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Discussion papers

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FOREIGN EXCHANGE DEALING AND
THE TRANSACTIONS DEMAND FOR
FOREIGN EXCHANGE

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1. INTRODUCTION

In a pure money economy only one commodity, money, can be traded directly for any other commodity. In modern monetary theory this medium of exchange is conventionally defined as an aggregate consisting of at least notes and coins issued by the central bank as well as demand deposits issued by commercial banks. Since, because of transaction costs, sales and purchases of goods cannot be completely synchronized, there is a transactions motive for holding money.

The present paper considers the transactions demand for international means of payments in the world where firms and households in each country have a preferred monetary habitat to hold only their domestic currency for transaction purposes and one national money can be converted into another through foreign exchange dealers, who are profit maximizing agents specialized in trading with currencies.

The basic source of inspiration for this paper is the recent book by Ronald McKinnon (1979). His message seems to be that provided that foreign exchange market is efficiently organized then domestic money holders can regard their money balances as if they represented international means of payments. The aim of the paper is to give an analytic description of the world in which McKinnon's statement is approximately true.

In chapter 2 we study the nature of the market equilibrium for foreign exchange. The standard macroeconomic issues concerning the determination of exchange rates are circumvented by the assumption of a stable macroeconomic structure which generates certain willingness on the part of domestic and foreign agents to enter in foreign trade. This willingness leads to trade contracts, and trade contracts lead to the need to convert one national money into another. The existence of foreign exchange dealers makes it possible for traders to convert immediately one national money into another. To cover the cost of standing ready to buy and sell on immediate demand the dealers require a reward. Therefore they sell currency to customers at a higher price than they buy it from other customers. In equilibrium the ask and bid prices must be such that the incoming sell orders on average match the incoming buy orders. Competition between dealers drives the ask-bid spread to the minimum.

In chapter 3 we analyze the behaviour of an individual dealer. The formal set-up is basically the same as the one Miller and Orr (1966) used in their analysis of the transactions demand for money by a firm. We make a distinction between retail transactions, i.e. those transactions the dealer makes with his customers, and wholesale transactions, i.e. those transactions the dealer makes with other dealers in the property of a customer. We show that the optimal size of the currency portfolio depends positively on the average volume of trade and the cost of the wholesale transactions and negatively on the rate of interest. Furthermore, our result implies that the decision on the average

allocation of the currency portfolio is independent of the decision on the allocation of the portfolio of interest bearing assets. In fact, currencies held for dealing purposes by foreign exchange dealers appear as complements rather than substitutes.

In the final chapter we discuss a few topics which seem to be related to our analysis. First, we comment on the literature in which the foreign exchange holdings of commercial banks has been approached from the point of view of the transactions motive. Secondly, we discuss some macroeconomic implications of our results. Specifically, we make a simple heuristic experiment to study the efficacy of monetary policy in a situation where foreign exchange dealing is efficiently organized but where there are no capital movements proper. It turns out that the mere existence of profit maximizing foreign exchange dealers implies some loss of monetary autonomy. In this respect our analysis resembles those based on the recently emerged currency substitution approach. Despite the similarities in implications these two approaches are based on different assumptions. Our approach emphasizes transactions motive and currency complementarity, whereas the currency substitution approach seems to emphasize speculative motive and high substitutability of currencies.

2. MARKET EQUILIBRIUM FOR FOREIGN EXCHANGE

In the following we shall characterize the market equilibrium for foreign exchange in a simplified world where firms and households in each country have a preferred monetary habitat to hold only domestic currency and where one national currency is converted into another through specialized foreign exchange dealers. The analysis draws on the paper by Demsetz (1968). Even though he analyzed transaction costs in the market for shares in New York Stock Exchange, the same general framework can be applied also to the foreign exchange market. We start with a number of assumptions and definitions, then characterize the nature of the market equilibrium for foreign exchange as well as for the market for dealers' services. Finally, we compare our characterization of the market equilibrium with that of the traditional theory based on the elasticities approach.

2.1. Assumptions

The following assumptions and definitions characterize the institutional framework we are dealing with:

1. There are two countries, home country and the rest of the world. Home country currency is called *Mark*, and the foreign currency is called *Dollar*.
2. The fundamental determinants of the foreign exchange transactions are the same that determine the willingness of domestic and foreign agents to enter in foreign trade contracts. In each contract two parties are involved,

a domestic importer and a foreign seller or a domestic exporter and a foreign buyer.

3. Payments for imports and exports can be made in either currency. Imports and exports are paid at the same time when trade contracts are agreed upon.
4. Trade partners agree upon contracts independently of the decisions of other partners, and the timing of contracts is stochastic.
5. Foreign exchange dealers are private profit maximizing agents, who have invested resources in non-interest bearing demand deposits with commercial banks both at home and abroad, and have announced their readiness to buy and sell foreign currency on immediate demand. Except foreign exchange dealers no other domestic agents hold foreign currency and no other foreign agents hold domestic currency.
6. Except currency flows between foreign and domestic foreign exchange dealers and those trade credits, which arise because of the lags between trade contracts and shipments, there are no other capital movements.
7. The natural preconditions for the analysis are the assumptions of free trade and full convertibility of currencies for all current transactions.

Some of the assumptions are not strictly necessary for the analysis. For example, the assumption that neither of the central banks intervenes with the foreign exchange market is not important, because we shall analyze a stationary equilibrium state only. For the same reason the exclusion of interest

bearing international assets and forward exchange contracts is not essential. If they were taken into account, there would be more spot transactions through foreign exchange dealers. By their exclusion we can manage with fewer behavioural assumptions.

The assumption that foreign exchange dealers are separate actors is neither an essential one. They could equally well be regarded as foreign exchange departments of commercial banks, whose main activity lies in financial intermediation and in clearing domestic payments.[1] This assumption only makes the presentation simpler, especially in the next chapter.

2.2. Traders and Dealers

We assume that the willingness of importers and sellers to agree upon import contracts depends on the Mark/Dollar exchange rate negatively, and that the willingness of exporters and buyers to agree upon export contracts depends on this rate positively. Taken into account the fact that trade contracts are made independently

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1) The following quotation of Einzig taken from Branson (1969) illustrates that this assumption need not be an unrealistic one: "Under the British banking practice Foreign Exchange departments are allotted a working capital, on which their head office charges interest rate usually slightly above the current rate for bills or deposits. ...The Foreign Exchange departments are allowed a free hand, within a reason, to accept deposits from, or place deposits with, their foreign correspondents. ...When they have more funds than they can use profitably in their own department, they can place the surplus on deposit with their own head office which allows them interest on it ... when they are short of funds they can borrow from their head office which charges interest on these loans."

and their timing is stochastic, the flow demand for dollars (supply of marks) per unit of time on the part of importers and sellers, and the flow supply of dollars (demand for marks) per unit of time on the part of exporters and buyers are written as follows:

$$(1) \qquad D_t = \bar{D}(s,Z) + u_t;\ \partial\bar{D}/\partial s < 0$$

$$(2) \qquad S_t = \bar{S}(s,Z) + v_t;\ \partial\bar{S}/\partial s > 0.$$

Mark/Dollar exchange rate is denoted by s, and Z stands for all other data directly or indirectly relevant for the decisions of all foreign and domestic agents to enter in foreign trade contracts. In the following we shall assume that Z remains constant. The stochastic variables, $u_t \sim \text{nid}(0,\sigma_u^2)$ and $v_t \sim \text{nid}(0,\sigma_v^2)$, illustrate the stochastic nature of the timing of contracts.

If all traders were able, collectively and without cost, to communicate their demands and supplies to each other at each moment of time, then all contracts would be settled simultaneously, implying that $u_t \equiv v_t$. In this case equations (1) and (2) would establish, for given Z, an equilibrium exchange rate s_0. But in this kind of world, without transaction costs, there would never be any need to convert one currency into another, and consequently no room for specialized institutions for foreign exchange dealing.

