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WHY HAS THE EURO BEEN FALLING?
AN INVESTIGATION INTO THE DETERMINANTS OF THE EXCHANGE RATE

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ABSTRACT

This paper reconsiders the determinants of the exchange rate by studying the historical episode after the fall of the Iron Curtain. Testing a modified portfolio balance model, we attribute the strength of the deutschmark in the early nineties and the puzzling decline of the euro during its virtual existence to changes in the demand for deutschmarks in eastern Europe and to variations in the demand for black money balances in Europe as a whole. We reject the view that the strength of the dollar and the weakness of the euro reflect the prosperity of the US and the weakness of the European economy on both theoretical and empirical grounds.

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1. INTRODUCTION

Not only professional investors have lost money by investing in the euro, many people have been utterly disappointed by the miserable performance of the new currency. Starting at a rate of $1.18, the euro has fallen with only few interruptions. At this writing (Spring 2001) it is languishing below 90 cents, having lost a quarter of its initial value, even though the European Central bank has frequently intervened in the currency exchange market.

When the US economy was still on its spectacular growth path, which many economists attributed to the New Economy, the weakness of the euro seemed natural. It seemed to result from the fact that investors were trying to escape the old continent to make their fortune in Silicon Valley, selling European currencies and demanding dollars to reshuffle their portfolios. Since it has become clear that the American stock market performed badly relative to the European one and since the American economy began to slump in the last quarter of 2000, this interpretation has lost much of its appeal, because contrary to expectations the euro continued to weaken against the dollar. Something else must have happened that explains why people are selling their euros. De Grauwe (2000) called this a "puzzling phenomenon", leaving it to future research to unravel it.

This paper elaborates on an explanation that one of us had suggested in newspaper articles, this explanation relating to the fact that holders of black money and eastern Europeans were afraid to convert their old European coins and bank notes against the euro in 2002.[1] The elaboration can be seen as an essay on an episode in economic history, but it may be more than that. It leads to an explanation of the negative correlation of the stock of deutschmarks in circulation and the value of the deutschmark which Frankel (1982, 1993)

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[1] Hans-Werner Sinn, Handelsblatt of 6 November 2000, Financial Times of 4 April 2001, and Süddeutsche Zeitung of 6 April 2000. The reactions to these articles were mixed. Bundesbank spokesman Wolfgang Moerke denigrated the explanation as "rubbish" (Süddeutsche Zeitung, 22 November 2000) and Paul Krugman praised them as the best explanations he had heard thus far (New York Times, 1 April 2001). The Bundesbank may have changed its mind though. See Bundesbank Geschäftsbericht of 4 April 2001.

called the “mystery of the multiplying marks”, and it modifies traditional interpretations of the portfolio balance approach.

Based on the portfolio balance approach it is often argued that the exchange rate is the relative price of interest bearing assets. Given the stocks of these assets, an increase in the profit expectations of US firms implies a change in the desired composition of the portfolio in the direction of US assets. Since the actual composition cannot change, the dollar appreciates until any preference for portfolio restructuring in the aggregate disappears.

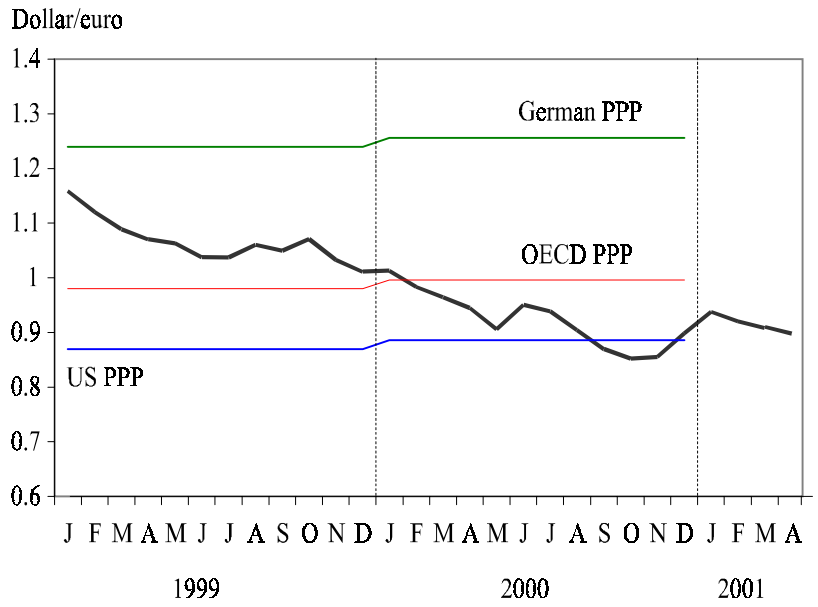
The problem with this interpretation is not only that it no longer fitted when the slump began, but also that it abstracted from the diversity of international portfolios. After all, the exchange rate is the price of a currency rather than shares, and shares have their own prices which are quoted instantaneously at the stock exchange. When share prices are flexible, a profit-based portfolio interpretation cannot easily explain the exchange rate because there are now two prices for shares, one of which seems to be redundant. If the profit expectations of the New Economy are captured by the Nasdaq, there is no need for the price of the dollar to capture them too.

