist in the timing or currency denomination of income and expenditure streams, economies of cash balances can be realized by pooling different income and expenditure streams together. In the simple importer example above and under certain simplifying assumptions, it can be shown that these economies are directly related to the value and number of separate expenditure streams that are pooled together and denominated in a single currency. This is demonstrated in the appendix.

There are, thus, economic advantages to be derived from the use of vehicle currencies even when, as we have assumed so far, the residents of a country are limited to holding only foreign *cash* assets in addi-

tion to domestic assets. The possibility of holding foreign interest-bearing assets increases the share of foreign exchange in general, and of vehicle-currency assets in particular, in the working balances of various economic units.

The demand for foreign-exchange and vehicle-currency assets has been ascribed so far to the place of these assets in working balances. This demand is additional, or at least complementary, to that motivated by the usual considerations of risk and return stressed by traditional foreign-exchange theory. Another source of demand for foreign exchange can be distinguished if the usual assumption that economic agents are concerned with the domestic-currency value of their net worth is relaxed.

Such an assumption may be unwarranted in a world in which an economic unit's country of residence is not necessarily the country in which this unit ultimately desires to dispose of its wealth. To give but two examples: a Middle Eastern potentate may be more interested in the Swiss-franc value of his wealth than in its domestic-currency value; an international oil company may be more concerned about the dollar value of its assets than about their value in the currency of the company's country of residence.

The ultimate goal of wealth accumulation can usually be taken to be consumption by present or future generations. To the extent that future consumption comprises goods and services supplied by foreign countries, a country's residents in fact want to accumulate part of their wealth in foreign-currency assets. When exchange rates are expected to remain fixed, accumulation of foreign-currency assets enables wealth owners to bypass future asset-exchange costs. When there is uncertainty as to the future course of exchange rates, accumulation of foreign-currency assets provides wealth owners with a hedge against a change in the value of their wealth in terms of goods and services. From this point of view a wealth owner should accumulate assets in currencies matching his future consumption needs.

Assets denominated in the currency of a country which looms large in world trade will be demanded on that account. Such demand contributes to the potential vehicle-currency status of a large country's means of payments. Moreover, if wealth owners are uncertain as to the country-by-country breakdown of their future import requirements, they can still accumulate command over foreign goods in general by holding assets in the currency of that country which offers the widest menu of potential import goods. (Note, however, that the principle of risk diversification works against the pooling of *all* wealth in one currency in the face of uncertainty.) The relevance of this discussion to the vehicle-currency status of the dollar is obvious.

The Choice of a Vehicle Currency

The preceding paragraph suggests that the question to be asked next is, *which* currency is likely to be used as a vehicle currency? The choice depends partly on historical accident, but also on factors about which it is possible to generalize.

In the first place, asset-exchange costs play an important role in this choice. For instance, conducting transactions on income account in dollars will be preferred to conducting these transactions in Dutch guilders if the asset-exchange costs from dollars to domestic currency are lower than those from guilders to domestic currency. It is likely that asset-exchange costs depend inversely on the size of the market for a particular asset: economies of scale in financial intermediation are likely to arise if only because of familiarity and bookkeeping economies. The size of the market for a particular currency depends, in turn, in part on the size of a country's foreign transactions and, therefore, on the volume of its external trade and the structure of its balance of payments.

Second, the currency of a country whose financial market exhibits "depth, breadth, and resiliency" is a good candidate for use in external markets if investors are risk-aversers. For, the risk of capital loss on the sale of an asset traded in such a market is smaller than that on an asset traded in a thinner market. There are at least two reasons for this. First, an economic unit acting alone is less likely to have an influence on the market price of securities in a broad than in a thin market. Second, an exogenous disturbance of given magnitude induces greater price variations in a thin than in a deep, broad, and resilient market; therefore, the range of interest-rate fluctuations is likely to be greater in the former market unless the size of disturbances is proportional to the size of markets.

Third, the expected behavior of exchange rates has some relevance to the choice of a vehicle currency; no currency which is expected to fluctuate wildly—or to depreciate continuously over the long run—is likely to be used as a vehicle currency by private wealth owners. Of course, a currency—for instance, sterling—which was initially chosen as a vehicle may subsequently begin to exhibit such characteristics. Such a currency need not lose its vehicle-currency status immediately, though persistent expected or actual instability will erode its usefulness as a vehicle in the long run. Finally, it may be worth noting that the fact that foreign currencies are pegged to the dollar contributes to its worth as a vehicle currency. Foreign central banks peg their currencies in terms of the dollar at approximately $\frac{3}{4}$ of one per cent on either side of par under the European Monetary Agreement. This means that, whereas the maximum range of exchange-rate fluctuation of any currency covered

by the Agreement in terms of the dollar is 1.5 per cent as long as par values are maintained, the *potential* range of fluctuation of a nondollar currency in terms of another nondollar currency is 3 per cent.

An interesting feature of the use of a vehicle currency is its tendency to reinforce itself. The more a currency is used in external markets, the lower are asset-exchange costs in that currency likely to be and the more likely it is that its use in foreign markets will expand. This is but one of the many instances where habit breeds convenience and convenience breeds habit. It is also the process by which a vehicle-currency system develops.

Such a system is characterized by the widespread use of a currency, the vehicle currency, as a unit of account and means of payment in transactions between the private residents of third countries. Moreover, assets denominated in the vehicle currency will be demanded by these same residents as a store of value *because* of their currency denomination. For example, the dollar is a vehicle currency, the United States the center of that particular system, and the rest of the world is made up of outer countries; on the other hand, the United States is an outer country in the system where sterling is the vehicle currency.

Seigniorage

The nature of the gains from use of a vehicle currency is an important issue in such a system. The gains which are shared by both center and outer countries have already been mentioned above. They reside in lower asset-exchange and hence transactions costs, a higher interest income on working balances, smaller risk of capital loss on assets denominated in the vehicle currency, and the possibility of wealth accumulation in instruments of fairly universal purchasing power.

Additional gains accrue exclusively to the country issuing the vehicle currency. In the first place, in the extreme case where all foreign trade is settled in the vehicle currency, the residents of the issuing country need keep no foreign cash in their working balances and are therefore able to bypass the costs attendant on exchanging domestic for foreign-currency assets. Also, to the extent that they are concerned with the domestic-currency value of their net worth, residents of the issuing country bear no part of the burden of exchange-rate uncertainty.

Second and more important, the residents of the center country obtain, because of the vehicle-currency status of their national monetary unit, gains akin to those accruing to a country whose currency is held as international reserves by foreign official institutions. The latter have been called gains from seigniorage by Professor Robert Mundell.¹ For

¹ Professor Robert Z. Aliber mentions and estimates the seigniorage profit from the reserve-currency status of the dollar in "The Costs and Benefits of the U.S. Role as a Reserve Currency Country," *Quarterly Journal of Economics*, Vol. LXXVIII (August

instance, the United States is sometimes said to obtain "free" command over foreign goods and services to the extent that foreign governments hold dollars as reserves. The United States does not have to pay for this loan, or, at least, the interest it serves on foreign official balances is lower than the rate of return on capital in the United States. That is, the ability to issue international reserves enables the United States to reap gains from seigniorage. This concept can be extended to those dollar holdings by private nonresidents which result from the vehicle-currency status of the dollar.

While seigniorage in the conventional sense of the word arises from the demand for a specific (reserve) asset, what may be called "private" or "denomination seigniorage" arises from the demand for wealth denominated in a specific currency. Suppose that all international transactions are denominated in U.S. dollars; then, *private* economic units will hold cash balances in that currency, not to the extent required by their trade with the United States, but to the extent required by foreign trade in general. Had trade been denominated in several different currencies, foreign holdings of dollar assets would have been much smaller.

To give an example, suppose that trade between Uruguay and Italy is settled in dollars. Growth in the volume of Italo-Uruguayan trade will induce traders in these countries to increase their dollar balances. That is, these traders are willing to exchange some resources for the privilege of holding additional liabilities of the American banking system. As long as the vehicle currency is in use, and as long as the volume of trade between Italy and Uruguay does not decrease, the newly acquired claims on the United States will not be exercised and might as well be considered, if they cost nothing to produce and bear no interest, as a gift to the United States.

