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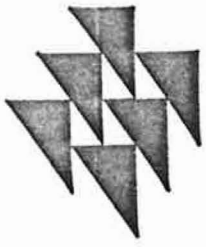

Foreign Exchange Dealing and the Transactions Demand for Foreign Exchange

Antti Suvanto*

The paper explores the demand for money for international transactions purposes in a world where the nonbank public in each country has a preferred monetary habitat to hold only their domestic currency for transactions purposes and where one national currency can be converted into another with specialized foreign exchange dealers (or commercial banks). It is shown that dealers' (stock) demand for foreign exchange as well as for domestic money depends positively on the average volume of retail transactions and the unit cost of a wholesale transaction and negatively on the opportunity cost of holding money. Domestic and foreign currencies appear as complements rather than substitutes, and there are likely to be economies of scale in the currency holdings of the dealer.

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1. Introduction

The notion of the transactions demand for foreign exchange dates back to the 1950's, when the so called dollar shortage was a big issue. Yeager (1959) reacted to the then ongoing debate by arguing that the much discussed inadequacy of international liquidity is a deplorably vague concept, and that the whole issue had arisen because of inconsistent attempts by central banks to avoid deflationary monetary policies and at the same time to keep the exchange rates fixed. Yeager's opinion was that under free market conditions, without the official pegging of exchange rates, traders and dealers can choose the optimal size of their foreign exchange holdings and can quickly and cheaply transform balances in one currency into balances in another currency simply by change of ownership.

Nine years later Heller (1968) returned to this issue and made an important distinction between the precautionary demand for international reserves by central banks on the one hand, and the transactions demand for foreign exchange by commercial banks, on the other hand. Central banks hold official reserves in order to be able to support the value of their currencies in times of temporary balance of payments deficits, but they do not directly participate in executing international payments. In practice, most international payments are effected by commerical banks, and therefore it is their foreign exchange holdings, which are interesting from the point of view of the transactions demand. [1]

In this paper we study the transactions demand for foreign exchange in a world where the nonbank public in each country has a preferred monetary habitat to hold only their domestic money for transactions purposes, and

where one national currency can be converted into another with specialized foreign exchange dealers (or commercial banks).

In Section 2 we study the nature of the equilibrium in the foreign exchange market and, in particular, in the market for dealer services. It is shown that the market demand for dealer services depends negatively on its price, i.e. the ask-bid spread. The supply side is more difficult to be handled analytically, because it would require a theory of the firm producing dealer services. A step towards such a theory is attempted in Section 3, where the behavior of an individual dealer is analyzed. It is shown that with no transactions and no exchange rate uncertainty the demand for foreign exchange by an individual dealer depends on the known time-profile of retail transactions, and the relative ask-bid spread is determined by the opportunity cost of holding money balances, i.e. the rate of interest. Introducing exchange rate uncertainty and assuming risk aversion makes the relative ask-bid spread positively dependent on the variance of daily changes in exchange rates. By assuming transactions uncertainty but no exchange rate uncertainty it is shown that the demand for foreign exchange (as well as for domestic money) depends positively on the volume of retail transactions and negatively on the rate of interest.

In contrast to the so called currency substitution approach (see e.q. Calvo and Rodriquez, 1977; Bilson, 1978; Miles,1978) domestic and foreign currencies appear as complements in this analysis. The reason for this is that both of them are needed for dealers to be able to buy and sell on immediate demand.

2. Market For Dealer Services

In this section we study the market equilibrium for foreign exchange in a simplified world where the public in each country has a preferred monetary habitat to hold only domestic money for transactions purposes, and where one national money can be converted into another with foreign exchange dealers. Standard macroeconomic issues concerning the determination of exchange rates are circumvented by assuming a stable macroeconomic structure and hence the existence of the equilibrium 'true' exchange rates consistent with that structure.[2]

There are two countries, home country and the foreign country. Domestic currency is called the Mark, and the foreign currency is called the Dollar. The stable macroeconomic structure generates a sequence of foreign trade contracts. In each contract two parties are involved, an importer and a seller or an exporter and a buyer. Payments are made at the same time when trade contracts are agreed upon. Irrespective of the currency in which the payment is made each contract implies the need on the part of one trading partner to convert dollars into marks or vice versa. It is assumed that it is always cheaper to make the conversion immediately with a foreign exchange dealer than to try to find some other trader who has an opposite conversion need.

Under decentralized trade each two partners agree upon trade contracts independtly of other contracts and the timing of contracts is stochastic. Hence the dealers receive market orders as a stochastic flow.

