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Working Paper

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Diskussionsbeiträge, No. 17

Provided in Cooperation with:
Department of Economics, University of Konstanz

Suggested Citation: Drexler, Wulf (1972) : The determination of the Eurodollar-Market within a fixed exchange rate system: A simple model, Diskussionsbeiträge, No. 17, Universität Konstanz, Fachbereich Wirtschaftswissenschaften, Konstanz

This Version is available at:
https://hdl.handle.net/10419/78113

THE DETERMINATION OF THE EURODOLLAR-MARKET WITHIN A FIXED EXCHANGE RATE SYSTEM: A SIMPLE MODEL

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March 1972

Diskussionsbeiträge
des Fachbereichs Wirtschaftswissenschaften
der Universität Konstanz

Nr. 17

Contents

I. Aim and Scope of this Paper [+]

Our aim that goes beyond this study is to develop a concept for the determination of the Eurodollar marekt (EDM) or in fact for any other foreign currency market (FCM) that is as powerful within the present and past international monetary arrangements and framework as within a free exchange rate system where individual national central banks can easily control the amount of international reserves they want to hold and therefore also the corresponding source components of their respective national monetary base.

To demonstrate this we would have to compare two models, one based on a free exchange rate system and the other based on a fixed exchange rate system. In the following we will not go as far as that but present only a relatively simple model based on a fixed exchange rate system. However, we will state very briefly where the main differences between the two kinds of systems come in. We hope that we can work out the main differences more clearly sometimes later, when we develop a somewhat more complicated model that explains in a more detailed way the main features of the EDM.

[+] The author wants to thank especially Karl Brunner for his decisive help in the take off period and as supervisor, the research project for many comments, and Volbert Alexander and Hans E. Loef for many Saturday mornings that quite often became late Saturday afternoons.

One of our major assumptions for the following is that any comprehensive explanation and determination of the EDM or any other foreign currency market that makes sense has to clarify the relationship or spill overs between the particular FCM in question and all other currency markets or at least some other major currency markets. One of the reasons is that in a national currency market the corresponding monetary authorities can easily be discerned and made responsible for the major developments in this domestic market, if we neglect foreign influences for a moment or at least partly, if we allow for strong dependence on foreign influences. But it is not possible to distinguish a single monetary authority which we could assign to the major responsibility for the developments in one of these FCM, be it the central bank of the country of issue of the currency in question or some other central bank outside this country.

We thus have mainly two options: One would be to determine the FCM solely by the joint behavior of commercial banks and the public and the other would be to explain it by the joint behavior of commercial banks, the public, and that of all or most central banks in the world. Though most authors in this field chose the first one, we chose the latter, because we see no other way how to determine otherwise exchange rates and the spill overs from one market to another, especially those that originate from different policies of central banks, which are not necessarily in accord with each other.

To accomplish this task we will use the monetary base concept as developed by Brunner-Meltzer for the USA [1]. This concept allows for a much more rigorous approach to our problem than all the different and quite vague "international liquidity concepts" developed so far. Further confidence to reach our aim we derive from the ample empirical evidencealready gathered with respect to the analytic usefulness of the monetary base concept for the USA especially by Brunner-Meltzer and Friedman-Schwartz.

This approach is complicated, however, by the fact that the monetary base concept so far has only been developed for an individual country, where we face mainly one monetary authority, one commercial banking system, one kind of public, and one kind of currency. To explain the EDM, however, the way we want to means that this concept has to be enlarged. Thus the following approach could also be interpreted as an exploration in this field and as a possible solution to this problem of generalization.

To alleviate our task considerably, however, we will make the following simplifying assumptions:

1. For the moment we are only interested in the explanation of three markets, which all show the basic patterns that are important for this kind of analysis: The USA-credit market or the domestic market of the country of issue of the currency in question at the FCM, the Eurodollar-credit market, and the composite credit market of all other countries. This also implies that we have to deal with

only two different countries, the US dollar and the composite currency of all other countries; two sets of public; two banking systems; and two central banks: the Fed and all other central banks combined.

2. Given this framework stated above, we will simplify still further to arrive at a more handable model, that serves as a first approach to separate these three markets in an as close as possible way with respect to the actual markets. At some other time we will then try to work out step by step the major factors shaping them, the different regulations put into effect, and the corresponding differences in the institutional arrangements.

Especially two assumptions with respect to the actual markets are here of importance to judge the scope of our simple model. For one central banks do not hold any deposits with the public or with any banking system nor do they grant any advances. The public on the other hand holds only one kind of deposits - no distinction being made between time and demand deposits - and in addition to that the US public and the US banking system will not hold any deposits in foreign currencies. Especially the first restriction is of high significance because it is almost certain that the various shifts in and out of deposits with commercial banks by central banks will explain a considerable part of the fluctuations we notice in foreign currency and domestic markets. But for simplicity reasons we will right now disregard these considerations.

To achieve a solution for the determination of the three credit markets that makes sense we first developed an International Monetary Base (IMB) and then partitioned the IMB into two parts: the monetary base of the USA (MB_{US}) and the monetary base of all other countries (MB_{n-1}). The two parts are related to each other by a parameter q: $MB_{US} = qMB_{n-1}$ This parameter q is one of the centerpieces of our analysis and its different treatment crucial for any evaluation of the differences between a fixed exchange rate or a free exchange rate system. This parameter q also tells us something about the approximate size of the two countries involved and thus a variation of the initial q will tell us something about the relationship of countries that vary in size.

Before the consequences of fixed exchange rates for our model and our parameter q can be analyzed, the factors determining exchange rates have to be established. For the exchange rate of all other currencies to dollars is determined by the three interest rates i^D_{US}, i^D_{ED}, and i^D_{n-1}; by the policy parameter q; by the ratio of that part of the volume of world trade carried through in dollars to the total volume of world trade $WT^{\$}/WT$, this ratio represents a proxy variable for changes in the productivity of the two currencies as means of transaction; the ratio of the yield on real capital in the USA to the yield on real capital outside the USA n_{US}/n_{n-1}; the ratio of an index of rates on US financial assets not traded on the bank credit market to an index of rates of non-US financial assets not traded on the bank credit market i^O_{US}/i^O_{n-1}; the ratio of non-US prices of current non-US output to US prices of

US current output p_{n-1}/p_{US}; and by a speculation parameter Spec. This dependence could be stated in the following way, whereby the sign of the derivative of the exchange rate function with respect to each of the arguments is stated above the equation:

$$\overset{\$}{e} = f\left(\overset{+}{i^D_{US}},\ \overset{+}{i^D_{ED}},\ \overset{-}{i^D_{n-1}},\ \overset{-}{q},\ \overset{+}{\frac{WT^{\$}}{WT}},\ \overset{+}{\frac{n_{US}}{n_{n-1}}},\ \overset{+}{\frac{i^o_{US}}{i^o_{n-1}}},\ \overset{+}{\frac{p_{n-1}}{p_{US}}},\ \overset{+}{\text{Spec}}\right)$$

Changes in q in which we are mainly interested represent nothing more than changes in the relative supply of dollars to non-dollars by central banks. If the Fed for example increases the US monetary base while all other central banks keep their bases constant, this just means that the Fed poured additional dollars into the system. This will certainly increase the total quantity of dollars traded, while the total amount of non-dollars traded remained about the same, so that the relative price between dollars and non-dollars changes in favor to non-dollars. Thus q represents a very effective tool for central banks to foster exchange rates and to offset other influences if wanted.

Also we can now work out very briefly the main differences between a free exchange rate and a fixed exchange rate system. In a free exchange rate system central banks fix the relative size of the quantities denominated in different currencies and influence or control in this way exchange rates. Because each central bank controls the quantity of one currency and because the exchange rate will only be determined if all quantities are fixed it might be quite possible that central banks never end up with a desired exchange rate, especially if they try to counteract each others measures to reach a certain exchange rate and are not so much oriented on domestic affairs.

In a fixed exchange rate system central banks fix the relative prices between currencies and thus should be willing to accept the consequences that result out of such a step. They have no control anymore of the relative quantities or of q and have to rely on SDR's and possibly unlimited intercentralbank-credit-lines. In a fixed exchange rate system q becomes an endogeneous variable, depending on all the variables that would otherwise influence the exchange rate.

In our model q will thus be determined in the following way:

$$q = g\left(\overset{+}{i^{D}_{US}},\ \overset{+}{i^{D}_{ED}},\ \overset{-}{i^{D}_{n-1}},\ \overset{+}{\frac{WT^{\varnothing}}{WT}},\ \overset{+}{\frac{n_{US}}{n_{n-1}}},\ \overset{+}{\frac{i^{o}_{US}}{i^{o}_{n-1}}},\ \overset{+}{\frac{p_{n-1}}{p_{US}}},\ \overset{+}{Spec}\right)$$

This means that in a fixed exchange rate system, we can either control MB_{US} or MB_{n-1}, but not their relative size. The stableness of this system depends very much on the willingness of different central banks to cooperate.

This willingness seems to have been not very effective in the past if we count all the instances at which exchange rates were changed and consider the political noises that went with it. It is quite likely that it was - with a few exceptions - the strongest whenever it was not needed and exchange rates would have remained about the same anyhow. In these periods it would have mattered little, if we would have been on a fixed or flexible exchange rate system. But this is an empirical question that depends especially on the development of q and the monetary streams from one country to another which we cannot answer right here.

If the above hypotheses, however, could be supported then it would explain to a great extent next information and adaption process, why the European central banks were rather successful in the past in "controlling" their respective bases and the empirical studies so far about the controllability of the monetary base in countries highly dependent on foreign influences would be not very conclusive for the general question of the controllability of the monetary base in such countries within a fixed exchange rate system [2]. Given this framework it is probably much lower and exists only in the very short run, if we do not just mean with controlling that changes in the foreign asset components of a national base can be offset by corresponding changes in the domestic source components as long as we have something to offset with and as long as the other central bank is willing it accept this offsetting policy.

A similar problem exists with testing empirically hypotheses about the international transmission of business cycles within a fixed exchange rate system. If our hypothesis is for example that instabilities are mainly the result of monetary policy [3], then an empirical study of this is here even further complicated by the quite many different transmission mechanisms. Even if the dependence is quite strong, simple testing may not reveal this strong dependence [4].

One possibility would be that q remains constant in the short and long run. Then we should notice parallel movements in the business cycles. Another would be that either country one or country two always adjusts its monetary base, if the initial equilibrium is disturbed by the other country. Then we should notice that business cycles are lagged and always initiated by the country which first disturbs the equilibrium q. A further possibility would be that each country adjusts its base to a certain degree if the equilibrium has been disturbed by one or the other country. The most likely case, however, will be that we had a combination of all above mentioned possibilities, so that it should be rather complicated to work out a clear pattern of the dependence between business cycles in different countries, even if we would not face the additional problem of revaluations.

II. The Simple Model

A. Basic Relations

1. The Development of the International Monetary Base

In the following the IMB will be derived in a similar way as a monetary base for an individual country from the consolidated balance-sheet statements of all monetary authorities involved in creating base money be it a central bank, a Treasury Department or an international institution as the IMF.

To develop this concept of an IMB we should be able to demonstrate:

a) that changes in the composition of our IMB have no or only very little effect on any parameter determined by the behavior of the public or by banks; b) that all operations which are excluded through the definition of the IMB like the establishment of intercentralbank credit lines and SDR's have no or little effect on any behavioral parameter of our system; c) that increases or decreases of the IMB have very decisive effects on the parameters determined by the public and by banks; d) that the size of the IMB can be controlled by the monetary authorities, be it through direct measures or by offsetting the undesired growth of components that are not directly controllable.

To simplify things we assume that the various monetary bases for individual countries are already derived from the consolidated balance-sheet statements of central banks and of the different Treasury departments. Further we assume for the moment that we have only one world currency or what would be the same that all national currencies can be aggregated into a composite currency that has the same porperties as a single currency. The only thing that then has to be done to arrive at an IMB is to aggregate all national monetary bases (MB) into a single one. Intercentralbank credits will cancel out against each other and we arrive at the following sources base:

$$IMB^S = G + S + A + D^{CB}$$

The sources base thus consists of the total gold stock G of central banks, of all securities in the portfolio of central banks, of all advances granted to commercial banks, and all deposits with commercial banks that are held by the various central banks. This last item is especially of interest. It consists of those assets the various central banks hold with foreign commercial banks and which they consider as a part of their international reserves. If all these deposits at foreign banks e. g. with US commercial banks or with Eurodollar banks would be reduced to zero - a quite reasonable step in a world with just one central bank and one single currency - our IMB would be nothing else than a national monetary base for the whole world, though the costs of advances might still differ as much from one region or nation to another as they do now. Because we are interested in the following in a model as simple as possible, the two components A and D^{CB} will be neglected in our further analysis.

Though - as we have seen - the construction of an IMB differs from an individual MB concept with respect to the sources base, this is not the case with respect to the allocation of base money by commercial banks and by the public. The uses base can therefore be stated as follows:

$$IMB^u = R + C.$$

It consists of the aggregated required and excess reserves and the total currency in the hands of the public.

2. The Decomposition of the IMB into Two Basic Components

If exchange rates of different currencies are introduced the IMB has to be decomposed. Otherwise our first test criterion will be violated. If we have to deal with two currencies then the IMB is decomposed into the monetary base of one individual country and the composite monetary base of all other countries. A consequence of this step, however, is that instead of dealing with one central bank, one banking system, and one set of public two sets of each have now to be analyzed simultaneously, a problem not encountered in the analysis of an individual country. Essential for its solution will be the parameter q that is defined as MB_{US}/MB_{n-1}, and allows to express the IMB in either MB_{US} or MB_{n-1}: $IMB = (1 + q)\ MB_{n-1}$.

The US monetary base and the composite base of all other countries are defined as follows:

$$MB^{S}_{US} = G_{US} + S^{Fed}_{US} + S^{Fed}_{n-1} + NP^{Fed}_{CB}$$

The sources base of the USA consists of the gold stock of the Fed, of all US and foreign securities in the portfolio of the Fed, and of the net position of the Fed against all other central banks, a component that would net out if we would derive the IMB.

$$MB^{S}_{n-1} = G_{n-1} + S^{CB}_{n-1} + S^{CB}_{US} + NP^{CB}_{Fed}$$

The sources base of all other countries consists of the total stock of gold of the respective central banks, all domestic and US securities in their portfolios, and of the net position of all other central banks against the Fed, a component that is of the same absolute size as the corresponding component in the US base, but enters with just the opposite sign.

$$MB^U_{US} = R_{US} + C_{US}$$

The uses base of the USA consists very simply of the total required and excess reserves of the US banking system and the total US currency in the hands of the US public. For simplicity reasons it is assumed that nobody else will hold any US currency.

$$MB^U_{n-1} = R_{n-1} + C_{n-1}$$

In an analogue way the uses base of all other countries consists of the total required and excess reserves of the n-1 banking system and the total n-1-currency in the hands of the non-US public. As in the case of an individual country the sources side and the uses side of each of the two monetary bases have to be equal and we can thus write:

$$MB^S_{US} = MB^U_{US} \tag{1}$$

$$MB^S_{n-1} = MB^U_{n-1} \tag{1'}$$

As we have already established in a fixed exchange rate system only one of the two major components of our IMB can be completely controlled while the other is determined by the model. We thus can control either MB_{US} or MB_{n-1}, but not q. For q the following already discussed relationships hold in a fixed exchange rate system:

$$MB_{US} = q\ MB_{n-1} \tag{2}$$

$$q = q\left(\overset{+}{i^{D}_{US}},\ \overset{+}{i^{D}_{ED}},\ \overset{-}{i^{D}_{n-1}},\ \overset{+}{\frac{WT^{\$}}{WT}},\ \overset{+}{\frac{n_{US}}{n_{n-1}}},\ \overset{+}{\frac{i^{o}_{US}}{i^{o}_{n-1}}},\ \overset{+}{\frac{P_{n-1}}{P_{US}}},\ \overset{+}{Spec}\right) \tag{3}$$

In a fixed exchange rate system all quantities can easily be stated in one currency by just multiplying all quantities denominated in different currencies by the respective exchange rate. In our analysis all quantities will be expressed in dollars. Our analysis thus implies the following relationship:

$$e^{S} = e \tag{4}$$

e represents a policy parameter that fixes the spot rate of all other currencies to dollars.