In addition to holding cash claims on the United States, foreign residents also hold interest-bearing liabilities of American residents. An element of denomination seigniorage arises in that case also; to make its nature clear, it will be useful to analyze the issue in some detail.

The value of seigniorage to the issuer of money is equal to the differ-

1964), pp. 444-445. The relevance of the concept of seigniorage to problems of international monetary reform has been noted by Professor Fritz Machlup in "The Cloakroom Rule of International Reserves: Reserve Creation and Resources Transfer," *Quarterly Journal of Economics*, Vol. LXXIX (August 1965), especially pages 353-355—though Professor Machlup does not use the word seigniorage. The seigniorage problem in the context of reserve currencies and the creation of international reserve assets was discussed in a paper by Professor Herbert G. Grubel, a comment by Professor Harry G. Johnson, and by various participants at the Chicago Conference on International Monetary Problems; see Robert A. Mundell and Alexander K. Swoboda, editors, *Monetary Problems of the International Economy*, to be published by the University of Chicago Press in the spring of 1968.

ence between the value of money issued and its cost of production. If paper money costs nothing to produce and foreign traders hold an amount M of the center country's paper money, the issuer of the vehicle currency receives an annual income rM from seigniorage, where r is the rate of return on capital expressed as a percentage per year. In other words, the gains from seigniorage are equivalent to those accruing from an interest-free loan of M , the proceeds of which can be invested at an interest rate of r . If the issuer of money pays a rate of interest i on the vehicle-currency balances held by foreign traders, his annual gains from seigniorage are reduced to $(r-i) \cdot M$.

Suppose now that foreign traders hold claims on the banking system of the country issuing the vehicle currency instead of the government's paper money. Suppose, furthermore, that the banking system of the issuing country is perfectly competitive, at least within that country's national borders. In this case, it might appear that seigniorage is eliminated, since competition among banks presumably equalizes the costs of production of money with the return from holding money, at least for the marginal bank. This is not the case, however, if commercial banks keep reserves in deposits bearing no interest at their central bank. Assume again that the cost of production of the monetary liabilities of the government is zero; denote by D the deposits held by foreign traders in the center country's banks and by k the ratio of reserves the latter keep against D . Then the annual value of seigniorage extracted from foreigners is $(r-i)M + rkD$. Seigniorage gains are obtained on the paper money held by foreigners, either directly, M , or through the intermediation of banks, kD .

The possibility of extracting seigniorage gains from foreigners is, of course, not restricted to vehicle-currency systems. Whenever residents of one country, say Denmark, hold the currency of another, say Spain, the latter gains some seigniorage. However, no important international redistribution of income is likely to be involved unless Spain is the center country in a vehicle-currency system, for Danish residents will hold working balances in Spanish pesetas only to the extent required by their trade with Spain—or if Spain pays a sufficiently high interest rate on its monetary liabilities. Moreover, Spanish residents are also likely to hold some working balances in Danish crowns, the two flows of seigniorage gains cancelling each other, at least to some extent. The issuer of a vehicle currency, on the other hand, can reap significant benefits from the external use of its currency.

Denomination Rents

In a vehicle-currency system, benefits accrue not only to the govern-

ment but also to the banking system of the center country. This is true as long as the production of banking services takes place under conditions of increasing costs, and the banking system of the center country, however competitive it may be internally, has a monopoly over the issue of monetary liabilities denominated in the vehicle currency. As the banking system of the center country expands the supply of monetary liabilities denominated in the vehicle currency to meet the demand of foreign wealth owners, intramarginal banks earn rents which they would not have received were their liabilities denominated in another currency. In other words, the average level of profits of the banking system of an issuing country will tend, other things equal, to be higher than that of the banking systems of outer countries.

This conclusion holds insofar as one source of monopoly power remains in the world we have described, namely, the privilege of the banking system of each country to issue liabilities in its own currency. When wealth owners are indifferent as to currency denomination, this monopoly power gives rise neither to seigniorage nor to special denomination rents accruing to commercial banks. When wealth owners show a preference for, say, dollars and are indifferent between other currencies, the American banking system reaps the benefits of this preference. Its value to a commercial bank in the United States should, theoretically, be reflected in the premium one would be willing to pay for a charter giving the right to issue dollar monetary liabilities rather than liabilities denominated in some other currency.

Denomination rents, then, like seigniorage, arise from the monopoly of the center country's residents over the denomination of liabilities in the system's vehicle currency. Such monopoly power implies a less-than-perfect efficiency of the international monetary system and is reflected in a higher spread between lending and borrowing rates than would prevail in its absence. The relevance of this discussion to an interpretation of the Euro-dollar market is that the latter can be viewed, among other things, as a means of distributing a part of denomination rents and some of the gains from denomination seigniorage to the residents of outer countries. That is, European banks, by issuing dollar liabilities, can bid away part of the gains from dollar denomination that previously accrued exclusively to American banks. Discussion of this issue can best be resumed after the relationship between capital mobility and the Euro-dollar market will be sketched in the next section.

III. CAPITAL MOBILITY, VEHICLE ASSETS, AND THE DISTRIBUTION OF SEIGNIORAGE

Perfect capital mobility requires as a prerequisite the absence of obstacles to international capital movements—convertibility, for short. One of its most interesting consequences is that it may, in some circumstances, imply an infinite interest elasticity of supply of capital to any small country, a situation which has far-reaching implications for the conduct of economic policy. Suppose, for instance, that there exists only one type of interest-bearing asset throughout the world; then there is only one world securities market, all securities are perfect substitutes in the portfolios of wealth owners, there can be no interest-rate differentials among countries, and the supply and demand of capital to any small country can be assumed to be infinitely elastic at the existing rate of interest.²

For the real world to resemble this model it is necessary that members of some class (or classes) of assets become near-perfect substitutes throughout the world and that such assets be widely held. Large international movements of capital in response to small changes in interest rates are likely to concentrate on such assets, which may be called international vehicle assets. I will argue below that certain classes of assets make better candidates for use as vehicles than others; that one of the principal obstacles to capital movements resides in the denomination of assets in different currencies; that such obstacles can be removed by denominating the liabilities of outer-country residents in a vehicle currency; that, in the process, some of the gains from denomination seigniorage are distributed; and that Euro-dollar claims on banks are a good example of international vehicle assets.

International Vehicle Assets

Two characteristics define international vehicle assets: (1) they are widely held throughout the world; and (2) individual members of that general class are close enough substitutes for small variations in their return relative to other members to cause large changes in quantities demanded and supplied.

The very term "class" of assets implies that individual members of the class are, in some sense, fairly good substitutes for each other, that they constitute a fairly homogeneous commodity. Individual bonds are,

² This is roughly the situation assumed in Robert A. Mundell, "Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates," *The Canadian Journal of Economics and Political Science*, Vol. XXIX (November 1963), pages 475-485; see also his "A Reply: Capital Mobility and Size," *Canadian Journal of Economics and Political Science*, Vol. XX (August 1964), pages 421-431. These two articles are also very relevant to the issues raised in section VI below.

in a sense, better substitutes for each other than they are for stocks, houses, or cash. Within the general class of fiduciary assets, one subcategory is likely to be much more homogeneous than others from the point of view of the portfolio choices of wealth owners, namely, claims on the banking sector of a country. This is especially true if this subcategory is restricted to the liabilities issued by prime-name commercial banks. Time deposits at Chase Manhattan and at First National City Bank are much closer substitutes for each other than are bonds issued by General Motors and bonds issued by Union Carbide—two companies in different industries; in the same way, three-month deposits at, say, the Deutsche Bank and the Frankfurter Bank are closer substitutes for each other than three-month commercial paper issued by Hoechst Chemical and similar paper issued by Allianz Versicherung.

Demand deposits at two prime-name commercial banks in the same country are very close substitutes because they share the same characteristics: they are both means of payments, they are both denominated in the same currency, the risk they carry is very small, and competition is likely to equalize the carrying costs on these two assets. Similarly, time deposits at the same two banks are close substitutes up to differences in interest return, since competition among banks is likely to give them very similar legal features. The time deposits of two prime-name banks located in different countries, however, are not as close substitutes as those of two prime-name banks located in the same country. What keeps them from being good substitutes are (1) differences in currency denomination, (2) intercountry differences in the cost of exchanging bank liabilities for other assets, and (3) other factors making for investors' preferences for the liabilities of specific banks—factors such as preferential customer-loan relationships, business hours, specific legal characteristics of a particular bank's liabilities, and so on.