Foreign exchange dealers are profit maximizing agents who have invested resources in non-interest bearing demand deposits with commercial banks both at home and abroad. With these inventories of monies they are able, with certain limits, to buy and sell foreign currencies on immediate

demand. In particular, the incoming buy orders and sell orders need not match at each moment of time.

The willingness of importers and sellers to agree upon import contracts depends negatively on the exchange rate, and the willingness of exporters and buyers to agree upon export contracts depends positively on this rate. Taking into account the stochastic timing of trade contracts the flow demand for dollars (supply of marks) per unit of time on the part of importers and sellers is:

(1) $D_t = D(s, Z) + u_t \quad ; \quad \partial D/\partial s < 0.$

The flow supply of dollars (demand for marks) per unit of time on the part of exporters and buyers is accordingly:

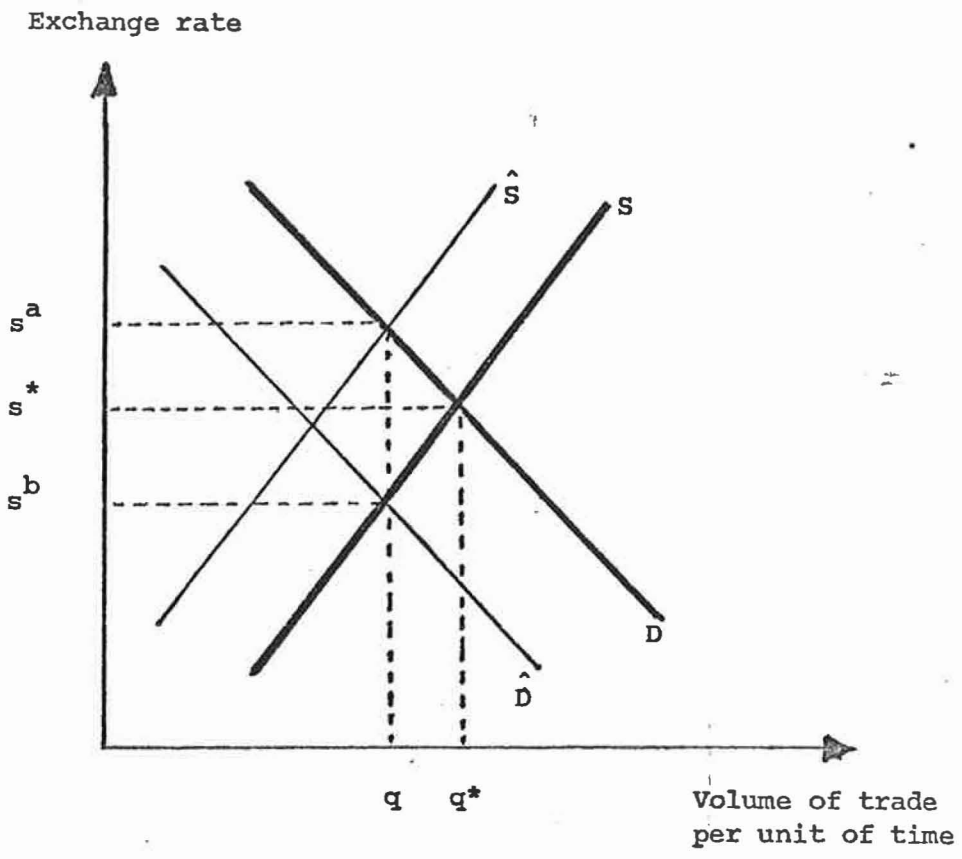
(2) $S_t = S(s,Z) + v_t \; ; \quad \partial S/\partial s > 0.$

The exchange rate s is defined as the price of one dollar in terms of marks. The variable Z stands for all other data directly or indirectly relevant for the decisions of all potential traders to enter in foreign trade contracts. The stochastic variables u_t and v_t illustrate the stochastic nature of the timing of contracts, and they are assumed to be nonautocorrelated and independent of one another.

We assume that the macroeconomic structure is stable so that for each given data, there is an equilibrium 'true' exchange rate $s^*(Z)$ which equalizes the incoming buy and sell orders of dollars on the average.

Because of transaction costs no transactions are made at the 'true' exchange rate. In the words of Demsetz (1968, p.35) "predictable immediacy is a rarity in human actions, and to approximate it requires that costs be borne by persons who specialize in standing ready and waiting to trade with

Figure 1



D and S: customers' demand and supply

$\hat{D}$ and $\hat{S}$: dealers' demand and supply

incoming orders of those who demand immediate servicing of their orders." In the foreign exchange market, foreign exchange dealers are such persons.