B. The Analysis of the Behavior of the Two Banking Systems.

1. The consolidated balance sheet statement of the US banking system.

$$R_{US} + EA_{US} = D^{P_{US}}_{US} + D^{P_{n-1}}_{US} + D^{B_{n-1}}_{US} \tag{5}$$

2. The consolidated balance sheet statement of the n-1-banking system.

$$R_{n-1} + D_{US}^{B_{n-1}} + EA_{ED} + EA_{n-1} = D_{n-1}^{P_{n-1}} + D_{ED}^{P_{n-1}} + D_{ED}^{P_{US}} \qquad (6)$$

As easily can be seen from the two statements the US banking system simply divides its assets into two components: Reserves and earning assets, both denominated in dollars. The n-1 banking system, however, has to decide how much it wants to allocate to reserves denominated in domestic currency R_{n-1}, to dollar deposits held with the US banking system $D_{US}^{B_{n-1}}$, to earning assets denominated in domestic currency, and to earning assets denominated in dollars.

3. The asset allocation if the US banking system.

a) The allocation of total reserves

$$R_{US} = r_{US} \left(D_{US}^{P_{US}} + D_{US}^{P_{n-1}} + D_{US}^{B_{n-1}} \right) \qquad (7)$$

$$r_{US} = r_{US} \, (\bar{i}_{US}) \qquad (8)$$

The US reserve ratio depends negatively on the US credit market interest rate.

b) The allocation of required reserves

$$R_{US}^{r} = r_{US}^{r} \left(D_{US}^{P_{US}} + D_{US}^{P_{n-1}} + D_{US}^{B_{n-1}} \right) \qquad (9)$$

For simplicity reasons we assume that the US banking system is confronted with just one single reserve rate for all deposits. This reserve rate represents a policy parameter of the Fed.

c) The allocation of excess reserves

$$R^{e}_{US} = r^{e}_{US}\left(D^{P_{US}}_{US} + D^{P_{n-1}}_{US} + D^{B_{n-1}}_{US}\right) \qquad (10)$$

$$r^{e}_{US} = r^{e}_{US}\,(\overset{-}{i}_{US}) \qquad (11)$$

The excess reserve ratioof the US banking systems depends negatively on the US credit interest rate.

4. The asset allocation of the n-1-banking system.

a) The allocation of total domestic reserves

$$R_{n-1} = r_{n-1}\left(D^{P_{n-1}}_{n-1} + D^{P_{n-1}}_{ED} + D^{P_{US}}_{ED}\right) \qquad (12)$$

$$r_{n-1} = r_{n-1}\,(\overset{-}{i}_{n-1}, \overset{-}{i}_{ED}, \overset{-}{sw}) \qquad (13)$$

The n-1-reserve ratio depends negatively on the domestic credit market interest rate, negatively on the ED credit market interest rate, and also negativley on the swap rate.

b) The allocation of required reserves

$$R^{r}_{n-1} = r^{r}_{n-1}\left(D^{P_{n-1}}_{n-1} + D^{P_{n-1}}_{ED} + D^{P_{US}}_{ED}\right) \qquad (14)$$

Because of different reserve requirements for domestic and ED deposits, we further get:

$$R^{r_1}_{n-1} = r^{r_1}_{n-1} \left(D^{P_{n-1}}_{n-1} \right) \qquad (15)$$

$$R^{r_2}_{n-1} = r^{r_2}_{n-1} \left(D^{P_{n-1}}_{ED} + D^{P_{US}}_{ED} \right) \text{ and} \qquad (16)$$

$$r^{r}_{n-1} = r^{r_1}_{n-1}\, u + r^{r_2}_{n-1}\, v \qquad (17)$$

$$\text{if } u = \frac{D^{P_{n-1}}_{n-1}}{D^{P_{n-1}}_{n-1} + D^{P_{n-1}}_{ED} + D^{P_{US}}_{ED}} \text{ and } v = \frac{D^{P_{n-1}}_{ED} + D^{P_{US}}_{ED}}{D^{P_{n-1}}_{n-1} + D^{P_{n-1}}_{ED} + D^{P_{US}}_{ED}}$$

$r^{r_1}_{n-1}$ and $r^{r_2}_{n-1}$ are both policy parameters.

c) The allocation of excess reserves held in domestic currency

$$R^{e}_{n-1} = r^{e}_{n-1} \left(D^{P_{n-1}}_{n-1} + D^{P_{n-1}}_{ED} + D^{P_{US}}_{ED} \right) \qquad (18)$$

$$r^{e}_{n-1} = r^{e}_{n-1} \left(\overset{-}{i}_{n-1}, \overset{-}{i}_{ED}, \overset{-}{sw} \right) \qquad (19)$$

The domestic currency excess reserve ratio depends negatively on the domestic credit market interest rate, negatively on the ED credit market interest rate, and also negatively on the swap rate.

d) The allocation of dollar deposits or dollar reserves held with the US banking system

$$D^{B_{n-1}}_{US} = r^D \; D^{P_{n-1}}_{n-1} + D^{P_{n-1}}_{ED} + D^{P_{US}}_{ED} \tag{20}$$

$$r^D = r^D \; (\overset{-}{i}_{n-1}, \overset{-}{i}_{ED}, \overset{+}{sw}) \tag{21}$$

The dollar excess reserve ratio depends as the domestic currency reserve ratio negatively on the domestic credit market interest rate and ED credit market interest rate, **but positively on the swap rate.**

e) The allocation of earning assets

$$EA_{n-1} = cEA_{ED} \tag{22}$$

$$c = c \; (\overset{+}{i}_{n-1}, \overset{-}{i}_{ED}, \overset{-}{sw}, \overset{-}{Spec}) \tag{23}$$

The earning asset ratio depends positively on the domestic credit market interest rate and negatively on the ED credit interest rate and on the swap rate.

C. Public's Asset Allocation

1. The US public

To arrive at definite derivatives with respect to the variables determining the US public's asset allocation, we first state the relationships that determine the individual asset components of the US public and then establish and substantiate the corresponding order conditions.

$$D_{US}^{P_{US}} = f_1\left(\overset{-}{i_{US}},\ \overset{-}{i_{ED}},\ \overset{+}{i_{US}^{D}},\ \overset{-}{i_{ED}^{D}},\ \overset{+}{\frac{Y^{P_{US}}}{Y_P^{P_{US}}}},\ \overset{+}{W^{P_{US}}}\right)$$

$$D_{ED}^{P_{US}} = f_2\left(\overset{-}{i_{US}},\ \overset{-}{i_{ED}},\ \overset{-}{i_{US}^{D}},\ \overset{+}{i_{ED}^{D}},\ \overset{+}{\frac{Y^{P_{US}}}{Y_P^{P_{US}}}},\ \overset{+}{W^{P_{US}}}\right)$$

$$E\,(D_{ED}^{P_{US}},\ i_{US}) < E\,(D_{US}^{P_{US}},\ i_{US})$$

$$E\,(D_{US}^{P_{US}},\ i_{ED}) < E\,(D_{ED}^{P_{US}},\ i_{ED})$$

$$E\left(D_{US}^{P_{US}},\ \frac{Y^{P_{US}}}{Y_P^{P_{US}}}\right) < E\left(D_{ED}^{P_{US}},\ \frac{Y^{P_{US}}}{Y_P^{P_{US}}}\right)$$

$$E\left(D_{US}^{P_{US}},\ W^{P_{US}}\right) < E\left(D_{ED}^{P_{US}},\ W^{P_{US}}\right)$$

These order conditions imply that the assets of that market where the particular interest rate is determined show a higher interest elasticity than assets from other markets and that ED assets of the US public show in general a higher wealth elasticity than the corresponding domestic assets in domestic currency. The argument for this latter order condition runs as follows: it requires substantial wealth to participate in the ED market, a requirement that is not prevalent for US citizens at their domestic market. In a similar way it seems also quite reasonable that US depositors at the EDM show a higher sensitivity in their asset allocation with respect to changes in $Y^{P_{US}}/Y_P^{P_{US}}$ than ordinary US citizens that hold almost **only US deposits.**

According tothe corresponding order conditions above we get the following relationship with respect to the asset allocation of the US public:

$$D_{US}^{P_{US}} = d\ D_{ED}^{P_{US}} \tag{24}$$

$$d = d\left(\overset{-}{i_{US}},\ \overset{+}{i_{ED}},\ \overset{+}{i_{US}^{D}},\ \overset{-}{i_{ED}^{D}},\ \overset{-}{\frac{Y^{P_{US}}}{Y_P^{P_{US}}}},\ W^{P_{US}}\right) \tag{25}$$

The deposit ratio of the US public depends negatively on the US credit market interest rate, the ED deposit rate, the ratio of current income to permanent income, the nonhuman real wealth of the US public and positively on the ED credit market interest rate and the US deposit rate.

$$C_{US} = k_{US}\ (D_{US}^{P_{US}} + D_{ED}^{P_{US}}) \tag{26}$$

For simplicity reasons we assume that the US currency ratio is constant.

2. The n-1-public

To arrive at definite derivatives with respect to the variables determining the non-US public's asset allocation, we first state - and just in the same way as we did with respect to the US public - the relationships that determine the individual asset components of the non-US public and then we establish and substantiate the corresponding order conditions:

$$D_{n-1}^{P_{n-1}} = f_3\left(\overset{-}{i_{US}},\ \overset{-}{i_{ED}},\ \overset{-}{i_{n-1}},\ \overset{-}{i_{US}^{D}},\ \overset{-}{i_{ED}^{D}},\ \overset{+}{i_{n-1}^{D}},\ \overset{-}{sw},\ \overset{+}{\frac{Y^{P_{n-1}}}{Y_P^{P_{n-1}}}},\ \overset{+}{W^{P_{n-1}}}\right)$$

$$D_{ED}^{P_{n-1}} = f_4\left(\overset{-}{i_{US}},\ \overset{-}{i_{ED}},\ \overset{-}{i_{n-1}},\ \overset{-}{i_{US}^{D}},\ \overset{+}{i_{ED}^{D}},\ \overset{-}{i_{n-1}^{D}},\ \overset{+}{sw},\ \overset{+}{\frac{Y^{P_{n-1}}}{Y_P^{P_{n-1}}}},\ \overset{+}{W^{P_{n-1}}}\right)$$

$$D_{US}^{P_{n-1}} = f_5\left(\overset{-}{i_{US}},\ \overset{-}{i_{ED}},\ \overset{-}{i_{n-1}},\ \overset{+}{i_{US}^{D}},\ \overset{-}{i_{ED}^{D}},\ \overset{-}{i_{n-1}^{D}},\ \overset{+}{sw},\ \overset{+}{\frac{Y^{P_{n-1}}}{Y_P^{P_{n-1}}}},\ \overset{+}{W^{P_{n-1}}}\right)$$

$$E(D_{US}^{P_{n-1}},\ i_{US}) > E(D_{ED}^{P_{n-1}},\ i_{US}) > E(D_{n-1}^{P_{n-1}},\ i_{US})$$

$$E(D_{ED}^{P_{n-1}},\ i_{ED}) > E(D_{US}^{P_{n-1}},\ i_{ED}) > E(D_{n-1}^{P_{n-1}},\ i_{ED})$$

$$E(D_{n-1}^{P_{n-1}},\ i_{n-1}) > E(D_{ED}^{P_{n-1}},\ i_{n-1}) > E(D_{US}^{P_{n-1}},\ i_{n-1})$$

$$E(D_{US}^{P_{n-1}}, i_{US}^{D}) > E(D_{ED}^{P_{n-1}}, i_{US}^{D}) > E(D_{n-1}^{P_{n-1}}, i_{US}^{D})$$

$$E(D_{ED}^{P_{n-1}}, i_{ED}^{D}) > E(D_{US}^{P_{n-1}}, i_{ED}^{D}) > E(D_{n-1}^{P_{n-1}}, i_{ED}^{D})$$

$$E(D_{n-1}^{P_{n-1}}, i_{n-1}^{D}) > E(D_{ED}^{P_{n-1}}, i_{n-1}^{D}) > E(D_{US}^{P_{n-1}}, i_{n-1}^{D})$$

$$E(D_{ED}^{P_{n-1}}, sw) > E(D_{US}^{P_{n-1}}, sw)$$

$$E(D_{ED}^{P_{n-1}}, W^{P_{n-1}}) > E(D_{US}^{P_{n-1}}, W^{P_{n-1}}) > E(D_{n-1}^{P_{n-1}}, W^{P_{n-1}})$$

$$E\left(D_{ED}^{P_{n-1}}, \frac{Y^{P_{n-1}}}{Y_P^{P_{n-1}}}\right) > E\left(D_{US}^{P_{n-1}}, \frac{Y^{P_{n-1}}}{Y_P^{P_{n-1}}}\right) > E\left(D_{n-1}^{P_{n-1}}, \frac{Y^{P_{n-1}}}{Y_P^{P_{n-1}}}\right)$$

The first three rows of order conditions imply that the assets of that market where the particular interest rate is determined show a higher interest elasticity than assets from other markets and that the assets placed at the ED market show a higher interest elasticity than assets of markets where the particular interest rate in question is not determined.

The next three rows imply that an asset shows a higher elasticity with its own price than other assets with respect to this price. We further assumed as above that EDM assets show a higher interest elasticity than the corresponding assets of markets where the particular interest rate in question is not determined. The reason for this being that ED are usually traded in large sums and by professional depositors of large companies and this with low information and transaction cost per unit currency, so that already small interest rate changes somewhere else in the world will induce them to shift their assets.

The seventh row implies that ED deposits show a higher elasticity with regard to swap rate changes than dollar deposits held with US commercial banks. The arguments for this order condition runs in the same way as for some others already established ones: ED participants are quite sensitive to small changes in any cost elements, mainly bcause of the high sums involved.

The eighth row implies that ED assets show in general a higher wealth elasticity than the corresponding dollar assets with US commercial banks and these again show a higher wealth elasticity than the corresponding domestic assets in domestic currency. The reason for this is that it requires already a substantial wealth level to participate in foreign currency markets and it requires even a more substantial wealth position to participate in the ED market, a requirement that is not prevalent to this extent at the domestic market. Similar arguments hold for the last row. ED depositors react more sensitively with respect to changes of the transitory income than depositors at the US market and at the domestic market, and this in that order. They face quite generally lower information, adaption, and transaction costs.