These differences help explain why, even in the face of full convertibility, time deposits at banks in various countries should yield different returns. However, except for currency denomination (and for varying degrees of official regulation of banks), these differences are likely to be less pronounced among the time deposits of various banks than among the individual members of some other class of assets, such as equities or liabilities of local authorities. Assuming other differences to be negligible, differences in currency denomination keep bank deposits in various countries from being perfect substitutes under perfectly fixed exchange rates because of the specific currency preferences arising from the interplay of variations in foreign-currency net worths with asset-conversion costs. Exchange-rate uncertainty enhances the influence of differences in currency denomination on asset choices. That is, with certainty, lack of

substitutability between two assets identical except for currency denomination stems from the cost of converting one currency into another. Uncertainty increases the difference between these two assets by increasing the *expected* cost (or expected disutility) of converting one currency into the other.

The interest elasticity of international capital movements, then, should increase significantly if differences in the currency denomination of otherwise similar assets can be eliminated. Suppose, for instance, that borrowers in Germany issue liabilities denominated in U.S. dollars. Then, at least as far as currency denomination is concerned, the liabilities of residents of Germany and of the United States will become perfect substitutes in wealth owners' portfolios. Suppose now that the dollar is a vehicle currency and that the residents of all countries denominate their liabilities in dollars. Then, still from the point of view of denomination, the liabilities of the residents of all countries are perfect substitutes in the portfolios of residents of all other countries. This implies that financial and other transactions between two countries may now be expressed in the currency of a third country and that the elasticity of supply of capital to any small individual country is (almost) infinite. For, it is sufficient for the residents of a small country to raise the interest rate they offer to pay on their liabilities by enough to cover the transactions costs of selling claims on other countries to attract any amount of capital consistent with that country's small size.

In the real world, of course, this idealized picture never obtains exactly. Reality, however, does approximate the theoretical model for certain classes of assets, namely, claims on banks expressed in a vehicle currency. A demand deposit at the Deutsche Bank may not be a very good substitute for a deposit at the Bank of London and South America if the one is denominated in marks and the other in pounds sterling. Should both be expressed in dollars, however, and the terms of deposit be the same—a condition which international banking competition helps fulfill—they will come very close to being perfect substitutes in wealth owners' portfolios.

In the present context and in deference to recent monetary history, bank deposits were chosen as the example of an international vehicle asset. Any other asset will do, provided it is a member of a fairly homogeneous category, provided it is denominated in the same currency throughout the international-market area, and provided it occupies an important place in investors' portfolios.

The Distribution of Seigniorage

For differences in currency denomination to be eliminated in this way,

however, it is necessary for borrowers in the nonvehicle-currency countries to find it advantageous to issue liabilities in a vehicle currency. That is, the net cost of issuing liabilities, at least to nonresidents, must be lower if these liabilities are denominated in the vehicle currency than if they are denominated in any other currency. This net cost is equal to interest and other costs, such as those of underwriting, advertising, and so on, minus the economies of cash balances, transactions costs, and so on, derived from issuing liabilities in one currency rather than in another.

There are several reasons why borrowers may find it advantageous to issue liabilities in foreign currency in general, and in a vehicle currency in particular. Borrowers whose income and expenditure streams occur partly in foreign currency may want to borrow foreign currencies, if only to avoid conversion costs. Moreover, they will usually find it more advantageous to incur liabilities in a single foreign (vehicle) currency, if only to bypass some of the fixed costs of entering into each individual loan arrangement. More generally, borrowers find it advantageous to issue liabilities in a vehicle currency because this enables them to bid away part of the denomination rents previously accruing to residents of the country issuing the vehicle currency. To the extent that it is the denomination of liabilities in the vehicle currency that lowers both the carrying and interest costs of borrowing it is possible to bid away denomination rents—and, in the process, to eliminate some of the seigniorage gains accruing to the issuing country's government—by “coining” one's liabilities in that currency.

Some gains from seigniorage, however, will always be retained by the center country: foreigners will usually hold larger amounts of the latter's currency and bank deposits (for instance, as reserves against those liabilities of outer countries that are denominated in the vehicle currency) than if it were not the center country in a vehicle-currency system.

To illustrate, when European banks issue dollar liabilities, they attract, at least in part, deposits that would otherwise have been made with the American banking system. They bid away some of the denomination rents previously accruing to American banks and eliminate part of the seigniorage accruing to the United States. Some gains from seigniorage, however, are retained by the latter, insofar as European banks keep working balances in New York as reserves against their dollar business and New York banks, in turn, keep reserves against their liabilities to European banks. Moreover, a general increase in the use of the dollar as a vehicle currency is likely to be accompanied by a general increase in working balances held with American banks. Nevertheless,

for any level of dollar holdings by outer-country residents, seigniorage is lower when part of these dollars have been issued by outer-country residents.

Relation to the Euro-Dollar Market

Most of the analysis up to this point has dealt with such general phenomena as seigniorage, capital mobility, and the use of vehicle currencies, rather than with the specific Euro-dollar institution. This emphasis reflects my belief that some of the essential features of the Euro-dollar market can best be understood in the light of these broader concepts.

To illustrate: consider, for instance, the Euro-currency liabilities of banks in various countries. These liabilities resemble closely the imaginary international vehicle asset described above. They are predominantly denominated in a vehicle currency, the dollar. They are standardized throughout the market area: maturities, terms of deposit, terms of withdrawal, and so forth, differ but little from country to country. They occupy an important place in the working balances of economic units in many countries. Owner and debtor of Euro-dollar deposits are frequently residents of countries other than the United States.

Furthermore, the high elasticity of international demand and supply of capital, at least of the vehicle-asset variety, is reflected in the large changes that occur in the "Euro-dollar positions" of many countries in response to small changes in interest rates.

Finally, the Euro-dollar market is considered by many European banks as a means of breaking the monopoly of American banks on dollar financial transactions. From the point of view of American banks, as Oscar Altman puts it, "the results of Euro-dollar operations take the form of a smaller volume of business, or of a less profitable volume of business, or both. From the point of view of a foreign bank, the results of Euro-dollar operations take the form of a larger volume of business, or of a more profitable volume of business, or both" (*IMF Staff Papers*, December 1961, page 315). The Euro-dollar market is a device by which denomination rents accruing to the American banking system can be bid away and, in the process, some of the gains from seigniorage accruing to the United States Government distributed.

The Euro-dollar market is, of course, also much more. It enables banks outside the United States to satisfy not only wealth owners' demand for dollar assets in general, but also for dollar assets located in Europe. It is a device which enables banks throughout the world to

assault monopoly positions and gentlemen's agreements, and to exploit to good advantage any competitive weakness forced on the banking system of another country by official regulation. It is a market in which banks can lend and borrow excess reserves denominated in a neutral currency, the dollar. In a sense, the Euro-dollar market acts like a Federal Funds market on an international scale. However, whereas the American banking system as a whole cannot be a net debtor or creditor in the Federal Funds market, individual countries can be net debtors and creditors in the Euro-dollar market. In general, dollar (or more generally, third-currency) denomination of financial transactions has been used by banks and their customers to bypass the legal or customary obstacles to the free national and international flow of capital.

Although the analysis has emphasized the Euro-dollar market, much of the reasoning can be applied to the Euro-sterling market, and some of it to other Euro-currency markets. The supply, of say, Swiss or French-franc liabilities by foreign banks, can be explained in part by lower costs of issue, an increase in international competition among banks, and so on. The demand for such deposits may stem partly from particular preferences for the currencies in which they are expressed, together with the attractiveness of investing in assets which are similar—save for currency denomination—throughout the market area. For some groups of wealth owners the French or Swiss franc may play the role of a (secondary) vehicle currency.

The Euro-dollar market, however, differs from other Euro-currency markets in kind as well as in amounts transacted: the nature of Euro-currency markets would not change radically if only the Euro-dollar market existed; on the other hand, Euro-currency markets bearing some resemblance to present institutions are hard to imagine in the absence of a Euro-dollar market. Dollar deposits constitute the link between various Euro-currency markets; they provide the medium into and out of which capital is shifted in response to changes in exchange-rate expectations and in national interest rates. Whereas a large part of transactions in currencies other than the dollar (and perhaps sterling) can be explained by the usual considerations of risk and return, and by specific imperfections in national money markets, the predominance of the dollar in Euro-currency markets can be attributed to currency preferences arising from the role of the dollar as the most important vehicle currency in international financial transactions.