In figure 1, the curves D and S illustrate the average flow of buy orders (demand) and the average flow of sell orders (supply) by the customers. Dealers buy dollars from customers, not in order to hold or to spend, but to sell them back at a higher price. Therefore, the dealers' supply curve lies everywhere above the customers' supply curve by the distance of the ask-bid spread, and the dealers' demand curve lies everywhere below the customers' demand curve by the same distance (cf. Demsetz, 1968 and Levich, 1979). For given ask-bid spread, the equilibrium ask-rate s^a is determined at the intercept of the dealers' supply curve and the customers' demand curve, and the equilibrium bid-rate s^b is determined at the intercept of the dealers' demand curve and the customers' supply curve. It is readily seen that when transactions are made at these prices the incoming buy and sell orders match on the average.

{Figure 1}

Figure 1 also shows that the volume of foreign exchange transactions depends negatively on the ask-bid spread or, in other words, the demand for dealers' services depends negatively on their price. The volume of trade is slightly smaller than the potential trade q*.

While the treatment of the demand side of the market for dealers' services is straightforward, the supply side is more difficult to be handled analytically. It would require a theory of the behaviour of an individual dealer and, furthermore, a theory of the market organization of the foreign exchange dealing industry. The behavior of an individual dealer is analyzed

in the following section. As regards the market organization, we must be contented with an intuitive explanation only.

As a first approximation, we simply assume that the foreign exchange dealers operate in a competitive environment. There are many dealers who compete for the same customers, the entry is free, and the product is homogeneous. Under these conditions, the ask-bid spread is the minimum price, which, for given volume of total trade, will just cover the costs, and at which no dealer earns extra profits.

3. The Behaviour of an Individual Dealer

In this section we analyze the behaviour of an individual dealer. In order to be able to buy and sell foreign exchange on immediate demand, the dealer has invested resources in non-interest bearing demand deposits with commercial banks both at home and abroad. The transactions that the dealer makes with the customers are called autonomous (or retail) transactions. In these transactions the dealer acts as a market-maker, which means that he sets the ask and bid rates at which he is willing to trade with the incoming buy and sell orders at any moment of time. The dealer has also a possibility to trade foreign exchange with other dealers or with the central bank. In this case the dealer operates in the 'wrong side' of the market as a customer, which means that he has to buy at the ask-rate or to sell at the bid-rate quoted by a market-maker. In general, these induced (or wholesale) transactions do not bring income to the dealer, rather they bring costs, namely transaction costs. Furthermore, the dealer can reduce or enlarge the size of his non-interest bearing deposits by buying or selling interest bearing assets. It is assumed that the transaction cost of switching between non-interest bearing demand deposits and interest bearing bonds is

considerably higher than the transaction cost of switching between currencies. The dealer's operations are constrained by the capital constraint

(3) $W = sF + D + B$

expressed in terms of domestic money. Here s is the exchange rate[3], F stands for foreign exchange holdings, D for domestic money holdings, and B for bond holdings. The latter item B may be negative indicating that the dealer operates on borrowed capital.

The dealer's objective is to maximize the return on his total capital when bond holdings yield interest income at the daily interest rate, and when the currency holdings bring income flow which is determined by the volume of retail transactions and the ask-bid spread, and where the costs incurred are in the form of transaction costs.

In his decisions, the dealer has to consider two kinds of uncertainties, transactions uncertainty and exchange rate uncertainty. We analyze these two cases separately.

No transactions and no exchange rate uncertainty

The simplest possible case is one where there is no exchange rate uncertainty and where the dealer knows exactly the time-profile of incoming buy and sell orders.[4] Let us assume that the dealer knows that he will make exactly t transactions in a day, the unit size of a transaction being m dollars. Let us further assume that an amount mt/2 dollars are sold every morning and the same amount is bought every afternoon. Given this time profile of retail transactions, it is readily seen that the size of the non-interest bearing trading portfolio need not be greater than mt/2; holding more would only imply greater cost in terms of lost interest income.

Assume that the dealer starts with dollar balances of the size mt/2.