This is not the world we are dealing with in the present paper. Instead we are dealing with a world where goods are traded for money also across the national borders, and where there is no such auction process that would always bring together those who want to convert marks into dollars and those who want to convert dollars into marks. 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 incoming orders of those who demand immediate servicing of their orders." In the foreign exchange market foreign exchange dealers are such persons, and trade partners are the persons who demand for their services and are ready to pay for it.

Recall that foreign exchange dealers are profit maximizing agents who have invested resources in non-interest bearing demand deposits with both domestic and foreign commerical banks. With this inventory of currencies they are able to stand ready to buy and sell foreign exchange on immediate demand. In relation to their customers foreign exchange dealers are *market makers*, which means that they are the party to whom buy orders and sell orders are presented, who give the quotations and then immediately execute the required transactions.

Foreign exchange dealers thus produce services for their customers. For the production of these services they require a reward which covers the costs including the opportunity cost arising because resources have been invested in non-interest

bearing assets. Other costs arise mainly from investment in information, since the dealers must be informed on the quotations of other dealers as well as on general economic and political conditions which may affect the exchange rate in the near future. Furthermore, by the nature of the business dealers necessarily assume open positions in foreign exchange and hence carry a foreign exchange risk, which is an extra cost element to be covered.

To cover these costs foreign exchange dealers are willing to sell dollars on immediate demand to importers and sellers at a price that is higher than the price at which they buy dollars from exporters and sellers. The selling price, the price asked, is called *ask-price* (s_a), and the buying price, the price offered, is called *bid-price* (s_b). Their difference, $\rho = s_a - s_b$, is called the *ask-bid spread*.

The ask-bid spread and the customers' average flow demand and flow supply schedules determine the dealers' demand and supply schedules. In Figure 1 the curves $\bar{D}$ and $\bar{S}$ illustrate the willingness of trade partners to agree upon contracts at each exchange rate and for given Z. At the same time they represent the *average* flow of sell orders on the part of importers and buyers and the *average* flow of buy orders on the part of exporters and sellers, each per unit of time.[2)]

2) Note that the emphasis is on the concept of *average flow per unit of time*. Using the expression of Demsetz (1968, p. 36) these curves "do not illustrate *always present* market orders; rather they measure time rates of demand and supply for which, at any given time, no market orders need be present" (Demsetz' italics).

Dealers buy dollars, not in order to hold them nor to spend them on goods, but to sell them sooner or later back to customers at a higher price. It follows that the dealers' supply schedule $\bar{\bar{S}}$ lies everywhere above the customers' average supply schedule $\bar{S}$ by the distance of the ask-bid spread, and dealers' demand schedule $\bar{\bar{D}}$ lies everywhere below the customers' average demand schedule by the same distance, or

$$(3) \qquad \bar{\bar{D}}(s,Z) = \bar{D}(s-\rho,\ Z) \text{ or } \bar{\bar{D}}(s+\rho,\ Z) = \bar{D}(s,\ Z)$$

$$(4) \qquad \bar{\bar{S}}(s,Z) = \bar{S}(s+\rho,\ Z) \text{ or } \bar{\bar{S}}(s-\rho,\ Z) = \bar{S}(s,\ Z)$$

2.3. Market Equilibrium for Given Ask-Bid Spread

We are now able to define the market equilibrium when the ask-bid spread is given, i.e. $\rho = \hat{\rho}$. Remember that dealers apply ask-price s_a to incoming sell orders; hence the equilibrium ask-price is determined at the intercept of the dealers' supply curve and the customers' demand curve (point B in Figure 1), or

$$(5) \qquad \bar{\bar{S}}(s_a,\ Z) = \bar{D}(s_a,\ Z).$$

Dealers apply bid-price s_b to incoming buy orders; hence the equilibrium bid-price is determined at the intercept of the dealers' demand curve and the customers' supply curve (point C in Figure 1), or

$$(6) \qquad \bar{\bar{D}}(s_b, Z) = \bar{S}(s_b, Z),$$

The remaining task is to establish that for given $\hat{\rho}$ the equilibrium ask and bid prices derived from equilibrium conditions (5) and (6) lead to the equality of the average flow of sell orders with the average flow of buy orders. That this holds follows directly from equations (3) and (4) in the following way:

$$(7) \qquad \bar{\bar{S}}(s_a, Z) = \bar{\bar{S}}(s_b+\hat{\rho}, Z) = \bar{S}(s_b, Z) = \bar{D}(s_a, Z)$$

$$(8) \qquad \bar{\bar{D}}(s_b, Z) = \bar{\bar{D}}(s_a-\hat{\rho}, Z) = \bar{D}(s_a, Z) = \bar{S}(s_b, Z).$$

2.4. The Determination of the Ask-Bid Spread

The equilibrium in the foreign exchange market was above characterized assuming that the ask-bid spread is given. In this way we were able to derive the equilibrium ask and bid prices as well as the average volume of trade per unit of time. Note that it is the willingness of traders to enter in foreign trade that is fundamental in determinig the approximate level of the exchange rate at which one national money is converted into another. Foreign exchange dealers play no role in determining this level. Their role is elsewhere. As market makers they have no autonomous need to convert one money into another; rather they produce services for those who have this need. The ask-bid spread is the price of these services, and this price is determined, like other prices, by demand and supply.

The demand for dealers' services is determined by the average flow supply and demand schedules of the customers. As seen from Figure 1 the average volume of trade per unit of time is the smaller the higher is the ask-bid spread, i.e. the demand for dealers' services depends negatively on their price. The elasticity of this demand with respect to the price is determined by the slopes of $\bar{D}$ and $\bar{S}$ schedules. To illustrate this let us write these schedules in a simple linear form as follows:

$$(9) \qquad \bar{D}(s_a, Z) = a_0 - a_1 s_a; \qquad a_0, a_1 > 0$$

$$(10) \qquad \bar{S}(s_b, Z) = b_0 + b_1 s_b = b_0 + b_1(s_a - \hat{\rho}); \quad b_0, b_1 > 0.$$

Their equality determines the equilibrium ask and bid prices as well as the average volume of trade in foreign exchange:

$$(11) \qquad s_a = \frac{a_0 + b_0}{a_1 + b_1} + \frac{b_1}{a_1 + b_1}\hat{\rho}$$

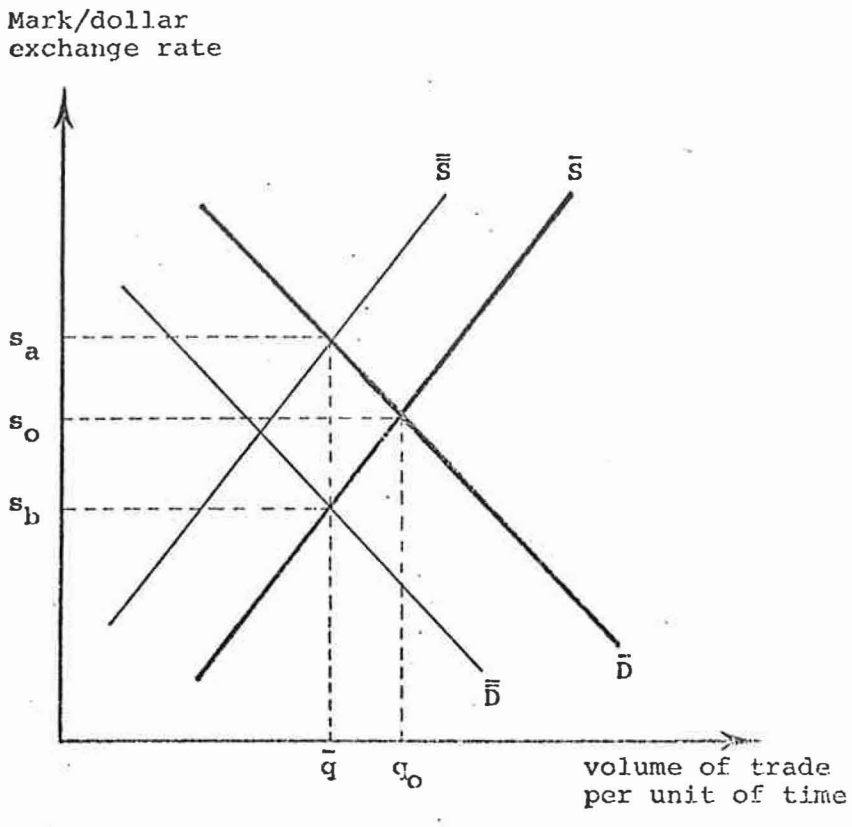
$$(12) \qquad s_b = \frac{a_0 - b_0}{a_1 + b_1} - \frac{a_1}{a_1 + b_1}\hat{\rho}$$

$$(13) \qquad \bar{q}^d = \frac{a_0 b_1 + b_0 a_1}{a_1 + b_1} - \frac{a_1 b_1}{a_1 + b_1}\hat{\rho}.$$