Theoretically, any currency (even an artificial unit created for the purpose) could play the role now assumed by the dollar in Euro-currency markets. In practice, however, only the dollar is likely to play this role in the foreseeable future. There are several reasons for this. First, the supply of the vehicle currency must be large to meet the need for

working balances held in the center country itself. Second, the costs associated with the vehicle use of a currency are likely to outweigh the benefits by far when the issuing country is small, for the demand for vehicle-currency balances held in the center country is likely to fluctuate with the volume of foreign-exchange transactions throughout the world; and such fluctuations would entail changes in the demand for a country's money supply relative to its national income, which are inversely proportional to the economic size of the country. Fear of the potential instability associated with the vehicle use of their currencies has led monetary authorities in several countries to discourage it. Finally, particular currencies, sterling at first and recently dollars, do not become vehicle currencies overnight or by decree. General acceptability (and the lowering of transactions costs associated with it) is gained gradually and slowly.³

To summarize, although sections II and III of this essay do not deal with specific institutional details, they do provide a general framework of analysis within which the Euro-dollar market can be put in perspective. The unfolding of our story from the simplest of rationales for holding foreign currencies to more complex forms of financial transactions denominated in third currencies does not necessarily correspond to the actual historical evolution of international financial practice; but there is a certain logic to the sequence of events implied by the analysis.

One could well imagine a world in which the volume of trade and international capital transactions is small. In such a world nationals of a country hold only few foreign interest-bearing assets and their working balances include various foreign-currency cash balances. As one country begins to dominate international transactions either by the volume of its foreign trade or the skill of its financial sector, that country's currency becomes, progressively, a vehicle currency. As international trade and credit expand, the demand for a variety of claims expressed in foreign currency expands with them. Investors display a preference for holding claims on the vehicle-currency country because of the currency denomination of these claims. Gains from seigniorage and denomination rents are quite important in such a situation, and new forms of international financial transactions are likely to arise to make possible their wider distribution. This whole process requires convertibility as a prerequisite and entails a high degree of capital mobility as a consequence.

The Euro-dollar market happens to be, at least in recent times, the best-known institutional form of the increasingly sophisticated international financial markets which such an evolution requires.

³ This paragraph reproduces an argument made in my "Vehicle Currencies and the Foreign-Exchange Market: The Case of the Dollar," in Robert Z. Aliber, editor, *The Market for Foreign Exchange* (tentative title), to be published by the University of Chicago Press.

IV. THE BALANCE OF PAYMENTS OF THE CENTER COUNTRY

There is little agreement in the literature as to the impact of the denomination of claims and debts in a foreign currency on the issuing (center) country's balance of payments. The Euro-dollar market has been alternatively praised and damned for being the savior or henchman of the balance of payments of the United States. As the following discussion makes abundantly clear, a precise statistical estimate of the impact of the Euro-dollar market on the American balance of payments is well nigh impossible. Nevertheless, an attempt at sorting out the analytical issues involved may prove worthwhile.

The main difficulty in such an attempt is to define precisely what is meant by impact of the Euro-dollar market on the American balance of payments. In the first place, the meaning of the impact of any occurrence on the American balance of payments needs to be specified. For some purposes it might be appropriate to evaluate this impact in terms of a statistically operational concept, such as the Lederer or Bernstein definitions. For ours, it is better to think in terms of a foreign-exchange concept of the balance of payments: anything that creates an excess demand for dollars improves the American balance of payments and *vice-versa*. In the second place, it is necessary to decide what is to be understood by the impact of an institution such as the Euro-dollar market on an economic variable such as the balance of payments. An answer to this question necessarily involves the comparison of two situations, one in which the institution is present and the other in which it is not. The question can be put in at least two ways. First, suppose a world in equilibrium into which the Euro-dollar market is introduced. The question then is, what is the effect of an *autonomous* growth of the Euro-dollar market on the American balance of payments? Second, suppose an excess demand for dollars to exist; then compare the impact of this excess demand on the American balance of payments in the absence of the Euro-dollar market with the impact of the excess demand in the presence of the Euro-dollar market. Though these two approaches may seem identical, each reflects a different view of the growth of the Euro-dollar market. The first implies that Euro-dollar intermediaries must induce a demand for their dollar-denominated liabilities in order to expand; the second presupposes that an excess demand already exists.

These two lines of inquiry are pursued below. To anticipate the perhaps disappointing results, it will be found that the first approach does not enable us to form an *a priori* judgment as to the direction in which an autonomous growth of the Euro-dollar market is likely to affect the American balance of payments. Moreover, this approach shows how difficult, if not impossible, it is to settle the issue on the basis of

statistical fact. The second approach, on the other hand, can be made to yield the conclusion that the Euro-dollar market tends to reduce the favorable impact of an initial excess demand for dollars in correcting an American balance-of-payments deficit. This conclusion, however, begs a very important question, namely, that the initial excess demand for dollars is not independent of whether a Euro-dollar market exists or not. The concluding remarks of this section attempt to establish the possibly controversial proposition that looking at the Euro-dollar market, not in isolation but as a reflection of the general phenomena discussed in the first sections of this essay, leads to ascribing to it a favorable long-run influence on the American balance of payments.

Autonomous Growth of the Euro-Dollar Market

Assume, then, the world economy to be in equilibrium: there is balance-of-payments equilibrium, no change in money supplies, equilibrium in the markets for goods and services, full currency convertibility, and no Euro-dollar market. Our task is now to introduce a Euro-dollar market into this world and examine the resulting effect on the balance of payments of the United States; that is, does the establishment of the Euro-dollar market induce wealth owners to acquire additional dollar assets, and borrowers to borrow from Euro-dollar intermediaries instead of borrowing from banks in this country, thus producing an excess demand for dollars, or *vice-versa*?

Suppose that, starting from the initial equilibrium, a new bank is created in the United Kingdom and that this bank's deposit liabilities are to consist solely of dollar deposits. The bank's assets consist either of sterling or dollar loans. The currency composition of the bank's loans does not matter here, since we will assume, for simplicity's sake, that the bank lends exclusively to borrowers outside the United States and that the latter convert all dollar-loan proceeds into sterling. (The virtue of these assumptions is that the only relevant feature of the bank's loans, from the point of view of the American balance of payments, is, then, whether they are substitutes for loans by American banks. The reader can easily work out the analysis for cases where the bank lends to residents of the United States or where the bank's borrowers decide to keep dollar assets.) Call this bank a Euro-bank to distinguish it from other banks in the United Kingdom. The Euro-dollar market is born—there is an autonomous growth of the Euro-dollar market—if this bank succeeds in attracting dollar deposits.

In order to ascertain the impact of this growth on the American balance of payments, two related questions must be answered: first, if equilibrium prevailed previously, how can a new bank enter the market

and operate profitably; and, second, what is the source of the bank's deposits and the use of the bank's loans?

Assume, for a moment, that the liabilities of the Euro-bank are perfect substitutes for the liabilities of American banks in the portfolios of wealth owners. Assume also that borrowers are indifferent to incurring liabilities to Euro-banks or other banks. Then, in order to attract deposits and to make loans, the Euro-bank must offer a slightly higher rate on deposits than American banks offer and grant loans at a slightly lower rate than other banks—that is, it must extend dollar loans at a lower rate than American banks and sterling loans at a lower rate than British banks. The Euro-bank can operate profitably on a lower interest margin than the current margins earned by American banks (strictly, by the marginal American bank) if it discovers a new and cheaper production process or if it is able to break down the barriers to entry into a monopolistic industry—where the term monopoly embraces rents arising from the ownership of scarce factors, such as the ability (or imagination required) to issue dollar liabilities. The now larger supply of dollar liabilities will be absorbed only if the entrance of the new firm raises the return on holding all dollar deposits (which are, by assumption, perfect substitutes). As the marginal cost of issuing dollar liabilities increases, American banks will wish to supply less of them and their profits will decrease. In the terminology previously introduced, the Euro-bank has bid part of the denomination rents away from the banking system of the United States.