His trading income for retail transactions is $(s^a-s^b)mt/2$, where s^a is the ask-rate and s^b is the bid-rate. This income has to cover, first, the opportunity cost of holding monies, rsmt/2, where r is the daily interest rate and s is the exchange rate (mid-rate), and secondly, the transaction costs bt, where b is the unit cost of a retail transaction. The relative ask-bid spread (relative to the mid-rate) which exactly covers the cost is hence

(4) $(s^a - s^b)/s = r + sb/sm.$

If the fixed transaction cost b is charged directly from the customers, the relative ask-bid rate is equal to the daily interest rate.

Note that the trading income, $(s^a-s^b)mt/2$, and the cost of retail transactions, bt, do not depend on how much money balances the dealer chooses to hold in the beginning of each day. An attempt to start with balances less than mt/2 would imply a need to buy dollars with marks during the day at the 'wrong side' of the market. Assume that the dealer starts with dollar balances of the size mt/2 - km, $k \leqq t/2 - 1$. The saving in the opportunity cost would then be rskm, but the trading income would also decline by $(s^a-s^b)km + c$, which is greater than rskm if the cost of a wholesale transaction $c>0$, and if other dealers apply the same quotations. Trading income declines because the dealer has to buy dollars at the same price at which he sells them to the customers.

As a conclusion, with the known time profile of retail transactions, this alone determines the size of the trading portfolio and the relative ask-bid spread is equal to the interest rate plus some margin which depends on the cost of executing retail transactions.

Exchange rate uncertainty but no transaction uncertainty

We still assume the same pattern of retail transactions as in the previous case, i.e. all buy orders of dollars come in the morning and all sell orders come in the afternoon, but we also introduce exchange rate uncertainty in the

following way. The dealer has an expectation about the 'true' exchange rate s^* , and in the morning he starts with the amount $mt/2$ of dollars. He knows that he will sell all these dollars during the morning hours and that in the course of the afternoon he will buy back the same amount of dollars. He has to make a decision about the ask-rate already in the beginning of the day, but he does not know for certain what is the buying price he is able to bid in the afternoon, because some news may change the expected 'true' exchange rate.

Let $s^a=s^*+\alpha$ be the ask rate which is quoted in the morning and let $s^b=s^*+\varepsilon-\beta$ be the bid-rate at which the dealer actually can trade in the afternoon, where ε stands for the unexpected change in the exchange rate in the course of the day. Expected trading income is hence $(\alpha + \beta)mt/2$, and its variance is $(mt/2)^2\sigma_\varepsilon^2$, where σ_ε^2 is the exchange rate uncertainty inherent in the system. The dealer is risk averse, and the utility he attaches to the risky income is

$$(5) \quad U = (\alpha + \beta)mt/2 - \lambda(mt/2)^2\sigma_\varepsilon^2$$

where $\lambda > 0$ measures the degree of risk aversion. This utility has to cover the opportunity cost $rsmt/2$ and the transaction costs bt. Hence the relative ask-bid spread becomes

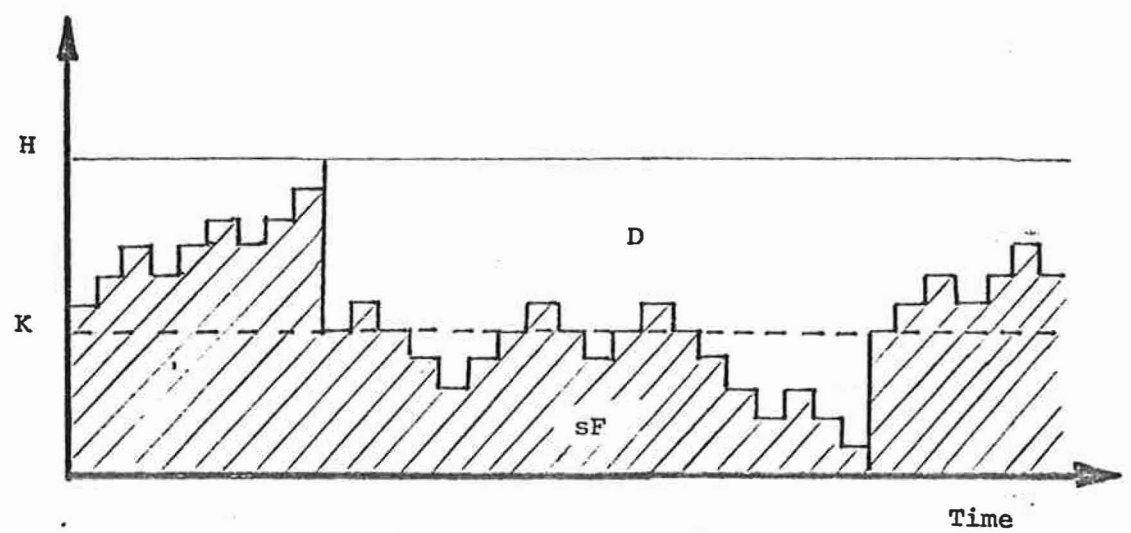
$$(6) \quad (s^a - s^b)/s = (\alpha + \beta)/s = r + 2b/ms + \lambda(mt/2)\sigma_\varepsilon^2 ,$$

and is the higher the greater is the inherent exchange rate uncertainty within the economy.