The last equation is the demand curve for dealers' services. In general, the slope of this demand curve with respect to the ask-bid spread is

$$(14) \qquad \frac{\partial \bar{q}^d}{\partial \hat{\rho}} = \frac{(\partial \bar{S}/\partial s)(\partial \bar{D}/\partial s)}{(\partial \bar{S}/\partial s) - (\partial \bar{D}/\partial s)} < 0.$$

Figure 1. Market Equilibrium for Foreign Exchange



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. What would be needed is a theory of the firm operating in foreign exchange dealing. A step towards such a theory is attempted in Chapter 3. At this stage we must be contented with an intuitive explanation only.

We assume that foreign exchange dealers operate in a competitive environment. Many dealers compete for the same customers, the entry to the industry is free, and the product is homogenous. Under competitive conditions the ask-bid spread is the minimum price which, for given volume of trade, will just cover the costs and at which no dealer earns extra profits. If an individual dealer will enlargen his spread, his customers will turn to other dealers. If, because of some technological improvement, one dealer is able to shrink his spread, his share of the market will increase at the cost of others, giving them an incentive to adopt the new technology.

An important feature in the dealing industry is the fact that, in addition to the investments in the communication network, the capital invested in producing dealers' services consists of fully liquid resources. As such this capital is highly mobile; it can be immediately directed to other uses, say, invested in interest bearing assets. Similarly, more resources can always be directed to producing dealers' services. Therefore, such phenomena as underutilization of capital, which is

common in many other industries, can hardly arise in the dealing industry. Obviously, this kind of flexibility supports our argument about the competitive nature of the market for dealers' services.

2.5. Conclusions

To sum up, the fundamental determinants of foreign trade determine the average supply and demand flows on the part of the traders. These determine the equilibrium exchange rate around which the ask and bid prices must be set. The size of the ask-bid spread determines the average volume of trade in foreign exchange from the demand side. From the supply side the competition between dealers drives the ask-bid spread to the minimum, given the payment and information technologies, uncertainty on exchange rate movements and the representative market rate of interest describing the cost of capital.

Under these conditions actual and potential traders can regard their domestic money balances *as if* they represented international means of payments, a point emphasized by McKinnon (1979). Any two trading partners are in a position, before a foreign trade contract is made, to compare the relevant prices of goods both at home and abroad.

Hence their decision to agree upon a trade contract is in no essential way different from a trade contract between two domestic partners. This implies, among others, that as far as

the 'law of one price' prevails within the national borders it holds also across the borders. Thus the whole question of the purchasing power parity is circumvented by concentrating on the willingness of traders to enter in foreign trade. This set-up applies equally well to the case where there is only one composite traded good as assumed in most models based on the monetary approach as to the case where the home country is specialized in production and generalized in consumption, which is the (often implicit) assumption characteristic to most models based on the elasticities approach. In the latter case the exchange rate, at the same time as it expresses the relative price of two national monies, expresses also the relative price of domestically produced goods in terms of the international good, or the terms of trade.[3)]

Even though the analysis was performed in a stationary environment, where the determinants of the willingness of domestic and foreign agents to enter in foreign trade remain constant, it should be apparent that we, in fact, have been dealing with the regime of flexible exchange rates. When some conditions change affecting the willingness of traders to enter in foreign trade, then the equilibrium exchange rate will change and the ask and bid prices will change accordingly.

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3) If the underlying theory is based on the monetary approach then the $\bar{D}$ and $\bar{S}$ schedules could be interpreted, for example, according to the monetary model of McKinnon (1979, p. 13-20). If the underlying theory is based on elasticities approach, then the $\bar{D}$ schedule could be interpreted as the demand curve for imports, and the $\bar{S}$ chedule as the demand curve for exports.

An important feature in our characterization of the market equilibrium for foreign exchange is the fact that, unlike the traditional analysis, our case does not imply a possibility of an unstable equilibrium. This is the benefit achieved when the conversion of currencies takes place through *visible* foreign exchange dealers as compared to the case where this task is left to the invisible hand. To make this point clear, let us briefly summarize the basic features of the traditional analysis of the market equilibrium for foreign exchange.

2.6. Comparison with the Traditional Analysis

In the traditional analysis, based on the elasticities approach, those (importers) who have to convert marks into dollars have to meet those (buyers) who have to convert dollars into marks.[4] Importers' demand for dollars depends negatively on the Mark/Dollar exchange rate, and this is also their supply of marks

$$(15) \qquad D_{\$}(s) = \frac{1}{s} S_{mk} \qquad \text{(dollars)},$$

where $\partial D_{\$}/\partial s < 0$. Note that the supply of marks is expressed in dollars by multiplying it by the Dollar/Mark exchange rate. Foreign buyers' demand for marks depends negatively on the Dollar/Mark exchange rate, and this is also their supply of dollars

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4) This analysis is presented in many international economics textbooks, see e.g. Heller (1974, p. 34-39), and Chacholiades (1978, p. 77-86).

(16) $$D_{mk}(\tfrac{1}{s}) = sS_{\$} \qquad \text{(marks)},$$

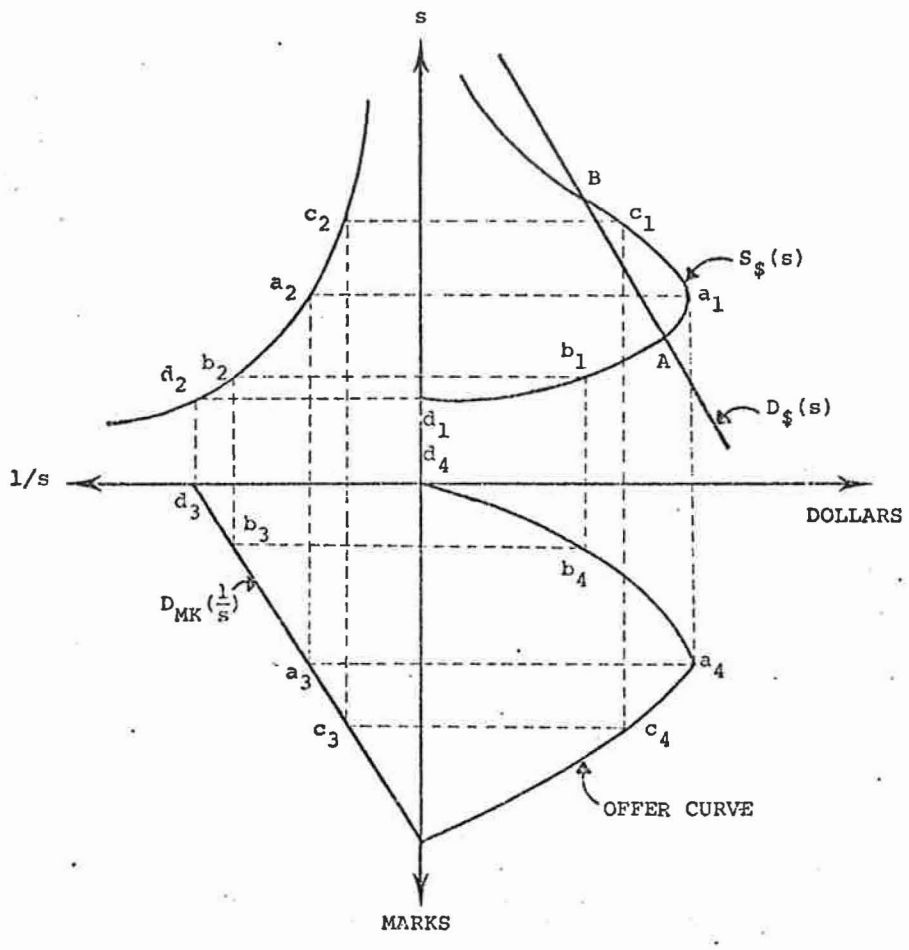
where $\partial D_{mk}/\partial(\frac{1}{s}) < 0$. Supply of dollars is translated into marks by multiplying it by the Mark/Dollar exchange rate.