According to the corresponding order conditions above we get the following relationship with respect to the asset allocation of the non-US public:

$$D_{n-1}^{P_{n-1}} = d_1 \left(D_{ED}^{P_{n-1}} + D_{US}^{P_{n-1}}\right) \tag{27}$$

$$d_1 = d_1 \left(\overset{+}{i_{US}}, \overset{+}{i_{ED}}, \overset{-}{i_{n-1}}, \overset{-}{i^D_{US}}, \overset{-}{i^D_{ED}}, \overset{+}{i^D_{n-1}}, \overset{-}{sw}, \overset{-}{\frac{Y^{P_{n-1}}}{Y_P^{P_{n-1}}}}, \overset{-}{W^{P_{n-1}}} \right) \tag{28}$$

This ratio depends positively on the US credit market interest rate, the ED credit market interest rate, the n-1 deposit rate, and negatively on the n-1 credit market interest rate, the US deposit rate, the ED deposit rate, the swap rate, the ratio of current income to permanent income, and on nonhuman wealth.

$$D_{US}^{P_{n-1}} = d_2 D_{ED}^{P_{n-1}} \tag{29}$$

$$d_2 = d_2 \left(\overset{-}{i_{US}}, \overset{+}{i_{ED}}, \overset{+}{i_{n-1}}, \overset{+}{i^D_{US}}, \overset{-}{i^D_{ED}}, \overset{+}{i^D_{n-1}}, \overset{-}{sw}, \overset{-}{\frac{Y^{P_{n-1}}}{Y_P^{P_{n-1}}}}, \overset{-}{W^{P_{n-1}}} \right) \tag{30}$$

This ratio depends positively on the ED credit market interest rate, the n-1 credit market interest rate, the US deposit rate, the n-1 deposit rate, and negativley on the US credit market interest rate, the ED deposit rate, the swap rate, the ratio of current income to permanent income, and on nonhuman real wealth.

$$C_{n-1} = k_{n-1}\left(D^{P_{n-1}}_{n-2} + D^{P_{n-1}}_{ED} + D^{P_{n-1}}_{US}\right) \qquad (31)$$

For simplicity reasons we assume the n-1 currency ratio is constant.

D. The Supply of Earning Assets

$$EA^{P}_{US} = \Bigg(\overset{-}{i_{US}}, \overset{+}{i_{ED}}, \overset{+}{i_{n-1}}, \overset{+}{\frac{Y^{P_{n-1}}}{Y_P^{P_{n-1}}}}, \overset{+}{\frac{Y^{P_{US}}}{Y_P^{P_{US}}}}, \overset{+}{W^{P_{US}}}, \overset{+}{W^{P_{n-1}}}, \overset{+}{sw},$$

$$\overset{+}{p_{US}}, \overset{-}{p_{n-1}}, \overset{+}{i^{o}_{US}}, \overset{+}{i^{o}_{n-1}}, \overset{+}{n_{US}}, \overset{+}{n_{n-1}} \Bigg) \qquad (32)$$

The supply of earning assets to the US banking system depends positively on the ED credit market interest rate, the n-1 credit market interest rate, the ratio of current income of the n-1 public to permanent income of the n-1 public, the ratio fo current income of the US public to permanent income of the US public, the nonhuman real wealth of the US public, the nonhuman real wealth of the n-1 public, the swap rate, the US prices of current US output, an index of rates on US financial assets not traded on the bank credit market, an index of rates on non-US financial assets in the USA, the yield on real capital outside the USA, and negatively on the US credit market interest rate and on the n-1 prices of current non-US output.

$$EA^{P}_{ED} = s_{ED}\left(\overset{+}{i_{US}},\ \overset{-}{i_{ED}},\ \overset{+}{i_{n-1}},\ \overset{+}{\frac{Y^{P_{n-1}}}{Y_P^{P_{n-1}}}},\ \overset{+}{\frac{Y^{P_{US}}}{Y_P^{P_{US}}}},\ \overset{+}{W^{P_{US}}},\ \overset{+}{W^{P_{n-1}}},\ \overset{+}{sw},\ \overset{+}{p_{US}},\ \overset{-}{p_{n-1}},\ \overset{+}{i^{o}_{US}},\ \overset{+}{i^{o}_{n-1}},\ \overset{+}{n_{US}},\ \overset{+}{n_{n-1}}\right) \tag{33}$$

The supply of ED earning assets depends on the same variables as the supply of earning assets to the US banking system and in the same way, except for two cases: The supply of ED earning assets depends positively on the US credit market interest rate and negatively on the ED credit market interest rate.

$$EA^{P}_{n-1} = s_{n-1}\left(\overset{+}{i_{US}},\ \overset{+}{i_{ED}},\ \overset{-}{i_{n-1}},\ \overset{+}{\frac{Y^{P_{n-1}}}{Y_P^{P_{n-1}}}},\ \overset{+}{W^{P_{n-1}}},\ \overset{-}{sw},\ \overset{-}{p_{US}},\ \overset{+}{p_{n-1}},\ \overset{+}{i^{o}_{US}},\ \overset{+}{i^{o}_{n-1}},\ \overset{+}{n_{US}},\ \overset{+}{n_{n-1}}\right) \tag{34}$$

The supply of non-dollar assets to the n-1 banking system depends positively on the US credit market interest rate, the ED credit market interest rate, an index for transitory income of the non-US public, the nonhuman real wealth of the non-US public, US prices of current output, n-1 prices of current non-US output, an index of rates on US financial assets not traded on the bank credit market, an index of rates on non-US financial assets not traded on the bank credit market, the yield on real capital in the USA, the yield on capital outside the USA, the swap rate, and the US prices of current US output.

E. The Determination of Deposit Interest Rates

$$i^D_{US} = i^D_{US}\ (\overset{+}{i_{US}},\ \overset{-}{sw}) \tag{35}$$

The US deposit rate depends positively on the US credit market interest rate and negatively on the swap rate.

$$i^D_{ED} = i^D_{ED}\ (\overset{+}{i_{ED}},\ \overset{-}{sw}) \tag{36}$$

The ED deposit rate depends positively on the ED credit market interest rate and negatively on the swap rate.

$$i^D_{n-1} = i^D_{n-1}\ (\overset{+}{i_{n-1}},\ \overset{+}{sw}) \tag{37}$$

The n-1 deposit rate depends positively on the n-1 credit market interest rate and on the swap rate.

F. The Relationship Between $D_{ED}^{P_{US}}$ and $D_{ED}^{P_{n-1}}$

To find a reasonable relationship between $D_{ED}^{P_{n-1}}$ and $D_{ED}^{P_{US}}$ is a quite bothersome task and can only be achieved if we take into account all the parameters we have already introduced.

First we express the US monetary base in $D_{ED}^{P_{US}}$ and $D_{ED}^{P_{n-1}}$:

$$MB_{US} = r_{US} \left[(d + r^D)\, D_{ED}^{P_{US}} + \left[d_2 + (1 + d_1 + d_1 d_2)\, r^D \right] D_{ED}^{P_{n-1}} \right] + k_{US}\, (1 + d)\, D_{ED}^{P_{US}} \qquad (1')$$

Next we express the combined other monetary bases in the same way:

$$MB_{n-1} = r_{n-1} \left[(1 + d_1 + d_1 d_2)\, D_{ED}^{P_{n-1}} + D_{ED}^{P_{US}} \right] + k_{n-1}\, (1 + d_1 + d_2 + d_1 d_2)\, D_{ED}^{P_{n-1}} \qquad (2')$$

By expressing MB_{US} in MB_{n-1} and substituting (1') into (2') we solve for $D_{ED}^{P_{US}}$ and $D_{ED}^{P_{n-1}}$:

$$D_{ED}^{P_{US}} = \frac{(r_{n-1} + k_{n-1})(1 + d_1 + d_1 d_2) + k_{n-1} d_2}{\frac{1}{q} \left[r_{US}\, (d + r^D) + k_{US}\, (1 + d) \right] - r_{n-1}} \;\; \frac{- \frac{1}{q}\, r_{US} \left[d_2 + r^D\, (1 + d_1 + d_1 d_2) \right]}{} \; D_{ED}^{P_{n-1}}$$

$$D_{ED}^{P_{US}} = d_5\, D_{ED}^{P_{n-1}} \qquad (3')$$

$$d_5 = d_5 \left[\overset{+}{i_{US}},\ \overset{\pm}{i_{ED}},\ \overset{-}{i_{n-1}},\ \overset{\mp}{i^D_{US}},\ \overset{+}{i^D_{ED}},\ \overset{\mp}{i^D_{n-1}},\ \overset{+}{k_{n-1}},\ \overset{-}{k_{US}},\ \overset{-}{sw},\ \overset{-}{\frac{Y^{P_{n-1}}}{Y_P^{P_{n-1}}}},\ \overset{+}{\frac{Y^{P_{US}}}{Y_P^{P_{US}}}},\ \overset{+}{W^{P_{US}}},\ \overset{-}{W^{P_{n-1}}},\ \overset{+}{\frac{WT^g}{WT}},\ \overset{+}{\frac{p_{n-1}}{p_{US}}},\ \overset{+}{\frac{n_{US}}{n_{n-1}}},\ \overset{+}{\frac{i^o_{US}}{i^o_{n-1}}},\ \overset{+}{Spec} \right]$$

The above stated signs of the derivatives of the variables that determine d_5 are derived in Appendix A with the help of order conditions. In those cases where it is difficult to justify the final order conditions for the determination of a special sign, we state both possibilities and in our further analysis we consider first the most likely sign and then in a second step we also check the other possibility and its consequences for the model. The instances where we will have to proceed in this way can be identified in the equation above by the signs $\pm$ or $\mp$ ordered in such a way that the first sign always represents the most likely case.

G. The Complete Model

1. The definition of money.

$$M_{US} = D_{US}^{P_{US}} + D_{ED}^{P_{US}} \tag{38}$$

$$M_{n-1} = D_{n-1}^{P_{n-1}} + D_{ED}^{P_{n-1}} + D_{US}^{P_{n-1}} \tag{39}$$

2. The equilibrium conditions for the three credit markets.

$$EA_{US}^{P} = EA_{US} \tag{40}$$

$$EA_{ED}^{P} = EA_{ED} \tag{41}$$

$$EA_{n-1}^{P} = EA_{n-1} \tag{42}$$

3. The complete model consists out of 42 equations and thus 42 endogenous variables can be determined:

M_{US}, M_{n-1}, R_{US}, R_{n-1}, R^{r}_{US}, R^{r}_{n-1}, $R^{r_1}_{n-1}$, $R^{r_2}_{n-1}$, R^{e}_{US}, R^{e}_{n-1},

$D_{US}^{B_{n-1}}$, $D_{ED}^{P_{US}}$, $D_{n-1}^{P_{n-1}}$, $D_{US}^{P_{n-1}}$, $D_{ED}^{P_{n-1}}$, C_{US}, C_{n-1}, EA_{US}, EA_{ED},

EA_{n-1}, EA^{P}_{US}, EA^{P}_{ED}, EA^{P}_{n-1}, MB_{US} or MB_{n-1}, i^{D}_{US}, i^{D}_{ED}, i^{D}_{n-1},

i_{US}, i_{ED}, i_{n-1}, q, d, d_1, d_2, r_{US}, r_{n-1}, r^{r}_{n-1}, r^{e}_{US}, r^{e}_{n-1},

r^{d}, e^{s}, $D_{US}^{P_{US}}$

4. The two central banks control the following parameters:

MB_{n-1} or MB_{US}, e, r^{r}_{US}, $r^{r_1}_{n-1}$, $r^{r_2}_{n-1}$

5. Other exogenous variables are:

$W^{P_{US}}$, $W^{P_{n-1}}$, $\frac{Y^{P_{US}}}{Y_P^{P_{US}}}$, $\frac{Y^{P_{n-1}}}{Y_P^{P_{n-1}}}$, sw, $\frac{WT^{\$}}{WT}$, $\frac{p_{n-1}}{p_{US}}$, $\frac{n_{US}}{n_{n-1}}$, $\frac{i^{o}_{US}}{i^{o}_{n-1}}$, Spec,

k_{n-1}, k_{US}, p_{US}, p_{n-1}, i^{o}_{US}, i^{o}_{n-1}, n_{US}, n_{n-1}

6. Because we are mainly interested in the determination of the following 10 endogenous variables: M_{US}, M_{n-1}, $D_{ED}^{P_{US}}$, $D_{ED}^{P_{n-1}}$, EA_{US}, EA_{ED}, EA_{n-1}, the model is reduced to 10 equations that will determine those endogenous variables and the three interested rates.

-

7. The Eurodollar deposit multiplier

Out of the equations (1'), (2'), and (3') in F. we receive

$$D_{ED}^{P_{US}} = \frac{q\ d_5}{d_5 [r_{US}(d+r^D)+k_{US}(1+d)] + r_{US} [\bar{d}_2+r^D(1+d_1+d_1d_2)]} MB_{n-1} \tag{43}$$

or

$$D_{ED}^{P_{US}} = \frac{d_5}{(r_{n-1}+k_{n-1})(1+d_1+d_1d_2) + k_{n-1}d_2 + \frac{1}{d_5}\ r_{n-1}} MB_{n-1}$$

$$D_{ED}^{P_{n-1}} = \frac{1}{(r_{n-1}+k_{n-1})(1+d_1+d_1d_2) + k_{n-1}d_2 + \frac{1}{d_5}\ r_{n-1}} MB_{n-1} \tag{44}$$

$$D_{ED}^{P_{US}} + D_{ED}^{P_{n-1}} = \frac{1 + d_5}{(r_{n-1}+k_{n-1})(1+d_1+d_1d_2)+k_{n-1}d_2+\frac{1}{d_5}\ r_{n-1}} MB_{n-1}$$

or

$$D_{ED}^{P_{US}} + D_{ED}^{P_{n-1}} = \frac{1 + d_5}{d_5 [\bar{r}_{US}(d+r^D)+k_{US}(1+d)] + r_{US} [\bar{d}_2+r^D(1+d_1+d_1d_2)]} MB_{US}$$

8. The two money market multipliers

$$M_{US} = \frac{q\ (1+d)}{d_5[r_{US}(d+r^D)+k_{US}(1+d)] + r_{US}[d_2+r^D(1+d_1+d_1d_2)]}\ MB_{n-1} \tag{45}$$

$$M_{n-1} = \frac{(1+d_2)(1+d_1)}{(r_{n-1}+k_{n-1})(1+d_1+d_1d_2) + k_{n-1}d_2 + \frac{1}{d_5}\ r_{n-1}}\ MB_{n-1} \tag{46}$$

9. The three credit market multipliers

a) if MB_{US} is exogenous

$$EA_{US} = \frac{(1-r_{US})[d_5(d+r^D) + d_2 + r^D(1+d_1+d_1d_2)]}{d_5[r_{US}(d+r^D)+k_{US}(1+d)] + r_{US}[d_2+r^D(1+d_1+d_1d_2)]}\ MB_{US}$$

$$EA_{ED} = \frac{d_5(1-r_{n-1}-r^D)(1+d_1+d_1d_2+d_5)}{q(1+c)\left[d_5[k_{n-1}d_2 + (r_{n-1}+k_{n-1})(1+d_1+d_1d_2)] + r_{n-1}\right]}\ MB_{US}$$

$$EA_{n-1} = \frac{cd_5(1-r_{n-1}-r^D)(1+d_1+d_1d_2+d_5)}{q(1+c)\left[d_5[k_{n-1}d_2 + (r_{n-1}+k_{n-1})(1+d_1+d_1d_2)] + r_{n-1}\right]}\ MB_{US}$$

b) if MB_{n-1} is exogenous

$$EA_{US} = \frac{q(1-r_{US})\left[d_5(d+r^D) + d_2 + r^D(1+d_1+d_1d_2)\right]}{d_5\left[r_{US}(d+r^D)+k_{US}(1+d)\right] + r_{US}\left[d_2+r^D(1+d_1+d_1d_2)\right]} MB_{n-1}$$

$$EA_{ED} = \frac{d_5(1-r_{n-1}-r^D)(1+d_1+d_1d_2+d_5)}{(1+c)\left[d_5\left[k_{n-1}d_2 + (r_{n-1}+k_{n-1})(1+d_1+d_1d_2)\right] + r_{n-1}\right]} MB_{n-1}$$

$$EA_{n-1} = \frac{cd_5(1-r_{n-1}-r^D)(1+d_1+d_1d_2+d_5)}{(1+c)\left[d_5\left[k_{n-1}d_2 + (r_{n-1}+k_{n-1})(1+d_1+d_1d_2)\right] + r_{n-1}\right]} MB_{n-1}$$

or

$$EA_{US} = a_{US}\, MB_{n-1} \tag{47}$$

$$EA_{ED} = a_{ED}\, MB_{n-1} \tag{48}$$

$$EA_{n-1} = a_{n-1} MB_{n-1} \tag{49}$$

10. The determination of interest rates in the three markets

$$a_{US}(i_{US}, i_{ED}, i_{n-1}, \ldots)\, MB_{n-1} = s_{US}(i_{US}, i_{ED}, i_{n-1}, \ldots) \tag{50}$$

$$a_{ED}(i_{US},i_{ED},i_{n-1},\ldots)\ MB_{n-1} = s_{ED}(i_{US},i_{ED},i_{n-1},\ldots) \tag{51}$$

$$a_{n-1}(i_{US},i_{ED},i_{n-1},\ldots)MB_{n-1} = s_{n-1}(i_{US},i_{ED},i_{n-1},\ldots) \tag{52}$$

The solution patterns for the three credit market interest rates can now be derived from the three equations above and inserted into the expressions describing $D_{ED}^{P_{US}}$, $D_{ED}^{P_{n-1}}$, M_{n-1}, M_{US}, EA_{US}, EA_{ED}, and EA_{n-1}.