The profitability of Euro-dollar operations makes the autonomous growth of the Euro-dollar market possible. The impact of this growth on the American balance of payments must be sought in the sources of the Euro-bank's newly acquired liabilities and in the uses to which it is putting them.

Two sources of the Euro-bank's deposits can be distinguished: claims on the Euro-bank which have been acquired by transferring existing dollar assets to the Euro-bank, D_{US} for short, and claims which have been acquired by purchasing dollars with foreign exchange, D_E for short. Similarly, the loans of the Euro-bank can be divided into two categories: L_{US} , loans which borrowers now incur to the Euro-bank instead of American banks and L_E , those which are not substitutes for loans previously granted by the United States. Then, assuming all loan proceeds to be converted into foreign currency and to end up in the coffers of foreign central banks, an approximate measure of the impact of the operations of the Euro-banks on the American balance of payments is

$$X = L_E - D_E = D_{US} - L_{US}$$

where X is the excess supply of dollars created by the Euro-dollar market.⁴ This expression, which may be positive, negative, or equal to zero, states simply that the Euro-dollar market has an unfavorable impact on the American balance of payments if borrowers wish to convert more dollars into foreign exchange than depositors want to convert foreign exchange into dollars. Alternatively stated, the American balance of payments suffers from the growth of the Euro-dollar market if depositors substitute Euro-dollar deposits for other (United States) dollar assets to a greater extent than borrowers substitute Euro-dollar loans for loans from American banks.

It is not possible to determine *a priori* whether an autonomous growth of the Euro-dollar market results in an excess supply or excess demand for dollars, for, as the market grows, the rate on dollar deposits increases and that on loans, particularly dollar loans, decreases. Depositors acquire claims on the Euro-bank both by shifting existing dollar assets to the bank and by acquiring dollars with foreign exchange. The lower loan rate induces borrowers to increase their liabilities to the Euro-bank at the expense of their liabilities both to American and to other European banks.

The issue, then, is an empirical one. But it is practically impossible to settle, even in the presence of complete information on the balance sheets of economic units, for the growth of the Euro-dollar market is not, in fact, superimposed on a world initially in equilibrium.

Suppose, for instance, that, after the Euro-dollar market has been instituted and the world has returned to a state of equilibrium, the Federal Reserve pursues an easy monetary policy. As the Federal Reserve buys bonds for money the American deposit rate temporarily falls below the Euro-dollar loan rate. Capital flows must take place, however, to reestablish equality between Euro-dollar and American rates if we assume that dollar deposits wherever located are perfect substitutes. As both residents and non-residents of the United States exchange American assets for Euro-dollar (and other European) assets the United States experiences a deficit, the fall in the interest rate spreads from the United States to the rest of the world, and incomes and prices rise to reestablish equilibrium. In this example, clearly, the increase in dollar deposits abroad is not *caused* by the existence or growth of the Euro-dollar market but is induced by a policy-created deficit in the American balance of pay-

⁴ X is only an approximate measure for at least three reasons: (1) it does not take into account the fact that banks and borrowers do not convert all loan proceeds into foreign currencies but keep dollar balances as reserves; (2) the interest-rate changes entailed by the growth of the Euro-dollar market induce changes in portfolios which are not reflected in the accounts of the Euro-bank; and (3) changes in interest will affect variables such as incomes and, hence, trade flows and balances of payments.

ments. Separating changes in this country's balance of payments which are due to an *autonomous* growth of the Euro-dollar market from those which are reflected in the market's *induced* growth presents almost insuperable statistical difficulties. We should not want to say that the existence of British government bonds causes a deficit in the American balance of payments whenever residents of the United States acquire such assets.

Product Differentiation

Allowing for the fact that Euro-dollar deposits are not actually perfect substitutes for dollar deposits in American banks changes neither the essence of the foregoing analysis nor the agnostic nature of its conclusions. The imperfect substitutability of the liabilities of Euro-banks for those of American banks can be interpreted to mean that the former represent, at least for some wealth owners, a new and differentiated product. This means, in turn, that an autonomous growth of Euro-dollar intermediaries is made possible not only by the discovery of cheaper production processes but also by the introduction of a new product.

The sources and uses of the Euro-bank's resources can now be viewed in a slightly different fashion. Euro-dollar intermediaries will be able to attract some deposits even at rates below those paid by American banks and to extend some loans at rates higher than those charged by American banks. For any given rates on deposits and on loans in the United States, the supply curve of dollar deposits to Euro-banks and the demand curve for loans from Euro-banks can now be broken down into several parts.

Roughly, the supply curve of Euro-dollar deposits can be said to be aggregated from the supply curves of three groups of investors: (a) Those wealth owners who, at equal interest rates, prefer to hold their dollars in Europe rather than in the United States because of closer bank-customer relationships, more convenient business hours, risk-diversification considerations, inertia, or what not. These investors will hold Euro-dollar deposits even at rates lower than those prevailing in the United States; part of their deposits represent dollars which would not have been held in the absence of the Euro-dollar market and have, therefore, been acquired in exchange for foreign currency. (b) Those investors for whom Euro-dollars and U.S. dollars are perfect or near-perfect substitutes. These wealth owners begin to shift their dollar assets from the United States to Euro-banks as the Euro-dollar rate begins to rise above the rate on time deposits in the United States. (c) Those investors who show a preference for keeping their dollars in the United States. As the Euro-dollar rate rises substantially above the American deposit rate, more and more investors switch their dollar assets from the United

States to Euro-banks—and, of course, also from foreign currencies to Euro-dollar deposits. This breakdown of the supply curve of deposits to the Euro-dollar market enables us to conclude that the amount of existing dollar assets transferred to the Euro-dollar market (D_{US}) varies directly with the interest-rate differential in favor of Euro-dollar deposits.

A similar analysis can be carried out for the demand for loans from Euro-banks. The latter can be said to be aggregated from the demand curves of three groups of borrowers: (a) Those who, at equal Euro-dollar and American borrowing rates, prefer to borrow in the Euro-dollar market (because they have only limited access to the American market, or for some other reason). (b) Those who, at equal rates, are indifferent between borrowing in the Euro-dollar market or in the United States, that is, borrowers for whom interest cost is the primary consideration. (c) Those who prefer to borrow in the United States (because of limited access to the Euro-dollar market, or for some other reason). The accommodation of the needs of the first type of borrowers by the Euro-dollar market does not take loan business away from American banks. As the Euro-dollar rate falls below the American loan rate, however, the loan demand of the second group, and, gradually, of the third group of borrowers is diverted toward the Euro-dollar market. In other words, the volume of loans which borrowers now incur to Euro-banks instead of American banks (L_{US}) is inversely related to the loan rate charged by Euro-dollar intermediaries.

Product differentiation does not modify the conclusion that it is impossible to determine *a priori* the impact of the Euro-dollar market on the American balance of payments; ($D_{US} - L_{US}$) may still be either positive or negative. On the assumption of a fairly constant markup of the Euro-dollar loan rate over the Euro-dollar deposit rate, it is possible to state, however, that the excess supply of dollars created by the Euro-dollar market tends to vary directly with the Euro-dollar lending and borrowing rates for given interest rates in the United States. Borrowers will want to convert more dollars into foreign exchange and depositors will want to convert less foreign exchange into dollars at high than at low Euro-dollar rates relative to American rates. Without additional information, however, it is impossible to determine, at any point of time, whether a high Euro-dollar rate is due to the autonomous growth of the market or to some other factor, such as tight monetary policy in, say, the United Kingdom.

Induced Growth of the Euro-Dollar Market

Turn now to the second approach to the impact of the Euro-dollar market on the American balance of payments. Suppose European resi-

dents suddenly decide that they want to hold dollar rather than foreign-currency deposits, that is, there is an excess demand for dollars. In the absence of the Euro-dollar market this excess demand will be eliminated by an exchange of foreign-currency for dollar assets and a corresponding gain of reserves for the United States and loss of reserves for Europe. (Of course, the reserve changes will be exactly equal to the initial excess demand for dollars and excess supply of foreign currency only under special circumstances, for instance, if capital is perfectly mobile internationally.)