In the equilibrium the demand for dollars (marks) should be equal to the supply of dollars (marks), or

(17) $$D_{\$}(s) = \frac{1}{s} D_{mk}(\tfrac{1}{s}) \qquad \text{(dollars)}.$$

The analysis of the equilibrium is done graphically in Figure 2. The demand curve for dollars by importers is drawn in the first quadrant, and the demand curve for marks is drawn in the third quadrant. The rectangular hyperbola in the second quadrant transforms the Mark/Dollar exchange rate into the Dollar/Mark exchange rate. The curve in the fourth quadrant is the offer curve. It illustrates the amount of dollars offered in exchange for the amount of marks demanded by buyers. This curve is derived by multiplying the demand for marks (in marks) by the Dollar/Mark exchange rate. Any given 1/s gives the corresponding s through the hyperbola as well as the corresponding amount of dollars offered through the demand curve for marks and the offer curve. Combining all these points for every 1/s gives the supply of dollars on the part of the buyers as a function of the Mark/Dollar exchange rate. As seen from Figure 2, the supply curve is upwards sloping for low values of s, but becomes downwards sloping as s increases. Given the normal downward sloping demand curve for dollars on the part of importers this implies the possibility of multiple equilibria, one of which (point B) is unstable.

Figure 2. Illustration of the Traditional Analysis of the Market Equilibrium for Foreign Exchange



We argued above that this result is not possible in our model. The impossibility of an unstable equilibrium in our case is admittedy the result of the way we defined the $\bar{D}$ and $\bar{S}$ schedules, rather than the result of an analysis. In particular, we deliberately left open the question of in what currency imports and exports are invoiced. The justification for this is that in our set-up it is not an important issue. If traders are free to make contracts and if currencies are convertible then traders are free to decide the currency of invoice. In the above characterization of the traditional approach, on the other hand, we delibarately assumed that importers have a need to convert marks into dollars and foreign buyers of our exports have a need to convert dollars into marks, i.e. trade contracts are always paid in the seller's currency.[5] Therefore, we have to reconsider our model under this assumption, even though its justification is not obviuous when full convertibility of currencies is assumed.

Thus the set-up is as follows. Our importers have a need to convert marks into dollars, and they can do it with domestic foreign exchange dealers at the Mark/Dollar ask-price s_a quoted by the dealers. Similarly, foreign buyers of our goods have a need to convert dollars into marks, and they can do it with foreign foreign exchange dealers at the Dollar/Mark ask-price s_a^* quoted by their dealers. This set-up has two interesting characteristics. First, dealers in one country never receive

5) This assumption is not strictly necessary for the traditional analysis. We made it simply to emphasize the contrast between our approach and the traditional approach, because in other cases our way to define $\bar{D}$ and $\bar{S}$ schedules seems obviuous. These other cases are the case when the choice of the currency of invoice is free and the case when both imports and exports are invoiced in the same currency, domestic or foreign.

buy orders of the currency of the other country from domestic customers. Therefore, no bid-prices are quoted for domestic customers. Secondly, because of this asymmetry in the currency flows of domestic dealers, the position in foreign currency sooner or later goes empty. But because this asymmetry applies for the dealers in both sides of the border, they as an aggregate have a common interest to trade currencies with each others, that is to establish an inter-dealer market for currencies. Once this inter-dealer market has been established, individual dealers in one country can buy the required foreign currency from the dealers of the other country. Because the trade is in balance on average, the dollars our dealers lose in transactions with our importers on average match the marks foreign dealers lose in transactions with the buyers of their country. Hence the dealers' needs to swap between currencies match on average. Because these swaps are always in the same direction, this equality establishes a unique Mark/Dollar exchange rate $\hat{s}$, and hence a unique Dollar/Mark exchange rate $\hat{s}^* = 1/\hat{s}$. Because dealers in both countries have to cover the costs of their operations, then the resulting inter-dealer equilibrium exchange rate must be such that $\hat{s} < s_a$ and $\hat{s}^* < s_a^*$. From this it follows that $1/s_a^* < \hat{s} < s_a$, or equivalently $1/s_a < \hat{s}^* < s_a^*$. Hence $1/s_a^*$ corresponds to the Mark/Dollar bid-price s_b in our general model, even though in this case domestic dealers never receive any buy orders of dollars from domestic customers so that this bid-price could be directly applied.

We conclude that the existence of foreign exchange dealers, who are interested in the ask-bid spread or the price of their services and not in the exchange rate itself, breaks the direct link, essential in the traditional analysis, between those, who are interested in the dollar price of their purchases from abroad and therefore in the Dollar/Mark exchange rate, and those, who are interested in the mark price of their purchases from abroad and therefore in the Mark/Dollar exchange rate.

3. THE BEHAVIOUR OF AN INDIVIDUAL DEALER

In the previous chapter we considered the market equilibrium for foreign exchange without specifying the behaviour of an individual dealer. In the equilibrium all dealers as an aggregate received a stochastic flow of buy orders of dollars, and this flow on average matched the incoming flow of sell orders of dollars. We did not assume that each individual dealer would necessarily at every moment of time have enough of the required currency to execute the required transactions at the quotations given by the market. A dealer facing this kind of situation would either have to try a new quotation and assume the risk that the customer turns to some other dealer or to accept the market quotations and simultaneously to buy the required currency from another dealer and sell it to the customer. In the following we shall analyze the behaviour of an individual dealer who frequently meets these kind of situations.

We call *retail* transactions all foreign exchange transactions which the dealer makes with his customers in the property of a market maker, and we call *wholesale* transactions all transactions which the dealer makes with some other dealer in the property of a customer. Retail transactions can also be called *autonomous* transactions, and wholesale transactions can be called *induced* transactions. We find this terminology, introduced by Akerlof (1978) for the analysis of the transactions demand for money, convenient and use it interchangably.

3.1. Assumptions

The assumptions made in the previous chapter are kept in force. In particular, we continue in assuming that the fundamental determinants of foreign exchange transactions remain, and are expected to remain, constant, from which it follows that the market quotations remain at the equilibrium level and are given to each individual dealer.

The decision making environment of an individual dealer is characterized by the following assumptions:

1. The net retail sales of dollars follow a simple symmetric *Bernoulli* process. At each fraction of a day (say, an hour) dollars are either sold. i.e. the dollar position goes short, by the equivalent of m marks with the probability p = 0.5, or bought, i.e. the dollar position goes long, by the equivalent of m marks with the probability 1-p = 0.5. Because there are only two currencies the lengthening of the dollar position implies the corresponding shortening of the mark position.

2. When dollars in a sequence of autonomous transactions are sold out, i.e. the dollar position goes empty, the dealer can immediately buy dollars with marks from other dealers at a given Mark/Dollar ask-price (sell marks at a given Dollar/Mark bid-price). Similarly, when the mark position goes empty the dealer can

immediately sell dollars for marks with other dealers at a given Mark/Dollar bid-price (buy marks at a given Dollar/Mark ask-price). For each induced transaction of this kind the dealer carries a transaction cost c which is independent of the amount transacted.

3. Whenever he wants the dealer can buy domestic interest bearing bonds with domestic money or liquidate his bond holdings into domestic money. The cost of a transaction between money and securities is considerably higher than the cost of a transaction between two national monies in the inter-dealer market.