To determine the exchange rate in the presence of flexible share prices, other assets whose prices are not flexible are required. In a formal model derived below, interest bearing assets whose rates of return are controlled by a central bank and money balances whose rates of return are fixed at a level of zero are considered in addition to stocks. We will use this model to explain the startling empirical development of the euro exchange rate with a changed demand for money balances. It is well known that the traditional portfolio balance model has been relatively unsuccessful in explaining the exchange rate (Taylor 1995, p. 30). Our version of the portfolio balances model reconciles the theory with the development of the deutschmark-dollar exchange rate in the period following the fall of the Iron Curtain because this period defines a unique historical experiment with huge shifts in the demand for deutschmarks.

2. EUROSCLEROSIS, NEW ECONOMY AND THE EURO

Let us begin with a look at the actual development of the euro. Figure 1 depicts the time path of the euro in terms of dollars since its launching on 1 January 1999. Obviously, there has been a clear downward trend leading to values as low as 84 cents in October 2000. After that, there was a recovery during a time when the newspapers were filled with reports of a pending American recession, but this recovery did not last very long. In March 2001, the rate fell again below 90 cents despite a dramatic worsening of the US situation.

Figure 1: *The development of the euro*

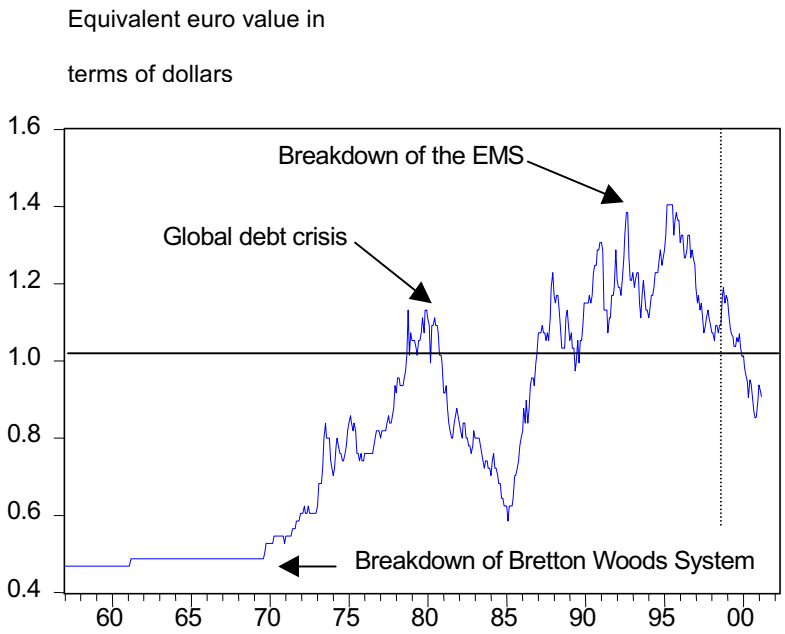


Source: OECD, Main Economic Indicators, March 2001, IMF International Financial Statistics, CD-ROM, March 2001 and own calculations
Note: Exchange rates are monthly data, while PPPs are given at an annual frequency. Different PPPs are computed with respect to the different consumption baskets in the US, the OECD and Germany.