III. The Solution for Equilibrium Values of the Three Credit Market Interest Rates

A. If we assume that the public's supply of earning assets to commercial banks is also linear in the logarithms of the variables we can write the demand and supply functions in the following way:

$$\log EA_{ED}^{P} = E(s_{ED},i_{ED}) \log i_{ED} + E(s_{ED},i_{US}) \log i_{US} + E(s_{ED},i_{n-1}) \log i_{n-1} + \sum_{t=1}^{m} E(s_{ED},V_t) \log V_t \tag{1}$$

$$\log EA_{ED} = \log MB_{n-1} + E(a_{ED}, i_{ED}) \log i_{ED} + E(a_{ED}, i_{US}) \log i_{US}$$

$$E(a_{ED}, i_{n-1}) \log i_{n-1} + \sum_{k=1}^{p} E(a_{ED}, W_k) \log W_k \qquad (2)$$

$$\log EA^{P}_{US} = E(s_{US}, i_{ED}) \log i_{ED} + E(s_{US}, i_{US}) \log i_{US} +$$

$$E(s_{US}, i_{n-1}) \log i_{n-1} + \sum_{i=1}^{n} E(s_{US}, T_i) \log T_i \qquad (3)$$

$$\log EA_{US} = \log MB_{n-1} + E(a_{US}, i_{ED}) \log i_{ED} + E(a_{US}, i_{US}) \log i_{US}$$

$$E(a_{US}, i_{n-1}) \log i_{n-1} + \sum_{l=1}^{o} E(a_{US}, X_l) \log X_l \qquad (4)$$

$$\log EA^{P}_{n-1} = E(s_{n-1}, i_{ED}) \log i_{ED} + E(s_{n-1}, i_{US}) \log i_{US} +$$

$$E(s_{n-1}, i_{n-1}) \log i_{n-1} + \sum_{u=1}^{q} E(s_{n-1}, U_u) \log U_u \qquad (5)$$

$$\log EA_{n-1} = \log MB_{n-1} + E(a_{n-1}, i_{ED}) \log i_{ED} + E(a_{n-1}, i_{US}) \log i_{US}$$

$$+ E(a_{n-1}, i_{n-1}) \log i_{n-1} + \sum_{r=1}^{r} E(a_{n-1}, Z_r) \log Z_r \qquad (6)$$

In the above equations V_t, W_k, T_i, X_l, U_u, and Z_r represent all variables that are exogenous in our model and which we have already discussed.

B. To simplify our further denotation and also our further analysis we define:

1. $E(a_{ED}, i_{ED}) - E(s_{ED}, i_{ED}) = A_{ED}$

$E(s_{ED}, i_{US}) - E(a_{ED}, i_{US}) = A_1$

$E(s_{ED}, i_{n-1}) - E(a_{ED}, i_{n-1}) = A_2$

2. $E(a_{US}, i_{US}) - E(s_{US}, i_{US}) = A_{US}$

$E(s_{US}, i_{ED}) - E(a_{US}, i_{ED}) = A_3$

$E(s_{US}, i_{n-1}) - E(a_{US}, i_{n-1}) = A_4$

3. $E(a_{n-1}, i_{n-1}) - E(s_{n-1}, i_{n-1}) = A_{n-1}$

$E(s_{n-1}, i_{ED}) - E(a_{n-1}, i_{ED}) = A_5$

$E(s_{n-1}, i_{US}) - E(a_{n-1}, i_{US}) = A_6$

C. The solution

1. Out of (1) and (2) follows

$$\log i_{ED} = \frac{1}{A_{ED}} \quad A_1 \log i_{US} + A_2 \log i_{n-1} + \sum_{t=1}^{m} E(s_{ED}, V_t) \log V_t$$

$$- \sum_{k=1}^{p} E(a_{ED}, W_k) \log W_k - \log MB_{n-1} \qquad (7)$$

2. Out of (3) and (4) follows

$$\log i_{US} = \frac{1}{A_{US}} \quad A_3 \log i_{ED} + A_4 \log i_{n-1} + \sum_{i=1}^{n} E(s_{US}, T_i) \log T_i$$

$$- \sum_{l=1}^{o} E(a_{US}, X_l) \log X_l - \log MB_{n-1} \qquad (8)$$

3. Out of (5) and (6) follows

$$\log i_{n-1} = \frac{1}{A_{n-1}} \quad A_5 \log i_{ED} + A_6 \log i_{US} + \sum_{u=1}^{q} E(s_{n-1}, U_u) \log U_u$$

$$- \sum_{r=1}^{s} E(a_{n-1}, Z_r) \log Z_r - MB_{n-1} \qquad (9)$$

4. Out of (7),(8), and (9) we solve for the three equilibrium credit market interest rates whereby

$K = A_1 A_4 A_5 + A_2 A_3 A_6$

$$\log i_{ED} = \frac{1}{A_{ED}\left(1 - \frac{K + A_{n-1} A_1 A_3 + A_{US} A_2 A_5}{A_{US} A_{n-1} - A_4 A_6}\right)} \Bigg[$$

$$-\left(1+\frac{A_{US}A_2 + A_{n-1}A_1 + A_1A_4 + A_2A_6}{A_{US}A_{n-1} - A_4A_6}\right)\log MB_{n-1} + \sum_{t=1}^{m} E(s_{ED},V_t)\log V_t$$

$$-\sum_{k=1}^{p} E(a_{ED},W_k)\log W_k + \frac{A_1A_{n-1} + A_2A_6}{A_{US}A_{n-1} - A_4A_6}\Bigg(\sum_{i=1}^{n} E(s_{US},T_i)\log T_i -$$

$$-\sum_{l=1}^{o} E(a_{US},X_l)\log X_l\Bigg) + \frac{A_1A_4 + A_{US}A_2}{A_{US}A_{n-1} - A_4A_6}\Bigg(\sum_{u=1}^{q} E(s_{n-1},U_u)\log U_u -$$

$$\sum_{r=1}^{s} E(a_{n-1},Z_r)\log Z_r\Bigg)\Bigg] \qquad (10)$$

$$\log i_{US} = \frac{1}{A_{US}\left(1 - \dfrac{K + A_{ED}A_4A_6 + A_{n-1}A_1A_3}{A_{ED}A_{n-1} - A_2A_5}\right)}\Bigg[$$

$$-\left(1+\frac{A_{ED}A_4 + A_{n-1}A_3 + A_2A_3 + A_4A_5}{A_{ED}A_{n-1} - A_2A_5}\right)\log MB_{n-1} + \sum_{i=1}^{n} E(s_{US},T_i)\log T_i$$

$$-\sum_{l=1}^{o} E(a_{US},X_l)\log X_l + \frac{A_{n-1}A_3 + A_4A_5}{A_{ED}A_{n-1} - A_2A_5}\Bigg(\sum_{t=1}^{m} E(s_{ED},V_t)\log V_t$$

$$-\sum_{k=1}^{p} E(a_{ED},W_k)\log W_k\Bigg) + \frac{A_{ED}A_4 + A_2A_3}{A_{ED}A_{n-1} - A_2A_5}\Bigg(\sum_{u=1}^{q} E(s_{n-1},U_u)\log U_u$$

$$-\sum_{r=1}^{s} E(a_{n-1},Z_r)\log Z_r\Bigg)\Bigg] \qquad (11)$$

$$\log i_{n-1} = \frac{1}{A_{n-1}\left(1 - \dfrac{K + A_{US}A_2A_5 + A_{ED}A_4A_6}{A_{ED}A_{US} - A_1A_3}\right)} \Bigg[$$

$$-\left(1 + \frac{A_{US}A_5 + A_{ED}A_6 + A_1A_5 + A_3A_6}{A_{ED}A_{US} - A_1A_3}\right) \log MB_{b-1} +$$

$$\sum_{u=1}^{q} E(s_{n-1},U_u) \log U_u - \sum_{r=1}^{s} E(a_{n-1},Z_r) \log Z_r + \frac{A_{ED}A_6 + A_1A_5}{A_{ED}A_{US} - A_1A_3}$$

$$\left(\sum_{i=1}^{n} E(s_{US},T_i) \log T_i - \sum_{l=1}^{o} E(a_{US},X_l) \log X_l\right) + \frac{A_{US}A_5 + A_3A_6}{A_{ED}A_{US} - A_1A_3}$$

$$\left(\sum_{t=1}^{m} E(s_{ED},V_t) \log V_t - \sum_{l=1}^{m} E(a_{ED},W_k) \log W_k\right) \Bigg] \qquad (12)$$

D. A short outlook for further analysis

If we assume for the moment - what seems very likely - that all As are positive and that $A_{ED} > A_1$, $A_{ED} > A_2$, $A_{ED} > A_3$, $A_{ED} > A_4$, $A_{ED} > A_5$, $A_{ED} > A_6$, $A_{US} > A_1$, $A_{US} > A_2, \ldots$, and $A_{n-1} > A_1, \ldots$, we can make for example the following statements:

1. If $K_{ED} = \dfrac{K + A_{n-1}A_1A_3 + A_{US}A_2A_5}{A_{US}A_{n-1} - A_4A_6}$ and $K_{ED} < 1$ then

an increase in MB_{n-1} will have a negative effect on the ED credit market interest rate. The more K_{ED} approaches 1 and the larger

$$\frac{A_{US}A_2 + A_{n-1}A_1 + A_2A_6 + A_1A_4}{A_{US}A_{n-1} - A_4A_6} = B_{ED}$$

the stronger will be the effect of a change in MB_{n-1} on the ED credit market interest rate.

2. If $K_{ED} > 1$ then an increase in MB_{n-1} will have a positive effect on the ED credit market interst rate. The larger B_{ED} and the more K_{ED} approaches 1 the stronger will be the effect of a change in MB_{n-1} on the ED credit market interest rate.

3. Similar relationships could also be established for i_{US} and i_{n-1}.

4. In a next step we could work out further conditions for different effects of a change in MB_{n-1} on all three credit market interest rates.

5. Further we have ample possibilities to work out the different effects of changes in our exogenous variables on all three credit market interest rates.

6. One could further check what difference it makes in a fixed exchange rate system if not MB_{n-1} is considered as exogenous but MB_{US}.

Footnotes

1) K. Brunner and A.H. Meltzer, Some Further Investigation of Demand and Supply Functions for Money, The Journal of Finance 19, 1964, pp. 240-283. See also K. Brunner and A.H. Meltzer, Liquidity Traps for Money, Bank Credit, and Interest Rates, The Journal of Political Economy 76, 1968, pp. 1-37.

2) Manfred Willms, Controlling Money in an Open Economy: The German Case, Review, Federal Reserve Bank of St.Louis, April 1971.

3) This proposition is very well worked out in: Hans-E. Loef, Ein monetäres Modell zyklischen Wachstumes, Dissertation, forthcoming.

4) For this see: Gerhard Graf, The International Transmission of Business Cycles, Diskussionsbeiträge des Fachbereichs Wirtschaftswissenschaften der Universität Konstanz, Nr. 14, 1972.

Appendix A

The Relationship between the Ratio d_5 and its Determinants

To simplify our further analysis, we first derive the most likely respective signs for all arguments that enter our explanation of d_5, d_5 consisting of a whole set of different components and variables. To accomplish that we have to establish certain order conditions and to interprete them. This is alleviated somewhat by the fact that we have already some a priori knowledge about the probable absolute size of most components. This knowledge could be summarized as follows: $d > 1$, $d_1 > 1$, $d_2 < 1$, $c > 1$, $k_{US} < 1$, $k_{n-1} < 1$, $r^D < 1$, $r_{US} < 1$, $r_{n-1} < 1$, $q < 1$, $k_{US} > r_{US}$, $k_{n-1} > r_{n-1}$, $k_{US} > r_{n-1}$, $k_{n-1} > r_{US}$, $r^D < r_{n-1}$, $r^D < r_{US}$.

For further simplification and to make it easier for the reader to check for himself some of the order conditions, we will first establish the needed order conditions mainly with the implicit help of a numerical example which fulfills all the restrictions above and tells us something about the exact absolute size of the ratios in question. It could be interpreted as a possible set of figures that could have prevailed or could prevail sometimes in the future for a short moment of time. To work out different consequences of the model, we will then vary especially the values of q, r^D, and r_{n-1} and check if such a variation will change the already established order conditions and thus the signs of the derivatives for some of the variables that determine d_5.

The paradigm will be described as follows: $c = 150$, $d_1 = 140$, $d_2 = \frac{3}{10}$, $d = 150$, $k_{US} = \frac{1}{4}$, $k_{n-1} = \frac{1}{3}$, $r^D = \frac{1}{100}$, $r_{n-1} = \frac{1}{12}$, $r_{US} = \frac{1}{10}$, $q = \frac{1}{5}$. In addition to that q, r^D, and r_{n-1} will also assume the following values: $q = 1$, $q = \frac{1}{1000}$, $q = 1000$, $r^D = \frac{1}{12}$, $r_{n-1} = \frac{1}{100}$.

If we now restate the detailed relationship between $D_{ED}^{P_{US}}$ and $D_{ED}^{P_{n-1}}$ as

$$D_{ED}^{P_{US}} = \frac{q\left[(r_{n-1} + k_{n-1})(1 + d_1 + d_1 d_2) + k_{n-1} d_2\right]}{r_{US}(d + r^D) + k_{US}(1 + d) - r_{n-1} g}$$

$$- \frac{r_{US}\left[d_2 + r^D(1 + d_1 + d_1 d_2)\right]}{} D_{ED}^{P_{n-1}}$$

and define the whole numerator as g and the denominator as f, g and f will always represent positive numbers as long as we consider our above formulated paradigm or - other things unchanged - if q assumes the value one or if the values of r^D and r_{n-1} are interchanged.