Now suppose the same excess demand for dollars to arise when the Euro-dollar market exists. Part of the excess demand for dollars will supposedly be satisfied by the acquisition of dollar claims on Euro-banks. That is, Euro-dollar intermediaries satisfy, at least partly, wealth owners' preferences for dollar assets. On this view of the role of the Euro-dollar market, the measurement of its impact on the American balance of payments is straightforward: the deficit generated by the market is equal to total Euro-dollar deposits—net of interbank deposits—minus the claims of Euro-banks on the United States. The assumptions underlying this approach are that the aggregate of Euro-dollar deposits would have been held in the United States in the absence of the market and that the activities of the Euro-banks do not reduce the foreign lending of American banks.

Although such a measure may be useful in estimating the amount of credit intermediated through the Euro-dollar market, its worth as an estimate of the impact of the market on the American balance of payments is doubtful at best. In the first place, it attributes the existence of the Euro-dollar market solely to an autonomous excess demand for dollars; it neglects both the possibility that the Euro-dollar market has grown at least partly in the autonomous fashion described previously and the fact that part of Euro-dollar holdings are the result of capital flows induced by government policies or other exogenous factors. In the second place, it neglects the fact that Euro-banks compete with American banks for dollar deposits: in other words, dollars are held with Euro-banks not only because they are dollars but also because Euro-banks offer higher interest rates than American banks, at least in some disequilibrium situations. It is true that Euro-banks can attract these deposits at a lower rate than if they were denominated in some currency other than the dollar; to this extent, the second measure of the market's impact on the American balance of payments has some usefulness, at least in the short run.

To confine one's attention to the balance sheets of Euro-dollar intermediaries in evaluating the long-run impact of the market on the Ameri-

can balance of payments leads one to expect the market to have, at best, a neutral effect. Such a narrow view, however, neglects the fact that the Euro-dollar market is part and parcel of the expanding vehicle-currency status of the dollar. The argument developed in the first parts of this essay strongly suggests that the demand for dollars is *not* independent of the existence of markets of the Euro-dollar type. It implies that such markets are a natural outgrowth of vehicle-currency use. Moreover, they help to make a continuing expansion of the use of the dollar as a vehicle currency acceptable to the residents of outer countries, for they provide a method of distributing some of the gains accruing to the center country of that system, the United States. Insofar as the Euro-dollar market reflects the growing use of the dollar as an international trading currency, it implies an increasing amount of dollar holdings either by traders and wealth owners in general, or by banks as reserves against their dollar liabilities. From this broader point of view, the Euro-dollar market can be interpreted as an attack on the monopoly position of American banks, but also as a tribute to the monopoly position of the dollar.

V. CREDIT CREATION

The preceding section viewed Euro-banks essentially in the role of financial intermediaries. As intermediaries Euro-banks represent an expansionary force in the world economy. As we have seen, their growth leads to a decrease in the rate of interest on loans and hence, presumably, to an increase in investment and income throughout the world. The expansionary role of the Euro-dollar market can also be viewed as an activation of previously idle balances. To illustrate this activation, it is useful to view Euro-dollar transactions as a series of chains along which the deposit of an "original lender" is transferred to a "final borrower" via the intermediation of Euro-banks.

Suppose, to use the example of section I once more, that a German exporter (the original lender) who holds a dollar deposit in New York transfers his title to it to a German commercial bank (a Euro-dollar intermediary) for, say, three months. Suppose, next, that the German bank decides to deposit these dollars with an Italian commercial bank (another Euro-dollar intermediary), which in turn lends the dollar deposit it has just acquired to an Italian importer (the final borrower) for the settlement of a debt with an American exporter. The final result (until repayment) is that a deposit has been transferred from the New York accounts of a German exporter to those of an American exporter to finance the latter's transactions with an Italian importer. Note that this American export to Italy could not have been financed by American banks if the latter had been fully loaned up. In our example, trade can be financed by European banks even if all banks in the world have, initially, no excess reserves. In other words, idle balances have been activated by the transfer of the German exporter's dollar deposit to the Euro-dollar market.

One question that comes readily to mind is whether the Euro-dollar market can create credit beyond the easing of credit, or activation of idle balances, attendant on the growth of any financial intermediary. Some monetary theorists are fond of drawing a distinction between nonbank financial intermediaries and commercial banks, on the grounds that the latter can create credit while the former cannot. Since Euro-dollar intermediaries are mostly commercial banks, it is tempting to draw an analogy between the so-called domestic credit or money multiplier and the process of chain deposits in the Euro-dollar market. In pursuing this analogy, it is necessary to distinguish carefully between actual credit creation and the pyramiding of interbank deposits. That is, it is necessary to distinguish between the amount of intermediation (pyramiding) which takes place in a single chain extending from original lender to final borrower and the redepositing in the market of the proceeds of the loan to the

final borrower. This redepositing starts a new chain and thus represents multiple credit creation. A few examples may clarify this distinction.

Pyramiding

Consider, first, the amount of pyramiding that occurs in a single Euro-dollar chain. Assume, for instance, that Euro-dollar intermediaries keep a uniform reserve ratio of 10 per cent against their dollar liabilities, either because they are required to do so or of their own will. Then, in the example given at the beginning of this section, suppose the German bank receives \$100 from the German exporter; the first bank relends \$90 to the Italian bank, which, in turn, lends \$81 to the Italian importer; in one sense, \$271 can be said to have been created in the Euro-dollar market. This creation, however, is not the analogue of that which takes place in the domestic money-multiplier process. What is relevant in the latter is the increase in bank deposits held by the public, not the increase in interbank deposits. In the Euro-dollar example, the multiple dollar creation vanishes when the balance sheets of the various intermediating banks are consolidated.

The amount lent to the final borrower in a single chain dwindles with an increase in the number of intermediaries. The number of intermediating banks in a single chain, however, is limited by the number of intermediations which can profitably take place between the rate paid to the original lender and that charged to the final borrower. Thus, in our example, each intermediation reduces the amount that is being lent by 10 per cent. The amount of gross lending—or pyramiding—is equal to the sum of the Euro-dollar liabilities generated in the chain from original lender to final borrower. In our example, gross lending amounts to \$271, the sum of the Euro-dollar liabilities of the German bank (\$100) and Italian bank (\$90) and of the Italian borrower (\$81). Net lending amounts to \$81.

In the familiar terms of monetary theory, the foregoing can be interpreted to mean that, thanks to the intervention of intermediaries, a deposit which previously belonged to idle balances has been partly transferred to active balances, thus increasing the transactions velocity of circulation; in the process of intermediation, part of the deposit returns to idle balances (in the form of dollar reserves of Euro-banks). In terms of our example, a previously idle deposit of \$100 in New York is transferred to active circulation outside the United States.

Multiple Credit Creation

It should not be concluded from this discussion that there cannot be any credit creation in the Euro-dollar market beyond the transfer of

funds from original lender to final borrower described above. For, when we considered the role of banks outside the United States in a single chain of Euro-dollar transactions, we described their role as financial intermediaries. When one considers the whole complex of banks operating in the Euro-dollar market—and all other banks for that matter—one examines a (commercial) banking system capable of multiple liability and credit expansion.

Any increase in lending by a bank can lead to a multiple expansion of credit. One interesting question is how much of this expansion will occur in the Euro-dollar market itself—that is to say, how much will take the form of an expansion of the dollar liabilities of Euro-banks held by the public. Formally the answer is simple. The amount of Euro-dollar creation depends on the “loan-retention ratio” prevailing in the market, namely, the proportion of dollars reaching the end of one Euro-dollar chain which is redeposited in the Euro-dollar market. If the recipients of the New York deposit borrowed by the final Euro-dollar borrower redeposit a certain percentage of their receipts in the market, or, to put the same thing another way, a certain proportion of the deposits reaching the end of the chain finds its way back into the market, a multiple expansion of credit takes place in the Euro-dollar market.

An autonomous increase in Euro-dollar deposits now induces further deposits, as some, or all, of the New York deposits borrowed by final Euro-dollar borrowers are redeposited in the market. The appendix shows that the credit-creation multiplier applicable to an expansion of Euro-dollar deposits is equal to the inverse of leakages into assets other than Euro-dollar deposits. There are two such leakages: the leakage into those dollar deposits that Euro-banks hold as reserves against their Euro-dollar liabilities, and the leakage stemming from the failure to redeposit in the market the entire amount lent to the final borrower in any single Euro-dollar chain.