It is true that the euro has not really been more volatile than the deutschmark was during its previous independent history. Figure 2 demonstrates the time path of the deutschmark in terms of dollars since 1950 where the common history with the euro is represented at the outward edge of the diagram. Obviously, the current period of decline,

which started in Spring 1996, is not a unique development. There was a similar period after the world debt crisis of 1981 bringing the dollar up to 3.45 deutschmarks, which would be equivalent to a decline of the euro to 0.56 cents. The current decline of the euro is still far removed from these figures.

Figure 2: *The value of the deutschmark in a long term perspective*



Source: Federal Reserve Bank of St. Louis, Economic and Financial database (http://www.stls.frb.org/fred/).
Note: The curve shows the time path of the monthly averages of the value of the deutschmark in terms of dollars converted into the euro value at the official deutschmark-euro exchange rate (1.96:1).

However, the decline of the euro is startling nevertheless. It looks particularly alarming when it is compared with the available PPP data. Figure 1 represents these data for alternative commodity baskets, including the German basket, the American basket and a standardised OECD basket. None of these baskets can claim superiority, but taken together the PPP figures specify a natural band for the long-term development of the exchange rate. On 1 January 1999, the euro had a value slightly below German PPP, but only one year later it had reached OECD PPP and in September 2000 it even fell below US PPP, which was at 87

cents. This event at last showed that something special must have been happening with the exchange rate. Why has it fallen so dramatically?

The reasons offered include Europe's labour market rigidities,[2] the European welfare net,[3] the Kosovo war,[4] Italy's ability to violate the Maastricht rules,[5] the excellent growth performance of the US economy[6] and the high US interest rates[7]. However, the most frequent argument, which may also underlie some of the quoted statements, was the high volume of capital flows into the US in recent years, in particular the high volume of direct investment flowing into the New American Economy[8]. We call this the prosperous-economy view.

As Figure 3 shows, capital flows into the United States were indeed enormous, and they continue to be so despite the ending of the American boom, totalling 3.5% of US GDP in 2000. In most years the capital flow was predominantly portfolio rather than direct investment, but in 1998 and 1999 direct investment was also substantial, peaking at about a third of total US capital import. In view of the size of the capital imports it is understandable that many observers have attributed the strength of the dollar to the prosperous investment opportunities in the American New Economy and the meagre outlook for a seemingly desolate Europe suffering from "Eurosclerosis".

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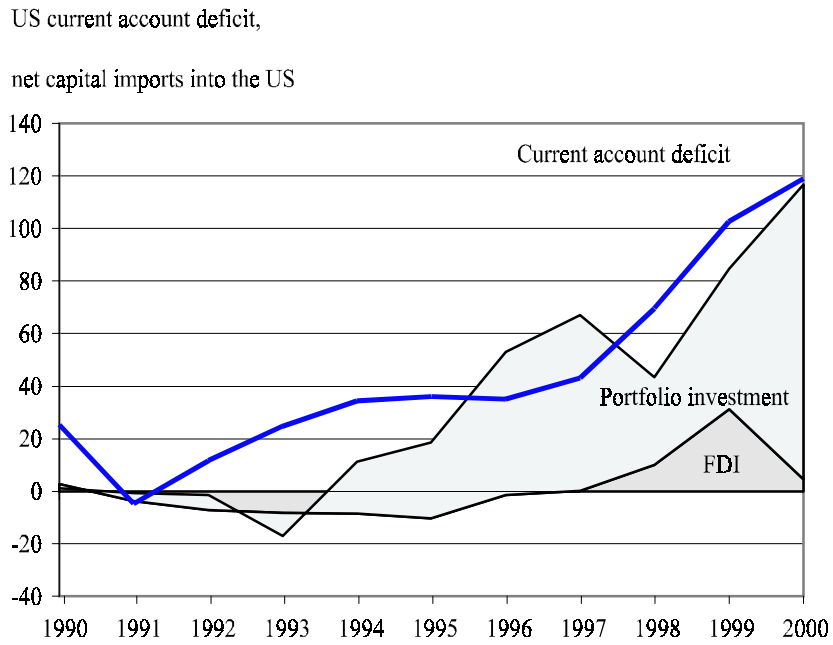
[2] Economist, 5 June 1999, p. 13; 20 April 2000, pp. 25-26. Der Spiegel, No. 10, 2000, "Interner Bericht des Finanzministeriums fordert tiefgreifende Reformen zur Stabilisierung des Euro."
[3] Economist, 5 June 1999, p. 14;
[4] ECB**,** Monthly Bulletin, June 1999, p. 39.
[5] Ibidem.
[6] Ibidem.
[7] Der Spiegel, online, Interview with Karl Otto Pöhl, 19 June 2000.
[8] "Interner Bericht des Finanzministeriums ...", ibidem. See also "Prospects for Sustained Growth in the Euro Area", Chapter 2, EUROPEAN ECONOMY, No 71, 2000. Office for Official Publications of the EC. Luxembourg, pp. 62-67."