Transactions uncertainty but no exchange rate uncertainty

The third case is the one where the exchange rate is known to remain constant but where the individual dealer does not know the timing of the customers' buy and sell orders. Specifically, we assume that the sequence of net retail sales of dollars follows a simple symmetric Bernoulli process (cf. Miller and Orr, 1966). In each fraction of a day, say, one hour, the

Figure 2



dealer either sells m dollars with the probability $p = \frac{1}{2}$ or buys m dollars with the probability $1 - p = \frac{1}{2}$. The expected change of the dollar balances (as well as of the mark balances) over n days is $\mu_n = 0$, and its variance is $\sigma_n^2 = nm^2t$, where t denotes the number of hours in a day. The variance becomes infinite as n grows indefinitely, which means that given the finite amount of initial money balances either dollars or marks are sold out with probability one some time in the future. When dollars are sold out, the dealer can immediately buy more dollars with marks from other dealers or from the central bank at the ask-rate quoted by the market. Similarly, when marks are sold out the dealer can immediately exchange dollars for marks with other dealers at their bid-rate. For each induced (or wholesale) transaction of this kind the dealer carries a transaction cost c, which is assumed to be independent of the amount transacted.

In this case, unlike in the first two cases, the dealer has a genuine choice problem. He has to decide the size of his trading portfolio, $H = sF + D$, and the size of the wholesale transaction when his position in either dollars or marks goes empty, as it will with probability one. Keeping the size of the trading portfolio small implies a small opportunity cost but at the same time, it implies frequent wholesale transactions and therefore higher transaction costs.

Let us assume that the dealer has a target composition for the trading portfolio, for instance, he wants to have a proportion K/H in dollars and a proportion (H-K)/H in marks on average. Hence, when dollars are sold out, the dealer will convert an amount K of marks into dollars, and when marks are sold out, he will buy H - K marks with dollars (cf. Figure 2).

{Figure 2}

When H and K are given and when the process starts from the target composition, then the expected value of the time duration (in hours) between two wholesale transactions is

$$(7) \qquad T = \frac{K}{sm} \cdot \frac{H-K}{sm}$$

The inverse of this multiplied by the number of hours in a day gives the expected number of wholesale transactions per day

$$(8) \qquad N = \frac{(sm)^2 t}{K(H-K)} \ .$$

Multiplying this by the unit cost of a wholesale transaction c gives the expected cost of wholesale transactions in a day. The opportunity cost of holding a trading portfolio of the size H is rH. The dealer's objective is to maximize the return on his capital, which in this case where the expected trading income from retail transactions $(s^a - s^b)mt/2$ and the retail transaction costs bt do not depend on H and K, is equal to minimizing the following cost function by a suitable choice of H and K:

$$(9) \qquad C = \frac{c(sm)^2 t}{K(H-K)} + rH$$

Differentiation of (9) with respect to K and H gives the necessary conditions

$$(10) \qquad \frac{\partial C}{\partial K} = -c(sm)^2 t \cdot \frac{H-2K}{\{K(H-K)\}^2} = 0$$

$$(11) \qquad \frac{\partial C}{\partial H} = -\frac{c(sm)^2 t}{K} \cdot \frac{1}{(H-K)^2} + r = 0 \ .$$

It is readily seen that the second derivatives are positive.

The first condition gives $K = H/2$, which implies that the decision concerning the composition of the trading portfolio is separable from the decision concerning the size of the total currency holdings. Inserting $K = H/2$ into the second condition gives the optimal size of the trading

portfolio,

$$(12) \qquad H^* = 2\left(\frac{c(sm)^2 t}{r}\right)^{1/3},$$

which result is in many respects similar to that of Miller and Orr (1966). The (stock) demand for dollars as well as for marks is hence $H^*/2$.

The interest rate elasticity of the demand for international means of payments by the dealer is -1/3. Because dollar holdings and mark holdings have the same opportunity cost, they are complements rather than substitutes. The rate of interest has here been defined as the domestic interest rate, but it could equally well be interpreted to represent the rate of return on some internationally diversified portfolio.