If, however, the value 1000 is assigned to q, f becomes negative and g remains positive while for $q = \frac{1}{1000}$ g becomes negative and f remains positive. If we now define $g = g_1 - g_2$, where g_1 equals $(r_{n-1} + k_{n-1})(1 + d_1 + d_1 d_2) + k_{n-1} d_2$ q and g_2 equals r_{US} $d_2 + r^D(1 + d_1 + d_1 d_2)$, we can make life still easier by assuming in the following analysis that if $q = 1000$, we can neglect the whole expression g_2 as so small that it is of no importance for our conclusions. Out of the same reason we will also neglect the expression q_1 and the ratio r_{n-1} in the denominator if $q = \frac{1}{1000}$.

1. The Dependence of the Ratio d_5 on the US Credit Market Interest Rate

1.1 The dependence of d_5 on i_{US} if the paradigm holds

a) $$\frac{\delta d_5}{\delta i_{US}} = \frac{f \dfrac{\delta g}{\delta i_{US}} - \dfrac{\delta f}{\delta i_{US}}}{f^{\,2}} \qquad (1)$$

b) $$\frac{\delta g}{\delta i_{US}} = \frac{\delta g_1}{\delta i_{US}} - \frac{\delta g_2}{\delta i_{US}} \qquad (2)$$

c) $$\frac{\delta g_1}{\delta i_{US}} = g \Big[(r_{n-1} + k_{n-1})(1 + d_2) \Big(\overset{+}{\frac{d_1}{i_{US}}} + \overset{-}{\frac{d_1}{i^D_{US}}} \; \overset{+}{\frac{i^D_{US}}{i_{US}}} \Big)$$

$$+ \Big[k_{n-1} + d_1) r_{n-1} + k_{n-1}) \Big] \Big(\overset{-}{\frac{\delta d_2}{\delta i_{US}}} + \overset{+}{\frac{\delta d_2}{\delta i^D_{US}}} \; \overset{+}{\frac{\delta i^D_{US}}{\delta i_{US}}} \Big)$$

$$+ \Big[(r_{n-1} + k_{n-1})(1 + d_1 + d_1 d_2) + k_{n-1} d_1 \Big] \overset{+}{\frac{\delta q}{\delta i^D_{US}}} \; \overset{+}{\frac{\delta i^D_{US}}{\delta i_{US}}}$$

$$\Bigg| \mathcal{E}(d_2, i_{US}) + \frac{d_1 (r_{n-1} + k_{n-1})(1 + d_2)}{d_2 \Big(k_{n-1} + d_1 (r_{n-1} + k_{n-1}) \Big)} \mathcal{E}(d_1, i^D_{US}) \, \mathcal{E}(i^D_{US}, i_{US}) \Bigg|$$

$$< \Bigg| \frac{r_{n-1} + k_{n-1})(1 + d_1 + d_1 d_2) + k_{n-1} d_2}{d_2 \Big(k_{n-1} + d_1 (r_{n-1} + k_{n-1}) \Big)} \mathcal{E}(q, i^D_{US}) \, \mathcal{E}(i^D_{US}, i_{US})$$

$$+ \mathcal{E}(d_2, i^D_{US}) \, \mathcal{E}(i^D_{US}, i_{US}) + \frac{d_1 (r_{n-1} + k_{n-1})(1 + d_2)}{d_2 \Big(k_{n-1} + d_1 (r_{n-1} + k_{n-1}) \Big)} \mathcal{E}(d_1, i_{US}) \Bigg| \qquad (3)$$

This seems to be a quite reasonable assumption, because the expression with which $\mathcal{E}(d_1, i_{US})$ is multiplied is clearly > 1 and it can also be taken for granted that $\mathcal{E}(d_1, i_{US}) > \mathcal{E}(d_2, i_{US})$. This last assumption holds because the asset component $D_{n-1}^{P_{n-1}}$ is much less affected by any change of i_{US} than either $D_{ED}^{P_{n-1}}$ or $D_{US}^{P_{n-1}}$. The effects of a change in i_{US} being negative for all three types of assets and the changes in $D_{US}^{P_{n-1}}$ and $D_{ED}^{P_{n-1}}$ being little offset by a change in $D_{n-1}^{P_{n-1}}$ result in a somewhat higher elasticity between the ratio d_2 and i_{US} than between d_1 and i_{US} where changes in $D_{US}^{P_{n-1}}$ being in the numerator and changes in $D_{ED}^{P_{n-1}}$ being in the denominator of d_2 have a much stronger offsetting effect. Further we know that $\mathcal{E}(d_2, i_{US}^D) > \mathcal{E}(d_1, i_{US}^D)$, because $D_{ED}^{P_{n-1}}$ is the nearest substitute to $D_{US}^{P_{n-1}}$ and i_{US}^D the direct price of $D_{US}^{P_{n-1}}$, while $D_{n-1}^{P_{n-1}}$ represents a substitute that is only little affected by a change in i_{US}^D. The denominator of d_1 further consists of both $D_{US}^{P_{n-1}}$ and its closest substitute $D_{ED}^{P_{n-1}}$, so that we have in addition quite a strong offestting effect that goes along with any change of i_{US}^D. Even though we have to take into consideration that $\mathcal{E}(d_1, i_{US}^D)\ \mathcal{E}(i_{US}^D, i_{US})$ is multiplied by a number > 1 in fact with the same as $\mathcal{E}(d_1, i_{US})$ - this effect will be too small to reverse the above stated order condition, especially if we further consider also $\mathcal{E}(q, i_{US}^D)\ \mathcal{E}(i_{US}^D, i_{US})$ and the expression by which it is multiplied.

d) $$\frac{\delta g_2}{\delta i_{US}} = r_{US}(1 + d_1 r^D)\left(\overset{-}{\frac{\delta d_2}{\delta i_{US}}} + \overset{+}{\frac{\delta d_2}{\delta i_{US}^D}}\ \overset{+}{\frac{\delta i_{US}^D}{\delta i_{US}}}\right) + r_{US} r^D (1 + d_2)$$

$$\left(\overset{+}{\frac{\delta d_1}{\delta i_{US}}} + \overset{-}{\frac{\delta d_1}{\delta i_{US}^D}}\ \overset{+}{\frac{\delta i_{US}^D}{\delta i_{US}}}\right) + \left[d_2 + r^D(1 + d_1 + d_1 d_2)\right] \overset{-}{\frac{\delta r_{US}}{\delta i_{US}}}$$

$$\left| \mathcal{E}(d_2, i_{US}^D)\, \mathcal{E}(i_{US}^D, i_{US}) + \frac{r^D d_1 (1 + d_2)}{d_2 (1 + d_1 r^D)} \mathcal{E}(d_1, i_{US}) \right| <$$

$$\left| \mathcal{E}(d_2, i_{US}) + \frac{d_1 r^D (1 + d_2)}{d_2 (1 + d_1 r^D)} \mathcal{E}(d_1, i_{US}^D)\, \mathcal{E}(i_{US}^D, i_{US}) \right.$$

$$\left. + \frac{d_2 + r^D (1 + d_1 + d_1 d_2)}{d_2 (1 + d_1 r^D)} \mathcal{E}(r_{US}, i_{US}) \right| \qquad (4)$$

This order condition seems to be justified especially on the ground that r_{US} is highly interest elastic and in addition to that multiplied by a number > 1. The high interest sensitivity of US commerical banks with regard to their reserve holdings garanties that the combined expression is certainly larger than $\mathcal{E}(d_2, i_{US}^D)$ which itself is multiplied by a further elasticity, an elasticity that is very likely below 1 or around 1, but hardly ever above 1. Otherwise commercial banks would run the risk in the long run to pay higher interest rates on deposits than they would earn on credits. The high elasticity of d_2 with regard to i_{US}^D as some other elasticities involved we have already discussed in the last paragraph. What we still need is a relationship between $\mathcal{E}(d_2, i_{US})$ and $\mathcal{E}(d_1, i_{US}^D)$. It is quite probable that $\mathcal{E}(d_1, i_{US}^D) > \mathcal{E}(d_1, i_{US})$, because the effects of a change in i_{US} are negative for all three types of assets and relatively small, while a change in i_{US}^D affects negatively only $D_{n-1}^{P_{n-1}}$ in the numerator and $D_{ED}^{P_{n-1}}$ in the denominator and positively $D_{US}^{P_{n-1}}$, also a component of the denominator. The increase of $D_{US}^{P_{n-1}}$ is only partly offset by a decrease in

$D_{ED}^{P_{n-1}}$, the closest substitute of $D_{US}^{P_{n-1}}$. But even if $\mathcal{E}(d_1, i_{US}^D)\ \mathcal{E}(i_{US}^D, i_{US}) < \mathcal{E}(d_1, i_{US})$ this effect will not be strong enough to offset in addition $\mathcal{E}(d_2, i_{US})$ plus the positive difference we discussed already in the beginning.

e) Out of (2), (3), and (4) thus follows without any further order condition - a fact that substantiates our considerations so far - that $\frac{\delta g}{\delta i_{US}}$ is positive. (5)

$$\text{f)}\quad \frac{\delta f}{\delta i_{US}} = (d + r^D)\ \overset{-}{\frac{\delta r_{US}}{\delta i_{US}}} + (r_{US} + k_{US}) \left(\overset{-}{\frac{\delta d}{\delta i_{US}}} + \overset{-}{\frac{\delta d}{\delta i_{US}^D}}\ \overset{+}{\frac{\delta i_{US}^D}{\delta i_{IS}}} \right)$$

$$- r_{n-1} \left(\overset{+}{\frac{q}{i_{US}^D}}\ \overset{+}{\frac{i_{US}^D}{i_{US}}} \right) \qquad (6)$$

g) Out of (1), (5), (6), and our knowledge that g and f are positive follows without any further order condition, a fact that substantiates our considerations still further, that $\frac{\delta d_5}{\delta i_{US}}$ is positive.

1.2 The dependence of d_5 on i_{US} if q varies

If q = 1 or q = 1000, the dependence remains the same as the one stated in our paradigm, though for q = 1000 we need the further order condition: $\left| f\frac{\delta g_1}{\delta i_{US}} \right| < \left| g_1 \frac{f}{i_{US}} \right|$

If $q = \frac{1}{1000}$, however, this dependence changes and becomes negative, because

$\frac{\delta d_5}{\delta i_{US}} = \frac{f \frac{\delta g_2}{\delta i_{US}} + g_2 \frac{\delta f}{\delta i_{US}}}{f^2}$ and δg_2, and δf represent negative figures, while g_2 and f are positive.

1.3 The dependence of d_5 in i_{US} if $r^D = \frac{1}{12}$ and $r_{n-1} = \frac{1}{100}$

This interchange will not alter the already stated dependence. This change will only become important of q becomes smaller. It will then enforce an earlier switch in the dependence.

2. The Dependence of the Ratio d_5 on the ED Credit Market Interest Rate

2.1 The Dependence of d_5 on i_{ED} if the paradigm holds

a) $$\frac{\delta d_5}{\delta i_{ED}} = \frac{f \frac{\delta g}{\delta i_{ED}} - g \frac{\delta f}{\delta i_{ED}}}{[f]^2} \qquad (1)$$

b) $$\frac{\delta g}{\delta i_{ED}} = \frac{\delta g_1}{\delta i_{ED}} - \frac{\delta g_2}{\delta i_{ED}} \qquad (2)$$

c) $$\frac{\delta g_1}{\delta i_{ED}} = q \Big[(r_{n-1} + k_{n-1})(1 + d_2) \left(\overset{+}{\frac{\delta d_1}{\delta i_{ED}}} + \overset{-}{\frac{\delta d_1}{\delta i^E_{ED}}} \overset{+}{\frac{\delta i^D_{ED}}{\delta i_{US}}} \right)$$

$$+ \left[k_{n-1} + d_1 (r_{n-1} + k_{n-1}) \right] \left(\overset{+}{\frac{\delta d_2}{\delta i_{ED}}} + \overset{-}{\frac{\delta d_2}{\delta i^D_{ED}}} \overset{+}{\frac{\delta i^D_{ED}}{\delta i_{US}}} \right)$$

$$+ (1 + d_1 + d_1 d_2) \overset{-}{\frac{\delta r_{n-1}}{\delta i_{ED}}} + \Big[(r_{n-1} + k_{n-1})(1 + d_1 + d_1 d_2)$$

$$+ k_{n-1} d_2 \Big] \left(\overset{+}{\frac{\delta q}{\delta i^D_{ED}}} \overset{+}{\frac{\delta i^D_{ED}}{\delta i_{ED}}} \right)$$

$$\left| \mathcal{E}(r_{n-1}, i_{ED}) + \frac{d_1(r_{n-1} + k_{n-1})(1 + d_2)}{r_{n-1}(1 + d_1 + d_1 d_2)} \mathcal{E}(d_1, i^D_{ED}) \mathcal{E}(i^D_{ED}, i_{ED}) \right.$$

$$\left. + \frac{d_2 \left[k_{n-1} + d_1(r_{n-1} + k_{n-1})\right]}{r_{n-1}(1 + d_1 + d_1 d_2)} \mathcal{E}(d_2, i^D_{ED}) \mathcal{E}(i^D_{ED}, i_{ED}) \right| \gtreqless$$

$$\left| \frac{r_{n-1} + k_{n-1})(1 + d_1 + d_1 d_2) + k_{n-1} d_2}{r_{n-1}(1 + d_1 + d_1 d_2)} \mathcal{E}(q, i^D_{ED}) \mathcal{E}(i^D_{ED}, i_{ED}) \right.$$

$$+ \frac{d_1(r_{n-1} + k_{n-1})(1 + d_2)}{r_{n-1}(1 + d_1 + d_1 d_2)} \mathcal{E}(d_1, i_{ED})$$

$$\left. + \frac{d_2 \left[k_{n-1} + d_1(r_{n-1} + k_{n-1})\right]}{r_{n-1}(1 + d_1 + d_1 d_2)} \mathcal{E}(d_2, i_{ED}) \right| \qquad (3)$$

It seems to be quite reasonalbe not to establish a certain order condition in this case. We know for one that d_2 is much more elastic with respect to i^D_{ED} then with i_{ED}, because d_2 is a ratio between an asset and its closest substitute and i^D_{ED} is the direct price of that asset. Further it is quite certain that $\mathcal{E}(i^D_{ED}, i_{ED})$ is around or a little bit smaller then one, because ED banks operate with small interest rate differences. $\mathcal{E}(d_2, i^D_{ED}) \mathcal{E}(i^D_{ED}, i_{ED})$ is thus clearly $>$ than $\mathcal{E}(d_2, i_{ED})$. Also should $\mathcal{E}(d_1, i^D_{ED}) \mathcal{E}(i^D_{ED}, i_{ED})$ be not much different in absolute size from $\mathcal{E}(d_1, i_{ED})$, because it seems quite likely that $\mathcal{E}(d_1, i^D_{ED}) > \mathcal{E}(d_1, i_{ED})$. Taken altogether so far a negative derivate seems to be well established, especially since its quite probable that further holds $\mathcal{E}(r_{n-1}, i_{ED}) > \mathcal{E}(d_1, i_{ED})$. But we have not considered yet the additional weight $\mathcal{E}(q, i^D_{ED}) \mathcal{E}(i^D_{ED}, i_{ED})$ and the expression it is multiplied by put on the right hand side. The question is if because of the possibly low elasticity of q with respect to i^D_{ED} the additional weight is heavy enough to turn the dependence around if multiplied by an expression >1. We don't know and will therefore allow for both possibilities.