4. The dealer's activities are constrained by the capital constraint

$$W = sF + D + B$$

where F stands for foreign currency holdings (in dollars), D for domestic money holdings, and B for domestic bond holdings.[6)]

The dealers objective is to maximize the return on his total capital when the bond holdings give interest income according to the (daily) interest rate r, and when the currency holdings bring an income flow which depends positively on the average volume of autonomous transactions $\bar{q}$ and on the market determined ask-bid spread ρ and negatively on the average volume of induced transactions as well as on their unit cost.

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6) We have chosen to use the mid rate $s = (s_a+s_b)/2$ as a unit of account in converting dollar balances into domestic money. This choice is not important to the analysis below.

This set-up is basically the one which Miller and Orr (1966) formulated for analyzing the transactions demand for money by firms. In their analysis the assumption that a firm's cash flow follows a symmetric Bernoulli process was not essential as such; the symmetricity was assumed only for analytic simplicity. In the present case the symmetricity assumption is an essential one. A drift in either direction, for instance, the probability of autonomous sales of dollars being greater than the probability of autonomous purchases of dollars, is not possible for all dealers as an aggregate given the otherwise stationary environment as we have assumed. If an individual dealer persistently meets an asymmetric flow of autonomous transactions he has to make more induced transactions relative to the size of his currency portfolio than other dealers, and consequently he is not able to apply the competitive ask-bid spread in the longer run. In the extreme case, where the probability of the dollar position going short is one, the dealer would receive no income, since he would have to sell dollars to his customers at the same price as he buys them from other dealers.[7] This illustrates the fact that the essence of foreign exchange trading on the part of specialized agents is dealing and not broking. In other words, the dealer's task is to 'produce' a great number of retail transactions with a small number of wholesale transactions.

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7) Note that the Miller-Orr formulation of the transaction demand for money by firms reduces to a simple static case as analyzed by Baumol (1952) and Tobin (1956), when the firm's cash flow has a deterministic drift in one direction (cf. Miller and Orr, 1966, p. 428).

The assumption that the transaction cost of a wholesale transaction is independent of the amount transacted is admittedly somewhat arbitrary and it will be relaxed later on.

We could easily allow for the presence of the central bank in the foreign exchange market without affecting the qualitative results as far as the behaviour of an individual dealer is concerned. This would only create an option for him to make wholesale transactions with the central bank instead of other dealers. We want, however, to exclude the central banks because of the potentially important macroeconomic implications which arise when their intervention is allowed for.

The inclusion of interest bearing assets in the balance sheet constraint of the dealer is motivated, first, by the fact that it gives a simple way to define the required rate of return on the non-interest bearing currency portfolio and, secondly, by the fact that the dealer must have some assets (or liabilities) to make marginal adjustments when the conditions change requiring a change in the size of the currency portfolio. The assumption that all interest bearing investments are in domestic bonds could be relaxed with ease; it would only require a redefinition of the required rate of return.

It is seen that many of the assumptions could be relaxed as far as the behaviour of an individual dealer under equilibrium conditions is concerned. We have made these relatively strict assumptions because we want to keep a door open for a more general macroeconomic discussion to which we shall come in the final chapter.

3.2. Analysis

Let us now proceed to the analysis of the behaviour of an individual dealer. As the first task we derive the expected number of induced transactions given the size of the currency portfolio H = sF + D. It can be shown that, if the change in the dollar position (equal to the change in the mark position in the opposite direction) follows a simple symmetric Bernoulli process with probabilities p = 0.5 and 1-p = 0.5, then the expected value of the change of the dollar position over time, say, in the course of n days, is $\mu_n = 0$, and its variance is $\sigma_n^2 = nm^2t$, where t denotes the number of hours (or other fractions of a day) within a day.[8] The expected value of the change in the dollar position in the course of day is $\mu_1 = 0$, and its variance is $\sigma_1^2 = m^2t$. It is a general property of this kind of a random walk process that, if it starts from any state between two absorbing barriers, it will hit one of the barriers with probability one when the duration of the walk increases indefinitely. This means that whatever the size of the currency portfolio and whatever its initial allocation the probability of an induced transaction in the finite future is one.

The dealers decision making problem is to choose the size of the currency portfolio as well as to prepare himself to meet forthcoming wholesale transactions by deciding the size of

8) Because the analysis follows so closely to that of Miller and Orr we can omit many of the technical aspects here. For theoretical properties of simple random walk processes, see e.g. Cox and Miller (1978, Ch. 2).

these transactions. Let us assume that the dealer has a target for the composition of the currency portfolio, for instance, he wants to have a proportion K/H of dollars and a proportion (H-K)/H of marks on the average. Hence, when the dollar position goes empty, the dealer will convert an amount K of marks into dollars, and when the mark position goes empty, the dealer will buy an amount H-K of marks with dollars (cf. Figure 3). When H and K are given, the *expected value* of the time duration between two induced transactions is[9)]

$$(17) \qquad G(H,K) = \frac{K}{m}\left(\frac{H-K}{m}\right) \qquad \text{(hours)}.$$

The inverse or this quantity multiplied by the number of hours in a day gives the *expected* number of induced transactions per day[10)]

$$(18) \qquad \bar{N} = \frac{m^2 t}{K(H-K)} \qquad \text{(transactions per day)}.$$

Multiplying this by the unit cost of an induced transaction c we get the expected cost of induced transactions per day.

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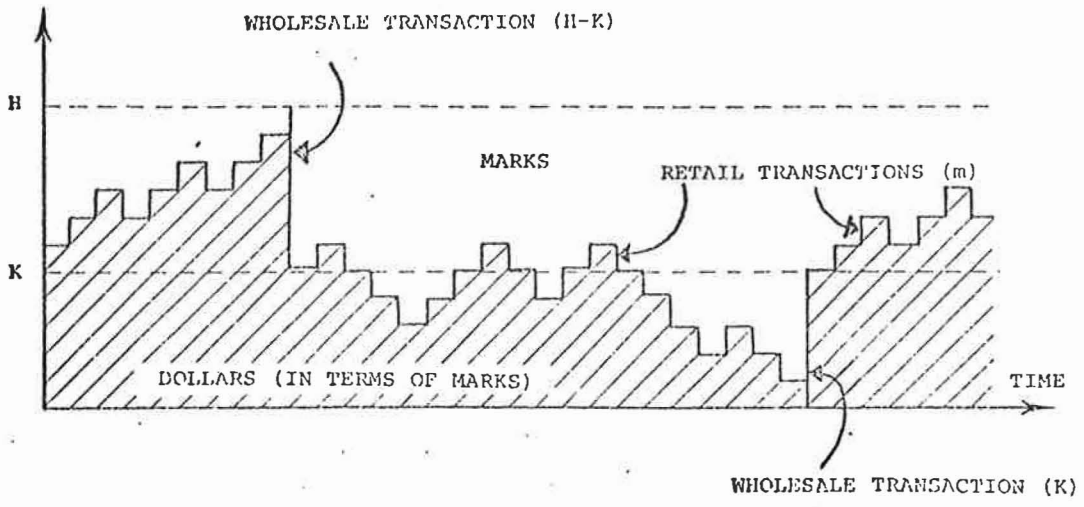
9) This is the expected time duration for a symmetric Bernoulli process starting from K, K < H, and taking steps of the size m, m < K, to wander either to the upper absorbing barrier H or to the lower absorbing barrier 0.

10) Note that the expected value of 1/x where x is a random variable is not exactly the inverse of the expected value of x even though it often is a good approximation for it. For this reason we call $\bar{N}$ the expected number of transactions and not the expected value of the number of transactions.