As an example, suppose that the recipient of the \$81 borrowed by the Italian importer redeposits the whole amount in the Euro-dollar market. This means that a new chain is created by an original deposit of \$81. After two bank intermediations, \$65.61 is lent to a new final borrower; as the proceeds are redeposited, the process continues *ad infinitum*—or *ad nauseam*. The multiplier in this example is approximately 5.26 and the total potential Euro-dollar creation due to the original \$100 deposit is therefore \$526. In fact, of course, the proportion redeposited is likely to be much smaller than one. The main drain on the proportion redeposited occurs when deposits are transferred to the accounts of residents of the United States or to central banks who do not choose to redeposit them. On the other hand, the proportion redeposited may be

quite large in the chains leading to the financing of trade between residents of outer countries.

The Euro-Dollar Market and the World Money Supply

Of course, even if the proceeds of the Euro-dollar loan are not redeposited in the market, their disposal can lead to a multiple expansion of credit somewhere else in the world economy. The withdrawal of a deposit from a bank in one country and its deposit in a bank in another is usually assumed to lead to a multiple contraction of the money supply in the first country and to a multiple expansion in the second. If the money multipliers are the same in both countries the expansion is equal to the contraction and the world money supply is left unchanged. The net effect of an expansion of the Euro-dollar market on the sum of bank deposits in the world, however, is likely to be positive rather than zero, for at least two reasons.

First, when an expansion of the Euro-dollar market reflects an increase in the efficiency of financial intermediation in the world, it reduces loan rates and increases deposit rates and, hence, increases the share of bank deposits in wealth owners' portfolios.

Second, to the extent that the process of multiple expansion takes place in the Euro-dollar market itself, no reduction of claims on the American banking system need occur. For, in that case, the sum of dollar reserves kept by Euro-banks against their dollar liabilities will be equal in amount to the deposit originally transferred from the United States to the Euro-dollar market. In our example, \$100, or 19 per cent of the total amount created in the Euro-dollar market (\$526), is kept on deposit in the United States. In fact, of course, part of the multiple expansion of credit will not occur in the Euro-dollar market itself. Nevertheless, assuming equal money multipliers throughout the world, the transfer of a deposit from New York to the Euro-dollar market always leads to an increase in the world money supply if Euro-banks keep any deposits in the United States at all. That is to say, the expansion in deposits outside the United States is greater than the contraction in the United States by the amount of Euro-bank reserves kept in New York times the money multiplier.

Furthermore, it is also worth noting that some expansion in the world money supply is likely to occur even if the original Euro-dollar deposit was acquired in the foreign-exchange market. If Euro-banks are allowed to hold dollar deposits in the United States against their dollar liabilities, the amount of credit need not change in Europe, while it can expand in the United States by a multiple of the deposits now held as reserves.

To summarize, capital flows which result in an expansion of the Euro-

dollar market will tend to increase the world money supply. The main reason is that a private banking system (the Euro-banks) keeps as reserves deposits in another private banking system (that of the United States).

The prospect of credit creation within the Euro-dollar market may seem frightening to those who identify the total of dollar claims on Euro-banks with a potential claim on the American gold stock. These fears are quickly allayed when it is realized that only deposits held in the United States by Euro-banks constitute a potential claim on the wares of Fort Knox. Dollar claims on European banks are claims on these banks alone. The latter must meet any withdrawal of dollar deposits either from their reserves or by acquiring the dollars in the foreign-exchange market.

VI. SOME POLICY IMPLICATIONS

The Euro-dollar market impinges on the conduct of economic policy in outer countries and in the center country, and on banking policy in general. In keeping with the highly selective character of this essay, only the briefest sketch of the market's import to these three policy areas is given here.

Economic Policy in Outer Countries

For an outer country's economic policy it is the capital-mobility aspect of the Euro-dollar market that is most relevant. It is a well-known proposition that capital mobility significantly reduces the influence of monetary policy on domestic interest rates and, hence, on the level of income. In fact, R. A. Mundell has demonstrated that, within the confines of a theoretical model, perfect capital mobility under fixed exchange rates prevents open-market operations from affecting the interest rate and the level of income in a country sufficiently small to have only a negligible influence on the world level of interest rates. On the other hand, monetary policy does have full impact on the balance of payments. The concrete counterpart of this abstract dilemma has more often than not been large changes in the Euro-dollar position of an outer country's banking system (and therefore in its balance of payments) in response to policy measures adopted to affect domestic interest rates.

Capital mobility limited to vehicle assets does leave some room for controlling domestic interest rates. Central banks (notably in Italy and Germany) have attempted to drive a wedge between return to foreign lender and cost to domestic borrower by intervening in the Euro-dollar market. The fact that it is capital denominated in foreign currency which is in highly elastic supply to the domestic economy makes it possible to substitute forward-exchange policy for monetary policy. By increasing the premium on forward dollars the central bank can increase the cost of borrowing in domestic currency. The central bank can also regain some control over domestic interest rates by regulating the specific institution through which the highly elastic supply of foreign capital is transmitted to the domestic economy, namely, the private banking system. The rationale of controlling the Euro-dollar operations of banks is to drive up the spread between return to lender and cost to borrower, for instance, by means of increasing reserve requirements against foreign-currency liabilities.

The Bundesbank and the Bank of Italy have used a combination of both these methods of intervention. By selling dollars to commercial banks and repurchasing them forward at a premium over the market

rate, they increase the cost of borrowing in domestic currency while at the same time limiting their intervention to the banking sector. That the effectiveness of such interventions is limited can be illustrated by an example. As of June 1963, the German banking system was a net creditor in the Euro-dollar market, while German corporations were net debtors by roughly the same amount. As the cost of Euro-dollar loans from domestic banks increased because of the central bank's intervention, German corporations turned to alternative (foreign) sources of short-term finance.

It is not surprising that the devices described above offer only a very partial escape from the limits imposed on monetary policy by capital mobility. When perfect confidence in the maintenance of existing exchange-rate margins and parities prevail, the scope for forward-exchange policy is as narrow as are the margins. Once forward dollars have reached the upper spot-intervention point, the speculative supply of forward dollars becomes perfectly elastic, or, to put the same point in a theoretically equivalent way, borrowers find it advantageous to incur uncovered liability positions in dollars. The effectiveness of controlling capital flows by regulating banks only is likely to be equally limited, for, to achieve a rising level of interest rates, it is necessary to increase reserve requirements continuously and such a policy entails well-known problems of equity and feasibility. Moreover, capital, though most mobile in Euro-dollar form, is also becoming generally more mobile, particularly in the form of foreign dollar loans to prime-name domestic corporations. Controlling banks only is like plugging only one of the many holes of a reservoir of fungible capital.

The main implication of the Euro-dollar market for the conduct of monetary policy in outer countries, then, is essentially similar to that of generalized capital mobility. Although the special nature of mobility of Euro-dollar capital gives monetary authorities some control over domestic interest rates, this leeway is rather limited. Note that capital mobility does not mean that monetary policy has lost all effectiveness. On the contrary, capital mobility allows monetary policy to have full impact on the variable which it is best designed to affect, namely, the balance of payments. The import of the Euro-dollar market for the international monetary system is that it makes the adoption of a proper policy mix more urgent than ever. The danger of abdicating the use of fiscal policy as the means of controlling income levels is to force that task on to monetary authorities. To hold monetary policy responsible for the stabilization of cyclical income fluctuations in a world of capital mobility is to invite exchange controls on Euro-dollar operations first and on other types of capital movements later.

Economic Policy in the Center Country

A misunderstanding of the impact of the outer use of a currency on the *issuing* country's economy is another potential source of exchange controls. As was argued earlier, the Euro-dollar market does not necessarily create a deficit in the balance of payments of the United States. Neither does it imply a pyramiding amount of claims on the gold stock of the United States. In the long run, the growth of the market is related to (and may be necessary to) the expanding vehicle-currency status of the dollar. In this context, it is dangerous to shape policy on the basis of a liquidity measure of the balance of payments which regards as a deficit the increase in short-term dollar balances kept as reserves against transactions financed in the Euro-dollar market.