d. $$\frac{\partial g_2}{\partial i_{ED}} = r_{US}(1+r^D d_1)\left[\frac{\partial \overset{+}{d_2}}{\partial i_{ED}} + \frac{\partial \overset{-}{d_2}}{\partial i^D_{ED}}\;\frac{\partial \overset{+}{i^D_{ED}}}{\partial i_{ED}}\right] + r_{US}r^D(1+d_2)$$

$$\left[\frac{\partial \overset{+}{d_1}}{\partial i_{ED}} + \frac{\partial \overset{-}{d_1}}{\partial i^D_{ED}}\;\frac{\partial \overset{+}{i^D_{ED}}}{\partial i_{ED}}\right] + (1+d_1+d_1d_2)r_{US}\;\frac{\partial \overset{-}{r^D}}{\partial i_{ED}}$$

$$\left| E(r^D,i_{ED}) + \frac{d_2(1+d_1r^D)}{r^D(1+d_1+d_1d_2}\,E(d_2,i^D_{ED})E(i^D_{ED},i_{ED}) + \frac{d_1(1+d_2)}{1+d_1+d_1d_2}\,E(d_1,i^D_{ED})E(i^D_{ED},i_{ED})\right| >$$

$$\left|\frac{d_2(1+d_1r^D)}{r^D(1+d_1+d_1d_2)}\,E(d_2,i_{ED}) + \frac{d_1(1+d_2)}{1+d_1+d_1d_2}\,E(d_1,i_{ED})\right| \qquad (4)$$

For all arguments that determine this order condition almost the same reasoning applies as above. In addition one argument is missing and we can further assume that r^D is highly elastic with respect to i_{ED}, more than r_{n-1}, so that this order condition seems to be well established.

e. Out of (2),(3),(4), and the following order condition it can be established that $\frac{\partial g}{\partial i_{ED}}$ is undetermined.

$$\Bigg| \frac{(r_{n-1}+k_{n-1})(1+d_1+d_1d_2)+k_{n-1}d_2}{r_{n-1}(1+d_1+d_1d_2)} E(q,i^D_{ED})E(i^D_{ED},i_{ED}) +$$

$$\frac{d_1(r_{n-1}+k_{n-1})(1+d_2)}{r_{n-1}(1+d_1+d_1d_2)} E(d_1,i_{ED}) + \frac{d_2\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]}{r_{n-1}(1+d_1+d_1d_2)} E(d_2,i_{ED}) +$$

$$\frac{r_{US}d_2(1+d_1r^D)}{qr_{n-1}(1+d_1+d_1d_2)} E(d_2,i^D_{ED})E(i^D_{ED},i_{ED}) + \frac{r_{US}r^D}{qr_{n-1}} E(r^D,i_{ED}) +$$

$$\frac{r_{US}r^Dd_1(1+d_2)}{qr_{n-1}(1+d_1+d_1d_2)} E(d_1,i^D_{ED})E(i^D_{ED},i_{ED}) \Bigg| \quad \gtrless$$

$$\Bigg| E(r_{n-1},i_{ED}) + \frac{d_1(r_{n-1}+k_{n-1})(1+d_2)}{r_{n-1}(1+d_1+d_1d_2)} E(d_1,i^D_{ED})E(i^D_{ED},i_{ED}) +$$

$$\frac{d_2\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]}{r_{n-1}(1+d_1+d_1d_2)} E(d_2,i^D_{ED})E(i^D_{ED},i_{ED}) + \frac{r_{US}(d_2+d_1d_2r^D)}{qr_{n-1}(1+d_1+d_1d_2)}$$

$$E(d_2,i_{ED}) + \frac{r_{US}r^Dd_1(1+d_2)}{qr_{n-1}(1+d_1+d_1d_2)} E(d_1,i_{ED}) \Bigg|$$

It seems to very questionable to establish a certain order condition in the above case, though most arguments that were established in 2e still hold. But it is quite difficult to say how much weight should be put on the additional expression on the left hand side which includes $E(q,i_{ED}^{D})E(i_{ED}^{D},i_{ED})$.

f. $$\frac{\partial f}{\partial i_{ED}} = (r_{US}+k_{US})\left(\overset{+}{\frac{\partial d}{\partial i_{ED}}} + \overset{-}{\frac{\partial d}{\partial i_{ED}^{D}}}\,\overset{+}{\frac{\partial i_{ED}^{D}}{\partial i_{ED}}}\right) + r_{US}\,\overset{-}{\frac{\partial r^{D}}{\partial i_{ED}}}$$

$$-\left(q\,\overset{-}{\frac{\partial r_{n-1}}{\partial i_{ED}}} + r_{n-1}\,\overset{+}{\frac{\partial q}{\partial i_{ED}^{D}}}\,\overset{+}{\frac{\partial i_{ED}^{D}}{\partial i_{ED}}}\right)$$

$$\left| E(r^{D},i_{ED}) + \frac{d(r_{US}+k_{US})}{r_{US}f^{D}}E(d,i_{ED}^{D})E(i_{ED}^{D},i_{ED}) + \frac{qr_{n-1}}{r_{US}r^{D}}E(q,i_{ED}^{D})E(i_{ED}^{D},i_{ED})\right| >$$

$$\left| \frac{d(r_{US}+k_{US})}{r_{US}r^{D}}E(d,i_{ED}^{D})E(i_{ED}^{D},i_{ED}) + \frac{qr_{n-1}}{r_{US}r^{D}}E(r_{n-1},i_{ED})\right|$$

The above established relationship seems to be quite reasonable, because we know that $E(d, i^D_{ED})$ represents a much higher elasticity than $E(d, i_{ED})$ and that $E(r^D, i_{ED}) > E(r_{n-1}, i_{ED})$. Even though $E(r_{n-1}, i_{ED})$ is multiplied with a number > 1, this effect is certainly offset by the remaining argument on the left hand side of the order condition and by the figure that results if the very large figure $\frac{d(r_{US}+k_{US})}{r_{US}r^D}$ is multiplied with the difference between $E(d, i^D_{ED})E(i^D_{ED}, i_{ED})$ and $E(d, i_{ED})$.

g. Out of (1),(5),(6), and a further order condition we do not want to state anymore but which could easily be constructed out of e and f follows that $\frac{\partial d_5}{\partial i_{ED}}$ is most likely positive. To arrive at this solution we would have to make quite rigorous assumptions that are not very well backed and seem highly speculative. Therefore it might be quite advisable to work in the following with both possibilities.

2.2 The dependence of d_5 on i_{ED} if q varies

If $q = 1$ the dependence remains undetermined while for $q = 1000$ the derivative becomes very likely positive and for $q = \frac{1}{1000}$ negative.

2.3 The dependence of d_5 on i_{ED} if $r^D = \frac{1}{12}$ and $r_{n-1} = \frac{1}{100}$

This interchange effects especially $\frac{\partial g}{\partial i_{ED}}$. It turns positive and thus $\frac{\partial d_5}{\partial i_{ED}}$ becomes clearly positive.

3. The Dependence of the Ratio d_5 on the n-1 Credit Market Interest Rate

3.1 The dependence of d_5 on i_{n-1} if the paradigm holds

a. $$\frac{\partial d_5}{\partial i_{n-1}} = \frac{f \frac{\partial g}{\partial i_{n-1}} - g \frac{\partial f}{\partial i_{n-1}}}{f^2} \qquad (1)$$

b. $$\frac{\partial g}{\partial i_{n-1}} = \frac{\partial g_1}{\partial i_{n-1}} - \frac{\partial g_2}{\partial i_{n-1}} \qquad (2)$$

c. $$\frac{\partial g_1}{\partial i_{n-1}} = \Big((r_{n-1}+k_{n-1})(1+d_1+d_1 d_1)+k_{n-1}d_2\Big)\left(\overset{-}{\frac{\partial q}{\partial i^D_{n-1}}}\ \overset{+}{\frac{\partial i^D_{n-1}}{\partial i_{n-1}}}\right)$$

$$+ q \Bigg[(r_{n-1}+k_{n-1})(1+d_2) \ \overset{-}{\frac{\partial d_1}{\partial i_{n-1}}} + \overset{+}{\frac{\partial d_1}{\partial i^D_{n-1}}}\ \overset{+}{\frac{\partial i^D_{n-1}}{\partial i_{n-1}}} +$$

$$\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]\left[\frac{\overset{+}{d_2}}{i_{n-1}}+\frac{\overset{+}{d_2}}{i^D_{n-1}}\,\frac{\overset{+}{i^D_{n-1}}}{i_{n-1}}\right]+(1+d_1+d_1d_2)\frac{\overset{-}{r_{n-1}}}{i_{n-1}}$$

$$\Bigg| E(d_2,i_{n-1}) + \frac{d_1(r_{n-1}+k_{n-1})(1+d_2)}{d_2\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]}E(d_1,i^D_{n-1})E(i^D_{n-1},i_{n-1}) +$$

$$E(d_2,i^D_{n-1})E(i^D_{n-1},i_{n-1})\Bigg| \quad < $$

$$\Bigg| \frac{(r_{n-1}+k_{n-1})(1+d_1+d_1d_2)+k_{n-1}d_2}{d_2\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]}E(q,i^D_{n-1})E(i^D_{n-1},i_{n-1}) +$$

$$\frac{r_{n-1}(1+d_1+d_1d_2)}{d_2\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]}E(r_{n-1},i_{n-1}) + \frac{d_1(r_{n-1}+k_{n-1})(1+d_2)}{d_2\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]}$$

$$E(d_1,i_{n-1})\Bigg| \qquad (3)$$

It seems to be quite resonable to establish the order condition above. We know that $E(d_1,i^D_{n-1})$ is substantially more elastic than $E(d_1,i_{n-1})$ and that $E(i^D_{n-1},i_{n-1})$ could at best be one, though because of Gentleman's Agreement among commercial banks dealing in this market and Government regulations it is very likely quite a bit below one. But altogether it seems still possible that $E(d_1, i^D_{n-1})E(i^D_{n-1}, i_{n-1}) > E(d_1, i_{n-1})$. The question now is if this difference can be made up together with the presumably quite low interest elasticities of d_2 with respect to i_{n-1} and i^D_{n-1} multiplied with $E(i^D_{n-1}, i_{n-1})$ by the high interest elasticity of r_{n-1} multiplied with a number above one and by the remaining expression on the right hand side. This is quite probably the case.

d. $$\frac{\partial g_2}{\partial i_{n-1}} = r_{US} \quad (1+d_1 r^D)\left(\frac{\partial d_2}{\partial i_{n-1}} + \frac{\partial d_2}{\partial i^D_{n-1}} \frac{\partial i^D_{n-1}}{\partial i_{n-1}}\right) + r^D(1+d_2)$$

$$\left(\frac{\partial d_1}{\partial i_{n-1}} + \frac{\partial d_1}{\partial i^D_{n-1}} \frac{\partial i^D_{n-1}}{\partial i_{n-1}}\right) + (1+d_1+d_1 d_2) \frac{\partial r^D}{\partial i_{n-1}}$$

$$\left| E(d_2, i_{n-1}) + E(d_2, i^D_{n-1})(i^D_{n-1}, i_{n-1}) + \frac{d_1 r^D(1+d_2)}{d_2(1+d_1 r^D} E(d_1, i_{n-1}) E(i_{n-1}, i_{n-1}) \right|$$

$$< \left| \frac{r^D(1+d_1+d_1 d_2)}{d_2(1+r^D d_1)} E(r^D, i_{n-1}) + \frac{d_1 r^D(1+d_2)}{d_2(1+r^D d_1)} E(d_1, i_{n-1}) \right| \qquad (4)$$

This assumption is difficult to justify. Again $E(d_1, i^D_{n-1})$

$E(i^D_{n-1}, i_{n-1})$ is assumed to be larger than $E(d_1, i_{n-1})$. In addition $E(r^D, i_{n-1}) < E(r_{n-1}, i_{n-1})$, because it is quite plausible that commercial banks will first rely on their reserves denominated in home currency when the interest rate in the home currency market raises and only to a smaller extent on their reserves denominated in foreign currency. r^D, however, is certainly more elastic with respect to i_{n-1} than either d_2 with respect to i_{n-1} or d_2 with respect to i^D_{n-1}. These elasticities are probably quite small, because of the offsetting effects involved, so that out of these reasons the above stated order condition seems to be justified, at least to a certain degree.

e. Out of (2),(3),(4), and a further order condition follows that $\frac{\partial g}{\partial i_{n-1}}$ is most likely negative.

$$E(d_2, i_{n-1}) + E(d_2, i^D_{n-1})E(i^D_{n-1}, i_{n-1}) + \frac{d_1(r_{n-1}+k_{n-1})(1+d_2)}{d_2 \quad k_{n-1}+d_1(r_{n-1}+k_{n-1})}$$

$$E(r_{n-1}, i_{n-1}) + \frac{r_{US} r^D(1+d_1+d_1 d_2)}{d_2 q \quad k_{n-1}+d_1(r_{n-1}+k_{n-1})} E(r^D, i_{n-1}) +$$

$$\frac{r_{US}r^{D}d_1(1+d_2)}{d_2 q\left|k_{n-1}+d_1(r_{n-1}+k_{n-1})\right|}\,E(d_1,i_{n-1})\Bigg| \quad <$$

$$\Bigg|\frac{d_1(r_{n-1}+k_{n-1})(1+d_2)}{d_2\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]}\,E(d_1,i_{n-1}) + \frac{r_{n-1}(1+d_1+d_1d_2)}{d_2\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]}\,E(r_{n-1},i_{n-1})$$

$$\frac{r_{US}(1+d_1r^{D})}{q\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]}\,E(d_2,i_{n-1}) + \frac{r_{US}(1+d_1r^{D})}{q\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]}$$

$$E(d_2,i^{D}_{n-1})E(i^{D}_{n-1},i_{n-1}) + \frac{d_1r^{D}r_{US}(1+d_2)}{qd_2\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]}\,E(d_1,i^{D}_{n-1})$$

$$E(i^{D}_{n-1},i_{n-1}) + \frac{(r_{n-1}+k_{n-1})(1+d_1+d_1d_2)+k_{n-1}d_2}{d_2\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]}\,E(q,i^{D}_{n-1})E(i^{D}_{n-1},i_{n-1})\Bigg| \qquad (5)$$

The main argument for this order condition is that $E(r_{n-1},i_{n-1}) > E(r^{D},i_{n-1})$ and $E(r_{n-1},i_{n-1})$ is multiplied with a number quite larger than the one with which $E(r^{D},i_{n-1})$ is multiplied. It is further assumed that all other expressions - one more on the right hand side - wash each other out to a high extent, so that the possibly resulting difference in favor of the left hand side could easily be made up by the difference between the two expressions involving r^D and r_{n-1}.

$$\text{f.}\quad \frac{f}{i_{n-1}} = r_{US}\frac{\partial \overset{-}{r}^D}{\partial i_{n-1}} - q\frac{\partial \overset{-}{r}_{n-1}}{\partial i_{n-1}} - r_{n-1}\left(\frac{\partial \overset{-}{q}}{\partial i^D_{n-1}}\frac{\partial \overset{+}{i}{}^D_{n-1}}{\partial i_{n-1}}\right)$$

$$\left|E(r^D,i_{n-1})\right| < \left|\frac{r_{n-1}q}{r^D r_{US}}\left(E(r_{n-1},i_{n-1}) + E(q,i^D_{n-1})E(i^D_{n-1},i_{n-1})\right)\right| \tag{6}$$

This assumption that the derivative of $\frac{\partial f}{\partial i_{n-1}}$ is positive is well justified, because $E(r_{n-1},i_{n-1}) > E(r^D,i_{n-1})$ and $E(r_{n-1},i_{n-1})$ is in addition multiplied by an expression > 1.

g. Out of (1),(5),and (6) follows without any further order condition - a fact that substantiates our conclusion so far - that $\frac{\partial d_5}{\partial i_{n-1}}$ is most likely negative.