Figure 3. Illustration of the Dealer's Retail and Wholesale Transactions with Foreign Exchange



Because the expected change in the dollar position in the course of a day is $\mu_1 = 0$, and because the total value of autonomous transactions is mt, the expected value of both autonomous sales and purchases, or the average volume of trade, is $\bar{q} = \frac{m}{2} t$. Given the competitive ask-bid spread ρ the expected income flow per day is $\rho\bar{q}$. Taking into account the interest income from bond holdings and the cost of induced transactions we get the following equation for the expected net income per day:

$$(19) \qquad \bar{R} = \frac{\rho mt}{2} - \frac{cm^2 t}{K(H-K)} + r(W-H) \qquad \text{(marks per day)}.$$

The dealer's objective is to maximize this income flow by choosing the size of the currency portfolio H and the size of the wholesale transactions K and H-K.[11] Differentiation of $\bar{R}$ with respect to H and K gives the necessary conditions for the maximum. We observe that differentation with respect to K gives

$$(20) \qquad \frac{\partial \bar{R}}{\partial K} = \frac{cm^2 t}{[K(H-K)]^2}(H-2K) = 0.$$

or, for any given H, K = H/2.[12] This is a nice result and shows that the decision concerning the composition of the

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11) Because the expected income from autonomous transactions is independent of H and K, maximizing E(R) with respect to H and K is equivalent to minimizing the following cost function

$$C = c\bar{N} + rH \rightarrow \min_{K,H}$$

where the first term describes the expected cost of induced transactions and the latter term describes the opportunity cost of holding non-interest bearing national monies.

12) The same result is, of course, received by minimizing the expected number of induced transactions with respect to K (cf. eq. 18).

currency portfolio is separable from the decision concerning the size of H. In this respect our formulation of the transactions demand for foreign currency by the foreign exchange dealers differs from the Miller and Orr formulation of the transactions demand for money by firms. Inserting K = H/2 into equation (19) and differentiating with respect to H gives

$$(21) \qquad \frac{\partial \bar{R}}{\partial H} = \frac{8cm^2t}{H^3} - r = 0.$$

from which the optimal size of the currency portfolio can be calculated:

$$(22) \qquad H^* = 2\left(\frac{cm^2t}{r}\right)^{1/3} \qquad \text{(marks)}.$$

The second derivatives are negative indicating that the resulting H* in fact leads to maximum net income.

Equation (22) gives a stock demand for international means of payments on the part of an individual dealer. The stock demand separately for dollars and marks is not determinate for each moment of time, but if we identify the dealer's stock demand for various currencies with their average balances then the stock demand of dollars is H*/2 multiplied by the Dollar/Mark exchange rate 1/s, and the stock demand for marks is also H*/2.

The result as regards the size of H* is in many respects similar with the result of Miller and Orr (1966, p. 423) for the upper threshold of the cash balances of the firm. The basic difference concerns the target level K. In the case of Miller and Orr the

firm's cash balances are always restored to the level which is one third of the upper bound, whereas in our case this level is one half of H*. This difference is due to the fact that in the Miller-Orr formulation the firm chooses a policy according to which the probability of hitting the lower bound (zero cash balances) is greater than the probability of hitting the upper bound. This leads to smaller average cash balances and hence to smaller opportunity cost, which benefit is to be weighted against greater cost of induced payments. In our case this trade-off does not arise, because the opportunity cost is independent of the composition of the currency portfolio.

We postpone the interpretation of this result and before that make a minor extension allowing the cost of an induced transaction to depend positively on the amount transacted.

To avoid excessive technical manipulations let us, with some loss of generality[13], straightforwardly assume that for given H the size of wholesale transactions is K = H-K = H/2. For simplicity we assume that the transaction cost c is proportional to the amount transacted, i.e. $c = \gamma(H/2)$. Inserting this and K = H/2 into equation (18) and differentiating with respect to H we get the following expression for the optimal size of the currency portfolio

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13) In a general case we should start without the assumption that K = H/2 and calculate the probability of the dollar position hitting the upper bound H and the probability of it hitting the lower bound zero separately and only thereafter derive the optimum K and H.

(23) $$H^{**} = \left(\frac{2\gamma m^2 t}{r}\right)^{1/2}$$ (marks).

Instead of the qubic-root equation we now have a square-root equation which in many respects resembles the static result of Baumol and Tobin.

3.3. Interpretation and Implications

Above we have established a positive dependence of the international means of payments and therefore also of the average dollar and mark balances of the dealer on the variance of retail transactions and on the transaction cost as well as a negative dependence of these items on the rate of interest.

The interest rate elasticity is rather high; in the case when the transaction cost is independent of the size of the wholesale transaction it is - 1/3.

According to equation (22) the demand for the international means of payments depends on the daily variance of the net retail transactions, $\sigma_1^2 = m^2 t$. This, in turn, depends on the average volume of trade in two different ways. The average volume of trade, $\bar{q} = \frac{mt}{2}$, may increase when the unit step m increases or, alternatively, when the frequency of the retail transactions (intensity of the process) increases, i.e. when t increases. Because of this ambiquity in the definition of the volume of trade, equation (22) does not give an exact value for the scale elasticity of the demand for currencies (cf. Miller and Orr, 1966, p. 425-426). If

changes in the volume of trade are dominated by changes in m then the scale elasticity is 2/3, and if they are dominated by changes in t then the scale elasticity is 1/3. On the whole it would appear that the scalé elasticity is less than one, which implies that there are economies of scale in the currency holdings of the dealers.

The possibility of the economies of scale in foreign exchange dealing leads to two potentially important implications which have some empirical relevance. First, the ask-bid spread tends to be the smaller the greater is the volume of trade between the currencies. In a multicurrency context this means that the ask-bid spread is smaller for the trade between the major currencies than for the trade between the minor ones.[14] Secondly, even in a two-currency context dealers may apply a greater ask-bid spread for those customers whose buy and sell orders are small than for those customers whose buy and sell orders are big.[15] If this is the case then a dealer, who mostly receives small orders, can buy currency in a wholesale transaction from another dealer, who mostly receives big orders, at an ask-price that is smaller than the ask-price he himself applies in his retail sales of this currency. This is the mechanism by which the benefits due to the economies of scale are distributed among the dealers.

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14) In general, the ask-bid spread in the quotation for US Dollar *vis a vis* any other currency is smaller than the spread for the quotations between these other currencies. The smaller spread in Dollar quotations explains the Dollar's role as a vehicle currency. I shall deal with this issue in a separate paper.

15) When dealers give foreign exchange quotations to other dealers in the inter-bank market, these quotations are thought to apply to the transactions of the size of 1 million US Dollars. For bigger transactions the spread is generally smaller and for smaller ones it is higher. The greatest spread is applied for tourist currency, but in this case the higher spread has to cover also the storage and transportation costs of bank notes.

Returning to equation (22) it is seen that $H^* \to 0$ as $c \to 0$. The interpretation is that, if there were no transaction costs in the foreign exchange trading, then there would be no specialized dealers. A customer who needs to convert one national money into another would always immediately find a counterparty who has an opposite need. The transaction cost c itself has so far remained unspecified and will unfortunately remain such. A hint towards its interpretation was given already in the previous chapter where it was stated that the transaction costs involved in foreign exchange dealing arise partly from the cost of being informed. The fact that we have associated the transaction costs with wholesale transactions can be justified by the fact that it is because of the necessity of making these transactions a dealer must be informed on the quotations of other dealers. Otherwise the dealer would be more apt to change his own quotations when a sequence of retail transactions empties the position in one currency which policy would lead to the loss of some customers and hence to smaller volume of trade and to smaller income.[16)]

Generalizing our result, according to which the foreign exchange dealers have 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

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16) The determination of transaction costs in the foreign exchange dealing is a subject that would require a special treatment. For a brief review to the relevant literature, see Levich (1979, p. 7-10).

an important constraint for the bank's operations in the foreign exchange spot market.[17)]

Finally, it is to be noted that our analysis has concerned only the working balances of the dealers, or the so called *nostro accounts* of commercial banks. Even though these balances are small in relation to all foreign assets held by commercial banks or to the value of international trade they play an extremely important role in clearing international payments. Their role is the same as the role of the currency and demand deposits, or M1, in facilitating monetary exchange in the purely domestic domain. According to our result a dealer's decision to hold currencies for transactions purposes is separable from the decision concerning the allocation of interest bearing assets. Therefore we could extend the analysis allowing the dealers to hold also interest bearing international assets of shorter and longer maturities. Because these assets always dominate demand deposits denominated in the same currency in terms of the return and risk, we can exclude the speculative motive as being relevant in explaining the currency holdings of the dealers except perhaps in the very short run, say, an hour, a minute or even a few seconds.[18)]

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17) McKinnon (1979, Ch. 8) has formulated a model where foreign exchange dealers have a positive demand for domestic money but in his formulation this demand is based purely on the speculative motive and hence depends on the expected rate of depreciation of the domestic currency and on the wealth constraint. He assumes no bond holdings on the part of the dealers and therefore no marginal adjustments between the currency portfolio and interest bearing assets.