The foregoing by no means implies that the Euro-dollar market presents this country's policy makers with no new problems. The increased international substitutability of assets does mean that capital flows are highly responsive to changes in interest rates and that the monetary policy of a large center country is an overriding factor in the determination of world interest rates. Interest rates in the United States largely determine Euro-dollar rates, and domestic interest rates in outer countries are tied to the latter, although the causation also runs the other way. The interdependence of capital markets throughout the world makes the international coordination of economic policies, or rather the definition of rules of the game, more necessary than ever.

Moreover, though the Euro-dollar market cannot be said to cause American balance-of-payments deficits, it does imply that this country's liabilities to foreigners accumulated through *past* deficits have become more volatile. Thus, a given interest-rate differential in favor of "Europe" in the face of an increasing degree of capital mobility resulted in a large outflow of capital to the Euro-dollar market at the latter's inception. The point is simply that, with an increasing degree of capital mobility, policies which are not geared to external equilibrium result in larger payments imbalances than before. The bright side of this particular coin is that correct policies will also be more effective.

Banking Policy

Finally, an increased degree of capital mobility and banking competition have important implications for banking policy as distinct from monetary policy. To the extent that prime-name banks in the major Western economies issue dollar liabilities and make dollar loans that are close substitutes internationally, these banks are becoming part of one and the same world-wide banking system. As a consequence, all the familiar problems of equity and competition which stem from the differential

regulation of various classes of banks within a single country arise also at the international level. Even apparently minor differences in regulations affecting bank competitiveness may cause large changes in the volume of business handled by a country's banking system and engender sizeable capital flows. This remark applies not only to type-Q regulations in the United States but also to imperfections in bank competition throughout the world.

Take, for instance, intercountry differences in reserve requirements. Their importance can be illustrated by a simple example: assuming required cash reserves to be 20 per cent, a bank borrowing at 3 per cent must earn 3.75 per cent on its investments to break even. The break-even rate for a bank with 10 per cent cash reserves, on the other hand, is 3.33 per cent. The second bank's edge over the first is five-twelfths of one per cent, a very sizeable margin in the highly competitive Euro-dollar market. Such differences exercise a pervasive influence on actual Euro-dollar operations. For instance, German commercial banks were, at one time, required to keep reserves against foreign-currency liabilities only if these were not matched by foreign-currency assets held abroad. As a consequence, they found it more advantageous to extend dollar loans to foreign Euro-banks than to domestic borrowers. The foreign Euro-banks, which were not subject to such reserve requirements, found it possible and profitable to turn around and relend the dollars to German corporations at rates lower than those which could have been offered by the German banks. This illustrates the point that the Euro-dollar market, by bringing banks within and among countries in direct competition, tends to eliminate any discrepancies between comparable lending and borrowing rates anywhere in the market.

The importance of the specific Euro-dollar institution should perhaps not be exaggerated. Nevertheless, the Euro-dollar market deserves attention, not because its present institutional forms are endowed with historical permanence, but because it is an embodiment of vehicle-currency use and capital mobility. As a reflection of these more general phenomena it contains the seeds of problems with which the international monetary system may increasingly have to cope.

APPENDIX

1. Currency Preferences

An importer's transactions demand for a specific foreign currency can easily be derived under the assumptions of the inventory approach to the demand for money developed by Professor Baumol.⁵

Consider an importer who must meet a stream of foreign-currency payments, M , over the relevant planning period. It is assumed that payments must be made continuously and at a constant rate. The importer must decide how much foreign cash to keep on hand and how much to invest in domestic bonds. Let r be the interest return on domestic bonds, a the fixed cost of converting domestic bonds into foreign cash, and suppose conversions of domestic bonds into foreign cash must occur in lots of even size, S .

The problem is to find the optimum size of such conversions (denoted by S^*). This will also determine the importer's optimum average foreign-cash balances, $F^* = \frac{S^*}{2}$ —or demand for the specific currency in which payments for imports must be made. The optimization criterion is to choose S so as to minimize the cost of holding foreign-cash balances, C :

$$(1) \quad C = \frac{aM}{S} + \frac{rS}{2}.$$

Expression (1) states that this total cost is equal to the number of bond-cash conversions $\frac{M}{S}$ multiplied by the cost per conversion, a , plus the

interest foregone, r , on average cash balances of $\frac{S}{2}$. To minimize costs, set

$$(2) \quad \frac{dC}{dS} = \frac{-aM}{S^2} + \frac{r}{2} = 0,$$

from which, following Baumol, we obtain the square-root formula for the optimum size, S^* , of lump-sum conversions into foreign cash,

⁵ William Baumol, "The Transactions Demand for Cash: An Inventory Theoretic Approach," *Quarterly Journal of Economics*, Vol. LXVI (November 1952), pages 545-556. See also James Tobin, "The Interest Elasticity of the Transactions Demand for Cash," *Review of Economics and Statistics*, Vol. XXXVIII (August 1956), pages 241-247.

$$(3) \quad S^* = \sqrt{\frac{2aM}{r}},$$

and

$$(4) \quad F^* = \frac{S^*}{2} = \sqrt{\frac{aM}{2r}}.$$

This establishes our claim that, in this case, average holdings of foreign cash, F^* , will be positive when $a > 0$. The foregoing is of course a reapplication of Baumol's results with terms appropriately redefined.

2. *The Demand for Vehicle Currencies*

We can now use the above results to show the savings from single-currency (or vehicle-currency) denomination of foreign transactions.

Take the case of an importer who trades with n countries and incurs continuous expenditure streams of M_1, M_2, \dots, M_n . Suppose that asset-conversion costs are the same for all currencies and are equal to a per conversion. Then, the importer will hold n different foreign-cash balances, $F_1^*, F_2^*, \dots, F_n^*$, or total cash balances in foreign currencies of

$$(5) \quad \sum_{i=1}^n F_i^* = \sum_{i=1}^n \sqrt{\frac{aM_i}{2r}}, \quad i = 1, 2, \dots, n,$$

where the separate cash balances are expressed in one currency by applying the proper exchange rates.

Now suppose that all foreign transactions are settled in a single currency. Let $\sum_{i=1}^n M_i = \bar{M}$, where again the value of all expenditures is expressed in terms of some single currency. Then the importer's foreign-currency cash balance is

$$(6) \quad \bar{F}^* = \sqrt{\frac{a\bar{M}}{2r}}.$$

The saving in cash balances is found by subtracting expression (6) from expression (5). Assuming for simplicity that $M_1 = M_2, \dots, = M_i, \dots, = M_n$, this yields

$$(7) \quad \left(\sum_{i=1}^n F_i^* \right) - \bar{F}^* = (n - \sqrt{n}) \sqrt{\frac{aM_i}{2r}} \\ = (n - \sqrt{n}) F_i^* > 0, \quad \text{for } n > 1.$$

Expression (7) states that there are positive economies of cash balances to be realized by denominating separate foreign-expenditure streams in one single currency. This economy of cash balances is directly related to the number, n , of currencies pooled and to the volume of individual foreign-expenditure streams, M_i . Economizing on cash balances yields an increase in interest income equal to the value of expression (7) multiplied by the rate of interest. This establishes the proposition that there are economic advantages to be derived from the use of vehicle currencies.

3. Credit Creation

Denote the amount deposited by the original lender by x , the reserve ratio by a (assumed to be the same for all intermediaries), and the amount lent by $b = 1 - a$. The total amount of pyramiding, or gross lending, which can take place in a single chain is

$$\sum_{i=0}^m x b^i,$$

where m denotes the number of intermediaries able to operate on the lending-borrowing spread. Net lending, the amount lent to the final borrower, is simply $x b^m$.

Suppose now that a proportion d of the proceeds of the loan received by the final borrower is redeposited in the Euro-dollar market. This means that an original deposit of x induces a further deposit of $d(x b^m)$. In the next round, $[d(x b^m)]^2$ is redeposited, and so on.

The credit multiplier in the Euro-dollar market is simply

$$\frac{1}{1 - b^m d},$$

assuming the number of intermediating banks in any one chain to be given and equal to m . This multiplier is derived by taking the limit of the series

$$\sum_{i=0}^n (b^m d)^i = 1 + b^m d + (b^m d)^2 + \dots + (b^m d)^n$$

as $n \rightarrow \infty$, for $b^m d < 1$.



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