3.2 The dependence of d_5 on i_{n-1} if q varies

If $q = 1$ or $q = \frac{1}{1000}$ the dependence remains unchanged, while for $q = 1000$ it becomes most likely positive.

We already established that $E(d_2, i_{US}^D) > E(d_1, i_{US}^D)$. Even though $E(d_1, i_{US}^D)$ is multiplied by an expression > 1, this will not change the order condition, because $E(q, i_{US}^D)$ multiplied by an expression > 1 gives additional weight to the left hand side.

$$\text{d)}\ \frac{\partial g_2}{\partial i_{US}^D} = r_{US}(1+r^D d_1)\ \overset{+}{\frac{\partial d_2}{\partial i_{US}^D}} + r_{US} r^D (1+d_2)\ \overset{-}{\frac{\partial d_1}{\partial i_{US}^D}}$$

$$\left| E(d_2, i_{US}^D) \right| \gtrless \left| \frac{r^D d_1(1+d_2)}{d_2(1+d_1 r^D)} E(d_1, i_{US}^D) \right| \qquad (4)$$

Though $E(d_2, i_{US}^D) > E(d_1, i_{US}^D)$ it is hard to tell which of the two expressions is larger, because $E(d_1, i_{US}^D)$ is multiplied by an expression > 1.

e) Out of (2),(3),(4), and the following order condition follows that $\frac{\partial g}{\partial i_{US}^D}$ is quite likely positive.

$$\left| E(d_2, i_{US}^D) + \frac{(r_{n-1}+k_{n-1})(1+d_1+d_1 d_2)+k_{n-1} d_2}{d_2\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]} E(q, i_{US}^D) + \frac{d_1 r^D r_{US}(1+d_2)}{q d_2\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]} E(d_1, i_{US}^D) \right| >$$

$$\frac{r_{US}(1+d_1 r^D)}{q\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]}\, E(d_2,i^D_{US}) + \frac{d_1(1+d_2)(k_{n-1}+r_{n-1})}{d_2\left[k_{n-1}+d_1(k_{n-1}+r_{n-1})\right]}$$

$$E(d_1,i^D_{US})\Bigg| \qquad (5)$$

It is difficult to establish a certain order dondition in the above case, because $E(d_2,i^D_{US})$ on the right hand side is multiplied by a number > 1 and $E(d_1,i^D_{US})$ on the right hand side is multiplied by an expression larger than the one by which $E(d_1,i^D_{US})$ on the left hand side is multiplied. But the additional weight $E(q,i^D_{US})$ multiplied with an expression > 1 seems to give good reason to establish the order condition the way we did.

f) $$\frac{\partial f}{\partial i^D_{US}} = (r_{US}+k_{n-1})\,\frac{\partial \overset{+}{d}}{\partial i^D_{US}} - r_{n-1}\,\frac{\partial \overset{+}{q}}{\partial i^D_{US}}$$

$$\left|\frac{(r_{US}+k_{n-1})d}{q\, r_{n-1}}\, E(d,i^D_{US})\right| > \left|E(q,i^D_{US})\right| \qquad (6)$$

This order condition is well established, because $E(d,i^D_{US})$ $> E(q,i^D_{US})$ and $E(d,i^D_{US})$ is multiplied by an expression > 1.

g) Out of (1),(5),(6), and a further order condition we do not want to state anymore follows that $\frac{\partial d_5}{\partial i^D_{US}}$

is most likely negative. But to arrive at this conclusion we would have to make quite rigorous assumptions. Out of this reason we will allow in the following for both possibilities.

4.2 The dependence of d_5 on i_{US}^{D} if q varies

If q = 1 the dependence remains undetermined, while for $q = \frac{1}{1000}$ it becomes most likely positive and for q = 1000 negative.

4.3 The dependence of d_5 on i_{US}^{D} if $r^D = \frac{1}{12}$ and $r_{n-1} = \frac{1}{100}$

This interchange will leave the dependence undetermined.

5. The Dependence of the Ratio d_5 on Eurodollar Deposit Rate

5.1 The dependence of d_5 on i_{ED}^{D} if the paradigm holds

$$\text{a)} \quad \frac{\partial d_5}{\partial i_{ED}^{D}} = \frac{\dfrac{\partial g}{\partial i_{ED}^{D}} - \dfrac{\partial f}{\partial i_{ED}^{D}}}{f^2} \qquad (1)$$

$$\text{b)} \quad \frac{\partial g}{\partial i_{ED}^{D}} = \frac{\partial g_1}{\partial i_{ED}^{D}} - \frac{\partial g_2}{\partial i_{ED}^{D}} \qquad (2)$$

$$c)\ \frac{\partial g_1}{\partial i^D_{ED}} = q\left[(r_{n-1}+k_{n-1})(1+d_2)\,\frac{\overset{-}{\partial d_1}}{\partial i^D_{ED}} + \left[(r_{n-1}+k_{n-1})d_1+k_{n-1}\right]\frac{\overset{-}{\partial d_2}}{\partial i^D_{ED}}\right]$$

$$+\left[(r_{n-1}+k_{n-1})(1+d_1+d_1d_2)+k_{n-1}d_2\right]\frac{\overset{-}{\partial q}}{\partial i^D_{ED}}$$

$$\left|\frac{d_1(r_{n-1}+k_{n-1})(1+d_2)}{d_2\quad k_{n-1}+(r_{n-1}+k_{n-1})}\,E(d_1,i^D_{ED}) + E(d_2,i^D_{ED})\right| > \left|\frac{(r_{n-1}+k_{n-1})(1+d_1+d_1d_2)+k_{n-1}d_2}{d_2\quad (r_{n-1}+k_{n-1})d_1+k_{n-1}}\,E(q,i^D_{ED})\right| \qquad (3)$$

This assumption seems to be well justified, because $E(q,i^D_{ED})$ is already smaller than $E(d_1,i^D_{ED})$.

$$d)\ \frac{\partial g_2}{\partial i^D_{ED}} = r_{US}\left[(1+d_1r^D)\,\frac{\overset{-}{\partial d_2}}{\partial i^D_{ED}} + r^D(1+d_2)\,\frac{\overset{-}{\partial d_1}}{\partial i^D_{ED}}\right] \qquad (4)$$

e) Out of (2),(3),(4), and a further order condition we do not want to state anymore follows that $\dfrac{\partial g}{\partial i^D_{ED}}$ is undetermined. (5)

$$f)\ \frac{\partial f}{\partial i^D_{ED}} = (r_{US}+k_{US})\,\frac{\overset{-}{\partial d}}{\partial i^D_{ED}} - r_{n-1}\,\frac{\overset{+}{\partial q}}{\partial i^D_{ED}} \qquad (6)$$

g) Out of (1),(5),(6), and a further order condition we also do not want to state here anymore follows that $\frac{\partial d_5}{\partial i^D_{ED}}$ is most likely positive.

5.2 The dependence of d_5 on i^D_{ED} if q varies

if q = 1 or q = 1000 the dependence remains the same while for $q = \frac{1}{1000}$ it becomes negative.

5.3 The dependence of d_5 on i^D_{ED} if $r^D = \frac{1}{12}$ and $r_{n-1} = \frac{1}{100}$

This interchange will leave the dependence positive.

6. The Dependence of the Ratio d_5 on the n-1 Deposit Rate

6.1 The dependence of d_5 on i^D_{n-1} if the paradigm holds

a) $$\frac{\partial d_5}{\partial i^D_{n-1}} = \frac{f \frac{\partial g}{\partial i^D_{n-1}} - \frac{\partial f}{\partial i^D_{n-1}} g}{f^2} \qquad (1)$$

b) $$\frac{\partial g}{\partial i^D_{n-1}} = \frac{\partial g_1}{\partial i^D_{n-1}} - \frac{\partial g_2}{\partial i^D_{n-1}} \qquad (2)$$

c) $$\frac{\partial g_1}{\partial i^D_{n-1}} = q\left[(r_{n-1}+k_{n-1})(1+d_2)\frac{\partial \overset{+}{d_1}}{\partial i^D_{n-1}} + \left((r_{n-1}+k_{n-1})d_2+k_{n-1}\right)\frac{\partial \overset{+}{d_2}}{\partial i^D_{n-1}}\right]$$

$$+\left((r_{n-1}+k_{n-1})(1+d_1+d_1d_2)+k_{n-1}d_2\right)\frac{\partial \bar{q}}{\partial i^D_{n-1}}$$

$$\left|\frac{d_1(r_{n-1}+k_{n-1})(1+d_2)}{d_2\left[k_{n-1}+(r_{n-1}+k_{n-1})d_1\right]}E(d_1,i^D_{n-1}) + E(d_2,i^D_{n-1})\right| >$$

$$\left|\frac{(r_{n-1}+k_{n-1})(1+d_1+d_1d_2)+k_{n-1}d_2}{d_2\left[k_{n-1}+(r_{n-1}+k_{n-1})d_1\right]}E(q,i^D_{n-1})\right| \qquad (3)$$

This order condition seems to be well justified because $E(q,i^D_{n-1})$ multiplied by a number > 1 is certainly smaller than $E(d_1,i^D_{n-1})$ multiplied by a number > 1.

d) $$\frac{\partial g_2}{\partial i^D_{n-1}} = r_{US}(1+r^D d_1)\frac{\partial \overset{+}{d_2}}{\partial i^D_{n-1}} + r_{US}(1+d_2)\frac{\partial \overset{+}{d_1}}{\partial i^D_{n-1}} \qquad (4)$$

e) Out of (2),(3),(4), and a further order condition we do not want to state anymore it follows that $\frac{\partial g}{\partial i^D_{n-1}}$ is undetermined. (5)

f) $$\frac{\partial f}{\partial i^D_{n-1}} = - r_{n-1}\frac{\partial \bar{q}}{\partial i^D_{n-1}} \qquad (6)$$

g) Out of (1),(5),(6), and a further order condition we do not want to state anymore it follows that $\frac{\partial d_5}{\partial i^D_{n-1}}$ is most likely negative. This particular relationship depends very much on the size of $E(q,i^D_{n-1})$. Because this elasticity could be quite small we will allow also for a positive dependence in our further analysis.

6.2 The dependence of d_5 on i^D_{n-1} if q varies

If $q = 1$ or $q = \frac{1}{1000}$ the dependence remains unchanged while for $q = 1000$ the relationship becomes negative.

6.3 The dependence of d_5 on $r^D = \frac{1}{12}$ and $r_{n-1} = \frac{1}{100}$

If r^D and r_{n-1} are interchanged the dependence remains unchanged.

7. The Dependence of the Ratio d_5 on the n-1 Currency Ratio

7.1 The dependence of d_5 on k_{n-1} if the paradigm holds

$$\frac{\partial d_5}{\partial k_{n-1}} = \frac{\left((1+d_1+d_1d_2) + d_2\right) q}{r_{US}(d+r^D)+k_{US}(1+d) - qr_{n-1}}$$

This expression represents a positive figure and thus the derivative is positive as expected.

7.2 The dependence of d_5 on k_{n-1} if q varies

If $q = 1$ or $q = \frac{1}{1000}$ the relationship remains unchanged while with $q = 1000$ the expression becomes negative.

8. The Dependence of the Ratio d_5 on the US Currency Ratio

8.1 The dependence of d_5 on k_{US} if the paradigm holds

$$\frac{\partial d_5}{\partial k_{US}} = \frac{-\left[\left[q\left[(r_{n-1}+k_{n-1})(1+d_1+d_1 d_2)+k_{n-1}d_2\right] - r_{US}(d_2+(1+d_1+d_1 d_2)r^D\right](1+d)\right]}{f^2}$$

This expression represents a negative figure and thus the derivative is negative as expected.

8.2 The dependence of d_5 on k_{US} if q varies

A variation of q will not change the dependence between d_5 and k_{US}

9. The Dependence of the Ratio d_5 on $\frac{Y^{P_{US}}}{Y_P^{P_{US}}}$ and $W^{P_{US}}$

9.1 The dependence of d_5 if the paradigm holds

a) $$\frac{\partial d_5}{\partial \frac{Y^{P_{US}}}{Y_P^{P_{US}}}} = \frac{- g \dfrac{\partial f}{\partial \frac{Y^{P_{US}}}{Y_P^{P_{US}}}}}{f^2} \qquad (1)$$

b) $$\frac{\partial f}{\partial \frac{Y^{P_{US}}}{Y_P^{P_{US}}}} = (r_{US} + k_{US}) \frac{\partial \bar{d}}{\partial \frac{Y^{P_{US}}}{Y_P^{P_{US}}}} \qquad (2)$$

c) Out of (1) and (2) follows that the derivative is positive.

9.2 The dependence of d_5 if q varies

If $q = 1$ or $q = 1000$ the relationship remains unchanged. If $q = \frac{1}{1000}$, however, the dependence becomes negative.

<u>10. The Dependence of d_5 on $W^{P_{n-1}}$ and</u> $\frac{Y^{P_{n-1}}}{Y_P^{P_{n-1}}}$

The dependence of d_5 if the paradigm holds

a) $$\frac{\partial d_5}{\partial W^{P_{n-1}}} = \frac{1}{f} \frac{\partial g}{\partial W^{P_{n-1}}} \qquad (1)$$

b) $$\frac{\partial g}{\partial W^{P_{n-1}}} = \frac{\partial g_1}{\partial W^{P_{n-1}}} - \frac{\partial g_2}{\partial W^{P_{n-1}}} \qquad (2)$$

c) $$\frac{\partial g_1}{\partial W^P{}_{n-1}} = q\left[(r_{n-1}+k_{n-1})(1+d_2)\frac{\partial \bar{d}_1}{\partial W^P{}_{n-1}} + \right.$$

$$\left.\Big(k_{n-1}+d_1(r_{n-1}+k_{n-1})\Big)\frac{\partial \bar{d}_2}{\partial W^P{}_{n-1}}\right] \qquad (3)$$

d) $$\frac{\partial g_2}{\partial W^P{}_{n-1}} = r_{US}\left[(1+r^D d_1)\frac{\partial \bar{d}_2}{\partial W^P{}_{n-1}} + r^D(1+d_2)\frac{\partial \bar{d}_1}{\partial W^P{}_{n-1}}\right] \qquad (4)$$

e) Out of (1),(2),(3),(4), and the order condition below follows that the derivative is negative.

$$\left|\frac{d_1(r_{n-1}+k_{n-1})(1+d_2)}{d_2\ \ k_{n-1}+d_1(r_{n-1}+k_{n-1})}E(d_1,W^P{}_{n-1}) + E(d_2,W^P{}_{n-1})\right| >$$

$$\left|\frac{r_{US}(1+r^D d_1)}{q\ \ k_{n-1}+d_1(r_{n-1}+k_{n-1})}E(d_2,W^P{}_{n-1}) + \right.$$

$$\left.\frac{d_1 r_{US} r^D(1+d_2)}{qd_2\ \ k_{n-1}+d_1(r_{n-1}+k_{n-1})}E(d_1,W^P{}_{n-1})\right|$$

This assumption is well established, because the expressions by which the elasticities on the left hand side are multiplied are larger than the corresponding ones on the right hand side.

10.2 The dependence of d_5 if q varies

If q = 1 or q = 1000 the dependence remains psoitive while if $q = \frac{1}{1000}$ the dependence becomes negative.