18) This interpretation conforms to the view expressed by a practical bank economist Brendan Brown (1980) in a different context.

4. DISCUSSION

Our final task is to relate the above analysis to earlier literature and to discuss some of its macroeconomic implications. We shall discuss only three topics. First, we comment the literature in which the foreign currency holdings of commercial banks has been treated from the transactions demand point of view. Secondly, we perform a heuristic macroeconomic simulation with a simple (verbal) model based on the principles presented in the two previous chapters. This leads to interesting conclusions concerning the monetary autonomy of a small open economy. Finally, we compare our approach with the recently emerged currency substitution approach.

4.1. Comments on Earlier Literature

The transactions demand for foreign exchange is no new idea. It dates back to the 1950's when the inadequacy of international reserves, so called dollar shortage, was a big issue. Yeager (1959) reacted to this discussion arguing that the much discussed inadequacy of international liquidity was 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 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 money into balances in another money simply by change of ownership.

Heller (1968) returned to this issue nine years later. He made an important distinction between the precautionary demand for international reserves by central banks and the transactions demand for foreign exchange by commercial banks. Official reserves are held to allow the maintenance of fixed exchange rates when the balance of payments is temporarily in deficit. In particular, they are not directly involved in making payments for international transactions. Yet, international transactions have to be paid for, and therefore there is a transactions motive to hold international reserves. Because commercial banks are directly involved in making international payments, the ratio of commercial banks' holdings of foreign exchange to the value of international trade is, according to Heller, a more meaningful index of the adequacy of international means of payments than is the ratio of official reserves to the value of trade.

Heller presented empirical data covering the years 1951-1966 and showed that, in the world as a whole as well as in certain groups of countries, the foreign assets of commercial banks had indeed grown faster than the value of imports. These observations supported Heller's conclusion that the adequacy of international reserves had improved in the long run.[19)]

19) Or rather it supported at the time popular view that international reserves had in the 1950's been inadequate and that this inadequacy had removed in the course of the 1960's.

Heller also acknowledged the possibility of economies of scale in the handling of foreign exchange transactions and calculated the ratio of commercial banks' foreign assets to the square root fo the value of imports. Because also this ratio showed an increasing trend he concluded that the adequacy of international means of payments for transactions purposes had risen even more sharply.

An immediate reaction to Heller's article came from Willett (1969). He argued that Heller's way to measure the adequcy of international reserves for transactions purposes by commercial banks' foreign exchange holdings is besides the point. Because commercial banks are optimizing agents and therefore hold their foreign exchange always approximately at the optimal level, the whole question of possible inadequacy of their foreign exchange holdings cannot be raised: being optimal these funds are by definition neither adequate nor inadequate.

In addition to Heller (1968) there are two other empirical studies on commercial banks' foreign exchange holdings.

Gilbert and Kreinin (1971) estimated the demand for foreign assets by commercial banks using data from seven European countries. Estimated equations were not explicitly derived from any theoretical considerations, but because the volume of international trade was among the explanatory variables, they can be interpreted also from the transactions demand point of view. The results showed that this scale variable

was significant, even though it is not possible to calculate the average scale elasticity because equations are linear and data on the variables used are not reported. Interest rate differential appeared as significant only in one case out of seven.

Officer (1976) accepted Heller's distinction between the precautionary demand for official reserves and the transactions demand for foreign exchange by commercial banks. He took notice of the theoretical results by Olivera (1969, 1971) and others which assert that there are economies of scale also in the precautionary demand for international reserves by central banks.[20] Hence, even though the motives to hold international reserves are different in the case of central banks and in the case of commercial banks, the resulting demand equations are similar in both cases as far as the scale elasticity is concerned. Thus Officer's aim was to test the square-root law for both official reserve holdings and commercial banks' foreign exchange holdings.

Instead of accepting the value of imports as an appropriate measure of the value of international transactions, Officer used a more comprehensive measure of the scale variable. His aim was to include all gross flows (total debits or total credits) in the country's balance of payments. Because data

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20) This holds for precautionary reserves in general, not just for official international reserves. In addition to Olivera (1969, 1971) see also Baltensberger (1974) and Makin (1974).

on certain short-term capital movements were not available on a gross basis, he could not use this ideal measure exactly, but in any case his scale variable was as comprehensive as possible.

Officer tested the square-root law for official reserves and commercial banks' foreign exchange holdings using annual data from 25 countries over the period 1959-1970. As regards the official reserves the economies of scale hypothesis was supported only in 10 cases. As regards the commercial banks' foreign exchange holdings, on the other hand, the scale elasticity was significant in 24 out of 25 cases. Only in one case did the economies of scale hypothesis receive some support. In all other cases the scale elasticity was significantly greater than one. In two cases it was significantly greater than two and in two other cases even significantly greater than three.

On the whole the results were catastrophic to the stated square-root hypothesis as far as commercial banks' foreign exchange was concerned. Despite this Officer did not reject the hypothesis as such but accused the deficiently measured value of international transactions for the upward biasedness of the scale elasticities. Even though this may be true, our conclusion is that much more important reason for big scale elasticities is the fact that the explanatory variable itself is inappropriately defined. All studies referred to above have used the foreign assets of commercial banks as published in *International Financial Statistics* to measure the foreign exchange held by banks for transactions purposes. During the

1960's the foreign assets of commercial banks became increasingly dominated by eurocurrency deposits which were borne as a part of the international financial intermediation by the commercial banks and hence are not directly involved in clearing international payments. According to our analysis the economies of scale hypothesis should apply only to non-interest bearing demand deposits held by banks in their foreign correspondent banks or the so called nostro accounts.[21] Data on them are not published in official statistics and generally not even in the balance sheets of international banks. We conclude that the economies of scale hypothesis has not yet been tested for the international means of payments.

Our dicussion leads to the conclusion that the nostro accounts of commercial banks as well as some part of their reserves in domestic money constitute the stock of international means of payments. In explaining their variations the transactions demand approach is appropriate. If broader aggregates are to be explained then other motives ought to be taken into account.[22]

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21) McKinnon (1979, p. 12) in commenting Heller's (1968) paper noticed that after 1966 "the IMF data become more difficult to interpret because growth in working balances of foreign exchange become swamped by a huge rise in interbank Eurocurrency deposits."

22) Note the similarity between this conclusion and the view advocated by some Keynesian monetary theorists (Akerlof, 1973, 1979, 1980) that transactions motive is relevant in explaining the demand for narrow money (M1) and that because M1 is dominated by time deposits in terms of risk and return then speculative motive is not needed in explaining the demand for M1.

4.2. Monetary Autonomy

We continue in assuming that except currency flows between the dealers there are no other capital movements. Furthermore, we assume that all imports and exports are invoiced in a foreign currency, from which it follows that no foreign exchange dealer has any incentive to hold our currency. By these assumptions we have characterized an example of a small open economy for which the conventional characterizations concerning the substitutability between domestic and foreign assets and hence the mobility of capital do not hold. We shall show that, given free international trade in goods and the convertibility of currencies, the behaviour of foreign exchange dealers lead to at least some loss of monetary autonomy in the sense that the effects of domestic monetary policy measures on economic activity are partially offset by currency flows. This holds irrespective of whether or not the central bank pegs the exchange rate.