According to equation (12), the demand for international means of payments depends on the daily variance of the net retail transactions $(sm)^2 t$ which, in turn, depends on the volume of retail transactions in two different ways. The average volume of trade $mt/2$ may increase when the unit size of a transaction increases or when the frequency of retail transactions (the intensity of the process), described by t, increases. If changes in the volume of trade are dominated by changes in m then the scale elasticity of the demand for trading currencies is 2/3, and if they are dominated by changes in t, the scale elasticity is 1/3. On the whole it would appear that the scale elasticity is likely to be less than unity implying economics of scale in the currency holdings of the dealer.

The relative ask-bid spread that makes the average daily trading income equal to the expected daily cost is

$$(13) \qquad (s^a - s^b)/s = 6\left(\frac{c r^2}{sm\, t^2}\right)^{1/3} + 2b/sm .$$

This is the minimum ask-bid spread at which the dealer can survive, given the stochastic flow of retail transactions, transaction costs and the rate of

interest. This would also be the ask-bid spread that would prevail under competitive circumstances if all dealers were identical and had equal market shares.

It is seen from equation (13) that the ask-bid spread depends positively on dealers' transaction costs and on the rate of interest but negatively on the volume of transactions.

The possibility of scale economies, however, creates a new problem. Because all dealers are not identical then the dealer whose market share is greatest either makes extra profits or quotes a lower ask-bid rate and a higher bid-rate thus increasing his market share still further. Clearly, more work is needed on this point.[5]

4. Conclusions

The purpose of the paper has been to analyze the microeconomic functioning of the foreign exchange market. On the whole, the analysis supports McKinnon's (1979) argument that, given decentralized trade and convertible currencies, if foreign exchange market is efficiently organized in the sense that exchange rates are approximately equal in all financial centers and that the ask-bid spread is small enough, then money holders in each country can regard their domestic money balances as if they represented international means of payments.

The analysis of the behavior of an individual dealer suggests that the relative ask-bid spread is determined by the volume and timing of retail transactions, the opportunity cost of holding non-interest bearing monies, the degree of exchange rate uncertainty and the direct transaction costs.

The possibility of the economies of scale in the holdings of trading

currencies by an individual dealer has two potentially important implications. First, it implies that the ask-bid spread tends to be the smaller, the greater is the volume of transactions between the currencies. In a multicurrency context, this would imply that the ask-bid spread is smaller in exchange rate quotations between the major currencies than between the minor ones. Secondly, the possibility of the economies of scale implies that the dealers may apply a higher ask-bid spread to trading in smaller amounts than to trading in greater amounts.[5]

In this analysis, domestic and foreign currencies appear as complements rather than substitutes. Both have the same opportunity cost and both are needed to facilitate transactions on immediate demand. Generalizing the result, according to which a foreign exchange dealer has a positive demand also for domestic money, to the case where foreign exchange dealing is just one activity of a commercial bank, implies that the liquidity of the bank is an important constraint to its operations in the foreign exchange market.

Footnotes

[1] Heller (1976) also acknowledged the possibility of the economies of scale in foreign exchange holdings and calculated the ratio of commercial banks' foreign assets to the square root of the value of imports. Because this ratio in the 1950s and 1960s showed an increasing trend, he concluded that the adequacy of international means of payments had increased dramatically during that period (see also Willett, 1969; Officer, 1976; and McKinnon, 1979, p. 9-13).

[2] What we need is a macroeconomic structure that generates flow demand and flow supply of foreign currency so that they match on the average as long as the structure remains constant. For example, McKinnon's (1979, p. 13-20) model can be thought as a description of that kind of a structure.

[3] Transactions are made at ask and bid rates. The unit of account in the valuation of foreign currencies in terms of domestic money need not be either of these. We have denoted that unit of account by s, and it can be interpreted, for instance, as the mid-rate.

[4] This corresponds to the transactions profile in the Baumol-Tobin model of the demand for money (Baumol, 1952 and Tobin, 1956).

[5] The analysis can be applied to the case where the intervention rule of the central bank under pegged exchange rates sets limits to the ask and bid rates the dealers can quote.

[6] Both of these implications are supported by empirical observations. For example, the ask-bid spread in exchange rate quotations between US dollars and any other currency is, in general, smaller than in quotations between this other currency and any third currency. The exchange rate quotations published in financial press are usually quotations which were applied to trading among banks in amounts of 1 million dollars or more at a particular moment of time.

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