11. The Dependence of d_5 on Spec, $\frac{WT^{\$}}{WT}$, $\frac{n_{US}}{n_{n-1}}$, and $\frac{p_{n-1}}{p_{US}}$

11.1 The dependence of d_5 if the paradigm holds

a) $$\frac{\partial d_5}{\partial Spec} = \frac{f \frac{\partial g}{\partial Spec} - \frac{\partial f}{\partial Spec}}{f^2} \qquad (1)$$

b) $$\frac{\partial g}{\partial Spec} = \left((r_{n-1}+k_{n-1})(1+d_1+d_1 d_2)+k_{n-1} d_2\right) \frac{\partial \overset{+}{q}}{\partial Spec} \qquad (2)$$

c) $$\frac{\partial f}{\partial Spec} = - r_{n-1} \frac{\partial \overset{+}{q}}{\partial Spec} \qquad (3)$$

d) Out of (1),(2),(3) follows that the derivative is positive.

11.2 The dependence of d_5 if q varies

If q = 1 the relationship remains unchanged, while for q = 1000 and $q = \frac{1}{1000}$ it becomes negative.

12. The Dependence of d_5 on the Swaprate

12.1 The dependence on sw if the paradigm holds

$$\text{a)}\quad \frac{\partial d_5}{\partial sw} = \frac{f\,\dfrac{\partial g}{\partial sw} - \dfrac{\partial f}{\partial sw}\,g}{f^2} \tag{1}$$

$$\text{b)}\quad \frac{\partial g}{\partial sw} = \frac{\partial g_1}{\partial sw} - \frac{\partial g_2}{\partial sw} \tag{2}$$

$$\begin{aligned}
\text{c)}\quad \frac{\partial g_1}{\partial sw} = q \Bigg[& (r_{n-1}+k_{n-1})(1+d_2)\left(\overset{-}{\frac{\partial d_1}{\partial sw}} + \overset{-}{\frac{\partial d_1}{\partial i^D_{US}}}\, \overset{-}{\frac{\partial i^D_{US}}{\partial sw}} + \overset{-}{\frac{\partial d_1}{\partial i^D_{ED}}}\, \overset{-}{\frac{\partial i^D_{ED}}{\partial sw}} \right. \\
& \left. + \overset{+}{\frac{\partial d_1}{\partial i^D_{n-1}}}\, \overset{+}{\frac{\partial i^D_{n-1}}{\partial sw}} \right) + \left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]\left(\overset{-}{\frac{\partial d_2}{\partial sw}} + \overset{+}{\frac{\partial d_2}{\partial i^D_{US}}}\, \overset{-}{\frac{\partial i^D_{US}}{\partial sw}} + \right. \\
& \left. \overset{-}{\frac{\partial d_2}{\partial i^D_{ED}}}\, \overset{-}{\frac{\partial i^D_{ED}}{\partial sw}} + \overset{+}{\frac{\partial d_2}{\partial i^D_{n-1}}}\, \overset{+}{\frac{\partial i^D_{n-1}}{\partial sw}} \right) + (1+d_1+d_1 d_2)\, \overset{-}{\frac{\partial r_{n-1}}{\partial sw}} \Bigg] + \\
& \left[(r_{n-1}+k_{n-1})(1+d_1+d_1 d_2)+k_{n-1}d_2\right]\left(\overset{+}{\frac{\partial q}{\partial i^D_{US}}}\, \overset{+}{\frac{\partial i^D_{US}}{\partial sw}} + \overset{+}{\frac{\partial q}{\partial i^D_{ED}}}\, \overset{+}{\frac{\partial i^D_{ED}}{\partial sw}} + \right. \\
& \left. \overset{-}{\frac{\partial q}{\partial i^D_{n-1}}}\, \overset{+}{\frac{\partial i^D_{n-1}}{\partial sw}} \right)
\end{aligned}$$

$$\left| \frac{(r_{n-1}+k_{n-1})(1+d_1+d_1d_2)+k_{n-1}d_2}{d_1(r_{n-1}+k_{n-1})(1+d_2)} E(q,i^D_{n-1})E(i^D_{n-1},sw) + E(d_1,sw) \right.$$

$$+ \frac{d_2\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]}{d_1(r_{n-1}+k_{n-1})(1+d_2)} \left[E(d_2,sw) + E(d_2,i^D_{US})E(i^D_{US},sw)\right]$$

$$\left. \frac{r_{n-1}(1+d_1+d_1d_2)}{d_1(r_{n-1}+k_{n-1})(1+d_2)} E(\text{[illegible]}_{n-1},sw) \right| \quad < $$

$$\left| E(d_1,i^D_{US})E(i^D_{US},sw) + E(d_1,i^D_{ED})E(i^D_{ED},sw) + E(d_1,i^D_{n-1})E(i^D_{n-1},sw) + \right.$$

$$\frac{d_2\left[k_{n-1}+d_1(r_{n-1}+k_{n-1})\right]}{d_1(r_{n-1}+k_{n-1})(1+d_2)} \left[E(d_2,i^D_{ED})E(i^D_{ED},sw) + E(d_2,i^D_{n-1})\right.$$

$$\left. E(i^D_{n-1},sw)\right] + \frac{(r_{n-1}+k_{n-1})(1+d_1+d_1d_2)+k_{n-1}d_2}{d_1(r_{n-1}+k_{n-1})(1+d_2)} \left[E(q,i^D_{US})E(i^D_{US},sw)\right.$$

$$\left. \left. + E(q,i^D_{ED})E(i^D_{ED},sw)\right] \right| \tag{3}$$

This order condition is somewhat difficult to establish because so many different arguments have to be considered. It can be assumed, however, that $E(d_2,sw)+E(d_2,i^D_{US})E(i^D_{US},sw) < E(d_2,i^D_{ED})$ $E(i^D_{ED},sw)+E(d_2,i^D_{n-1})E(i^D_{n-1},sw)$, because the elasticities in the first expression are quite small except for $E(d_2,i^D_{US})$, while the corresponding elasticities in the second expression show a somewhat higher elasticity. This is mainly due - as already discussed - to the EDM's role as a mediator between different national markets and the limited access for only very few customers. The other two elasticities on the left hand side of our order condition if we neglect for a moment the one that involves q are both highly elastic. They represent the effects of a swap rate change on banks' and public's asset distribution between home currency assets and dollar assets. $E(r_{n-1}, sw)$ is, however, multiplied by a number < 1, so that altogether these two expressions are possibly smaller than the other elasticities on the right hand side if we neglect for a moment the ones we have already discussed and the ones that involve q, This probably holds even though these elasticities are not very large, especially because $E(d_1, i^D_{US})$ and $E(d_1, i^D_{ED})$ are quite small. The expressions involving q will wash out each other to a high extent, so that quite likely we will have only a small difference in favor of the right hand side - a fact that will substantiate somewhat the order condition established in the above way.

$$\text{d.} \quad \frac{\partial g_2}{\partial sw} = r_{US} \Bigg[(1+r^D d_1) \left(\frac{\partial \overset{-}{d}_2}{\partial sw} + \frac{\partial \overset{+}{d}_2}{\partial i^D_{US}} \frac{\partial \overset{-}{i}{}^D_{US}}{\partial sw} + \frac{\partial \overset{-}{d}_2}{\partial i^D_{ED}} \frac{\partial \overset{-}{i}{}^D_{ED}}{\partial sw} + \frac{\partial d_2}{\partial i^D_{n-1}} \frac{\partial i^D_{n-1}}{\partial sw} \right) + r^D(1+d_2) \left(\frac{\partial \overset{-}{d}_1}{\partial sw} + \frac{\partial \overset{-}{d}_1}{\partial i^D_{US}} \frac{\partial \overset{-}{i}{}^D_{US}}{\partial sw} + \frac{\partial \overset{+}{d}_1}{\partial i^D_{n-1}} \frac{\partial \overset{+}{i}{}^D_{n-1}}{\partial sw} \right.$$

$$\left.\frac{\overset{-}{\partial d_1}}{\partial i^D_{ED}}\;\frac{\overset{-}{\partial i^D_{ED}}}{\partial sw}\right) + (1+d_1+d_1d_2)\;\frac{\overset{+}{\partial r^D}}{\partial sw}\Bigg]$$

$$\left|\frac{d_2(1+r^D d_1)}{d_1 r^D(1+d_2)}\Big(E(d_2,sw) + E(d_2,i^D_{US})E(i^D_{US},sw)\Big) + E(d_1,sw)\right| <$$

$$\Bigg|\frac{(1+r^D d_1)}{d_1 r^D(1+d_2)}\Big(E(d_2,i^D_{n-1})E(i^D_{n-1},sw) + E(d_2,i^D_{ED})E(i^D_{ED},sw)\Big) +$$

$$\frac{(1+d_1+d_1d_2)}{d_1(1+d_2)}\,E(r^D,sw) + E(d_1,i^D_{US})E(i^D_{US},sw) + E(d_1,i^D_{ED})E(i^D_{ED},sw)$$

$$+ E(d_1,i^D_{n-1})E(i^D_{n-1},sw)\Bigg| \qquad (4)$$

This order condition seems to be quite well justified, especially because in addition to what we know from the last paragraph the left hand side consists of one expression less if we do not count all expressions that involve q and on the right hand side we find an additional expression, namely $E(r^D,sw)$.

e) Out of (2),(3),(4), and a further order condition we do not want to state anymore follows that $\frac{\partial g}{\partial sw}$ (5)

is most likely negative. But to arrive at this conclusion we have to make quite rigorous assumptions. Because of that we will keep in mind that the above order condition is not too well established.

$$\text{f) } \frac{\partial f}{\partial sw} = r_{US} \overset{+}{\frac{\partial r^D}{\partial sw}} - q \overset{-}{\frac{\partial r_{n-1}}{\partial sw}} + r_{n-1} \overset{+}{\frac{\partial q}{\partial i^D_{ED}}} \overset{-}{\frac{\partial i^D_{ED}}{\partial sw}} +$$

$$\overset{+}{\frac{\partial q}{\partial i^D_{US}}} \overset{-}{\frac{\partial i^D_{US}}{\partial sw}} + \overset{-}{\frac{\partial q}{\partial i^D_{n-1}}} \overset{+}{\frac{\partial i^D_{n-1}}{\partial sw}} \qquad (6)$$

g) Out of (1),(5),(6), and without a further order condition - a fact that substantiates our considerations so far - follows that $\frac{\partial d_5}{\partial sw}$

is negative.

12.2 The dependence of d_5 on sw if q varies

If q = 1 or q = 1000 the dependence remains unchanged while if $q = \frac{1}{1000}$ the dependence becomes positive.

Appendix B

List of Symbols

A	total advances of central banks to commercial banks
a_{ED}	the ED earning asset multiplier
a_{n-1}	the n-1 earning asset multiplier
a_{US}	the US earning asset multiplier
C	total currency in the hands of the public
CB	all central banks with the exception of the Fed
C_{n-1}	total n-1 currency in the hands of the non-US public
C_{US}	total US currency in the hands of the US public
c	the ratio of earning assets in non-US currency to ED earning assets
$D_{US}^{B_{n-1}}$	total dollar deposits of the n-1 banking system with the US banking system
$D_{ED}^{P_{n-1}}$	total ED deposits of the n-1 public
D^{CB}	total deposits held by central banks with commercial banks
$D_{n-1}^{P_{n-1}}$	total non-dollar deposits of the non-US public with the non-US banking system
$D_{US}^{P_{n-1}}$	total dollar deposits of the non-US public with the US banking system
$D_{ED}^{P_{US}}$	total ED deposits of the US public
$D_{US}^{P_{US}}$	total dollar deposits of the US public with the US banking system

d	the ratio of total dollar deposits of the US public held with the US banking system to total dollar deposits of the US public held with the non-US banking system
d_1	the ratio of total non-dollar deposits of the n-1 public with the non-US banking system to total dollar deposits of the n-1 public
d_2	the ratio of total dollar deposits of the n-1 public held with the US banking system to total ED deposits of the n-1 public
EA_{ED}	total dollar earning assets of the non-US banking system
EA_{n-1}	total non-dollar earning assets of the non-US banking system
EA_{US}	total dollar earning assets of the US banking system
ED	Eurodollars
EDM	Eurodollar market
e	the exchange rate of non-dollars to dollars as fixed by central banks
e^S	spot rate of non-dollars to dollars
FCM	foreign currency market - represents a market where the currency in question is traded outside the country of origin
Fed	Federal Reserve System of the United States
G	total gold stock of the world central bank
G_{n-1}	total gold stock of all non-US central banks
G_{US}	total gold stock of the Fed

IMB^S	International Monetary Base (sources side)
IMB^U	International Monetary Base (uses side)
i^{ED}	ED credit market interest rate
i_{n-1}	n-1 credit market interest rate
i_{US}	US credit market interest rate
i^D_{ED}	ED deposit rate
i^D_{n-1}	n-1 deposit rate
i^D_{US}	US deposit rate
i^o_{n-1}	an index of rates of non-US financial assets not traded on the bank credit market
i^o_{US}	an index of rates of US financial assets not traded on the bank credit market
k_{n-1}	non-US currency ratio
k_{US}	US currency ratio
MB^S_{n-1}	monetary base of all countries except the USA (sources side)
MB^U_{n-1}	monetary base of all countries except the USA (uses side)
MB^S_{US}	monetary base of the USA (sources side)
MB^U_{US}	monetary base of the USA (uses side)
NP^{Fed}_{CB}	net position of the Fed against all other central banks
NP^{CB}_{FED}	net position of all other central banks against the Fed
n-1	all countries except the USA

n_{n-1} yield on real capital outside the USA

n_{US} yield on real capital in the USA

p_{n-1} non-US prices of current non-US output

p_{US} US prices of current US output

q the ratio of MB_{US} to MB_{n-1}

R total reserves of all banking systems

R_{n-1} total reserves of the non-US banking system held with CB

R_{US} total reserves of the US banking system held with the Fed

R^{e}_{n-1} total desired excess reserves of the n-1 banking system held with CB

R^{e}_{US} total desired excess reserves of the US banking system held with the Fed

R^{r}_{n-1} total required reserves of the n-1 banking system

R^{r}_{US} total required reserves of the US banking system

$R^{r_1}_{n-1}$ total required reserves of the n-1 banking system on n-1 deposits

$R^{r_2}_{n-1}$ total required reserves of the n-1 banking system on ED deposits

r^{D} the ratio of dollar reserves held with the US banking system by the n-1 banking system to total deposits of the n-1 banking system

r_{n-1} the n-1 reserve ratio

r_{US} the US reserve ratio

r^{e}_{n-1} the n-1 excess reserve ratio

r^{e}_{US} the US excess reserve ratio

r^{r}_{n-1} the sum of the n-1 deposit and ED deposit reserve requirement ratios

r^{r}_{US} the reserve requirement ratio for US deposits

$r^{r_1}_{n-1}$ the reserve requirement ratio for n-1 deposits

$r^{r_2}_{n-1}$ the reserve requirement ratio for ED deposits

S total stock of securities of the world central bank

S^{CB}_{n-1} total stock of non-US securities in the portfolio of CB

S^{Fed}_{n-1} total stock of non-US securities in the portfolio of the Fed

S^{CB}_{US} total stock of US securities in the portfolio of CB

S^{Fed}_{US} total stock of US securities in the portfolio of the Fed

$W^{P_{US}}$ nonhuman real wealth of the US public

$W^{P_{n-1}}$ nonhuman real wealth of the non-US public

$WT^{\$}/WT$ ratio of that part of the volume of world trade carried through in dollars to the total volume of world trade

$Y^{P_{n-1}}$ current income of the non-US public

$Y^{P_{US}}$ current income of the US public

$Y_P^{P_{n-1}}$ permanent income of the non-US public

$Y_P^{P_{US}}$ permanent income of the US public