Let us assume that the central bank decreases the supply of base money through an open market sale of bonds. Domestic interest rates increase and the demand for real balances reduces. We assume that this portfolio adjustment on the part of the public takes place instantenously, or the economy is always on the LM-curve. But as the domestic interest rate increases the required rate of return on the non-interest bearing currency porfolio on the part of the dealers increases as well. As a consequence, they want to decrease the size of their currency portfolio. This they can do by buying bonds with domestic money but sooner or

later they have also to change dollars into marks and buy bonds with the marks so received. If the central bank does not intervene in the foreign exchange market, and because by assumption foreign dealers hold no marks, they can get rid of their extra dollars only by changing quotations so that the customers' flow demand of dollars increases and their flow supply of dollars decreases. This implies a reduction in both the ask-price and the bid-price of dollars i.e. an appreciation of the domestic currency. Hence, the result is an appreciation of the Mark and a temporary deficit in the balance of trade as importers are more willing to make import contracts because the exchange rate is now more attractive to them, and exporters are less willing to sell abroad because the exchange rate is now less attractive to them. As the Mark appreciates the prices of importables decrease and the domestic price level decreases, increasing the supply of real balances, which means that the LM-curve moves back to the right and the domestic interest rate decreases. This sequence of reactions takes place over and above of the presumably slower adjustment in the goods market (affecting Z in eqs. 1 and 2 in Chapter 2). The reaction of the domestic price level may be fast or slow depending, among others, on demand conditions, price expectations and the inventory revaluation practices of firms. Therefore we cannot argue that monetary policy is straightly impotent, but our example shows that it most likely is less efficient than in the standard Keynesian LS-LM-model.[23)]

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23) Note that in this example the dealers' behaviour brings more price flexibility into the economy. It is a well known result that within the standard LS-LM-model the price rigidity assumption is essential for the efficacy of monetary policy. Compare our conclusion with that of Hicks (1974, p. 29): "So it is that the stocks which play the part we have been discussing are in that case, chiefly at least, stocks of foreign exchange. If, however, the exchange rate is allowed to float, with stocks of foreign exchange no longer being used as a stabilizer, the foreign goods as a whole become flexprice, not fixprice, goods."

If in the above example we assume that the central bank has decided to peg the exchange rate, then the dealers can get rid of their extra dollars by changing them into marks with the central bank and buying now more attractive bonds with the marks so received. This, however, would imply an increase in the supply of nominal base money and the LM-curve would shift back to the right decreasing the rate of interest. Hence the net result would be qualitatively similar to that with no central bank intervention. In the latter case foreign currency (titles of ownership of demand deposits in foreign commercial banks) flows from dealers to the central bank, and in the former case it flows from dealers through importers to foreign sellers and hence out of the country.

This is all what can be said in general terms. A more profound analysis of the degree of monetary autonomy would require the specification of supply and expenditure functions, the public's demand-for-money function as well as the formation of exchange rate expectations on the part of the public and foreign exchange dealers. We, however, regard our result on the impossibility of pure monetary autonomy robust given the assumptions of free trade and the convertibility of currencies. The reason is that under these conditions international trade is monetary exchange and is not essentially different from monetary exchange within the national borders.

4.4. Currency Substitution

The strict assumption about the role of the capital movements in the above example were made, first, to emphasize the important role of foreign exchange dealers and, secondly, to contrast our model with the so called currency substitution approach. This approach has emerged relatively recently as a reaction to the widely held view, according to which the regime of flexible exchange rates will make an individual country free to pursue independent monetary policy still allowing free movement of goods and capital across the borders.[24)]

According to the currency substitution approach real money balances as an aggregate are held in a portfolio of currencies, not just in domestic currency.[25)] Because the exchange rate is a relative price of two national monies, the theory of exchange rate determination is a problem of portfolio choice. When relative supplies of different currencies change, people all over the world reallocate their currency portfolios, which leads to exchange rate movements as well as to currency flows between countries. This implies at least some loss of monetary autonomy on the part of an individual country. In this respect our model resembles those based on the currency substitution approach.

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24) This view has been advocated, among others, by Friedman (1953), Mundell (1968) and Johnson (1969).

25) For the currency substitution approach, see Calvo and Rodriquez (1977), Bilson (1978), Makin (1978), and Brillembourg and Schadler (1979).

The advocates of the currency substitution approach have not been explicit as regards the motives of holding a diversified currency portfolio. In general, they seem to accept the view that the same motives which are relevant for holding domestic money balances are relevant also for holding balances in foreign currencies. Thus transactions motive has not been forgotten. For instance Miles (1978, p. 428) writes: "anyone who consistently makes purchases from foreign countries has at least the same transactions motives for demanding foreign currency balances as for demanding domestic currency balances. Importers and exporters, businessmen who travel abroad, tourists, and residents of border areas all have incentives to diversify their currency balances." Also Brillembourg and Schadler (1979, p. 10) took transactions motive into account in their definition of the nonpecuniary return on money holdings. [26] Interesting enough, none of these authors has mentioned commercial banks or foreign exchange dealers as such agents who may have a motive to diversify their liquid resources between different currencies. Apparently this is due to the old tradition in monetary theory to regard as money only money balances held by the non-bank public. Thus, because foreign exchange held by commercial banks appear as a liability of commercial banks in other countries, these balances cancel out when all commercial banks of the world are aggregated together. Our example, however, shows that the neglect of the foreign currency balances of the dealers may not be justified.

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26) In their empirical application, however, the income variable as a proxy for the volume of transactions either did not appear significant or appeared with a wrong sign (Brillembourg and Schadler, 1979, p. 21-23).

On the whole writers on currency substitution approach seem to emphasize the speculative motive for holding a diversified currency portfolio. When looked from this perspective, the elasticity of substitution between currencies depends on the money holders' risk aversion and on the variances and covariances of bilateral exchange rates. If the elasticity of substitution is high, small changes in relative money supplies will lead to substantial changes in exchange rates. In the extreme case, with almost perfect substitutability, a persistently higher rate of monetary expansion in one country would lead to hyperinflation and hyperdepreciation and finally drive this currency out of use as a medium of exchange also in domestic transactions. It is this kind of currency substitution, basically derived from money holders' attitudes towards risk, which lead to the basic proposition of the currency substitution approach according to which the "freedom to conduct an independent monetary policy is an illusion in the world of currency substitution" (Bilson, 1978, p. 394).

Writers on the currency substitution approach are not always explicit on the definition of money, but consistently with their emphasis of the speculative motive they seem to emphasize the broad definition, i.e. they assume money holders to diversify not only between demand deposits denominated in different currencies but also between time deposits denominated in different currencies.[27] According to our approach demand deposits dominate time deposits as far as the transactions

27) Cf. Makin (1978, p. 434) and Brillembourg and Schadler (1979, p. 9). Also Calvo and Rodriquez (1976, p. 617, n. 2) justify the relevance of the currency substitution approach by noting that in Europe nowadays not all deposits in the Euro-dollar market are held by American residents.

motive is concerned, and efficient foreign exchange dealing takes care of the fact that domestic money balances can be regarded as if they represented international means of payments on the part of the domestic public in most cases, exceptions being multinational corporations and, perhaps, travelling businessmen. On the other hand, time deposits dominate demand deposits denominated in the same currency in terms of risk and return and hence from the point of view of the speculative motive.

In the present circumstances holding an eurocurrency deposit, say, an eurodollar deposit, is an alternative to holding corresponding balances in time deposits with US commercial banks. But in the euromarket the interest rate parity holds almost exactly making covered investments in eurocurrency deposits perfect substitutes, i.e. an investor receives the same riskless return, measured in the same unit of account, on all eurocurrency deposits if he chooses to cover his investments through forward exchange sales. Hence, a decision to diversify between time deposits denominated in different currencies is a decision to diversify between time deposits with commercial banks in different countries and a "single" eurocurrency deposit.[28)]

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28) Brillembourg and Schadler (1979, p. 10-11) implicitly include eurocurrency deposits among non-money financial assets for which they assume the interest rate parity to hold.

Consequently, the issues raised by the currency substitution approach reduce to a more traditional question of why the interest rate parity does not hold between financial assets, money or non-money, of any two countries, or looked from another angle, why some financial assets are more international than others. In this light the currency substitution approach appears less radical than it may appear at the first sight.

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