Figure 3: *Capital imports into the US and current account deficit*



Source: IMF, International Financial Statistics, CD-ROM, March 2001.
Note: FDI = Foreign direct investment. The current account is defined as the sum of the capital account and the balance of payments (which is near 0 in the US). The capital account is the sum of net direct investment, net portfolio investment and other investment. Other investment includes international credit and repayments of credits, participation of governments in international organisations and international real estate purchases.

However, there are two problems with this interpretation: (i) a possible confusion between supply and demand and (ii) a theoretical mistake in the reasoning underlying the prosperous-economy view. Let us consider these problems in more detail.

i) Supply or demand?

The prosperous-economy view implicitly assumes that the capital flow into the United States results from an increase in demand for American assets by European investors. The demand, it is said, drives up the value of the dollar, because the price of the dollar is the price of American assets.

However, if an observable capital flow results in Europeans buying American assets, the reason could also be an increase in the supply of such assets. The supply of American

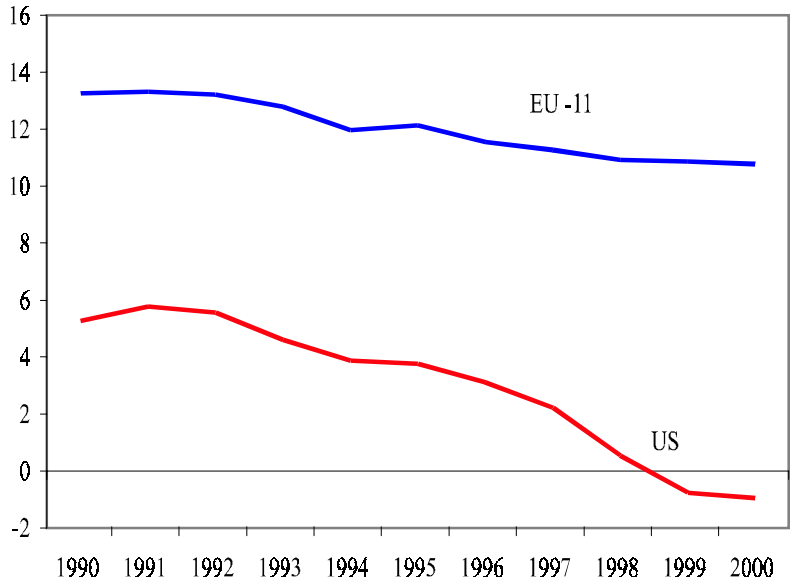
assets is equivalent to an excess of planned investment over planned savings, and this is the same as a planned current account deficit or an excess of planned commodity imports over exports. A planned current account deficit is a net supply of American assets in the international capital markets. If the planned current account deficit goes up and if the price of the dollar is the price of American assets, the value of the dollar will fall, rather than rise, when the capital flow into the US increases.

As always, an increase in trading volume in a market says little about whether this increase was demand or supply driven. One indication for it being demand driven is the strength of the dollar itself. Isn't this a compelling argument for the prosperous economy view? Well, it isn't. First we will see that there are other reasons for the strength of the dollar, and second there are two empirical observations that support the supply-side rather than the demand-side explanation of the capital flows.

The startling decline of the savings rate of private US households is one of these observations. In the beginning of the nineties the savings rate was about 5%, but then it fell continuously, and in 1999 and 2000 it even took on negative values.[9] By way of contrast, the Euro-11 savings rate was nearly 11% in the year 2000. The negative savings rate meant that American households were no longer buying assets but were selling them to finance their excess absorption of resources. Given the high American investment volume, an increase in the current account deficit and an increase in the supply of assets in the international capital markets might have been the only way to find a replacement for the lack in American savings.

[9] The officially measured savings rate does not include capital gains. This is not a problem in the present context where the savers' willingness to absorb assets offered in the capital market is concerned.

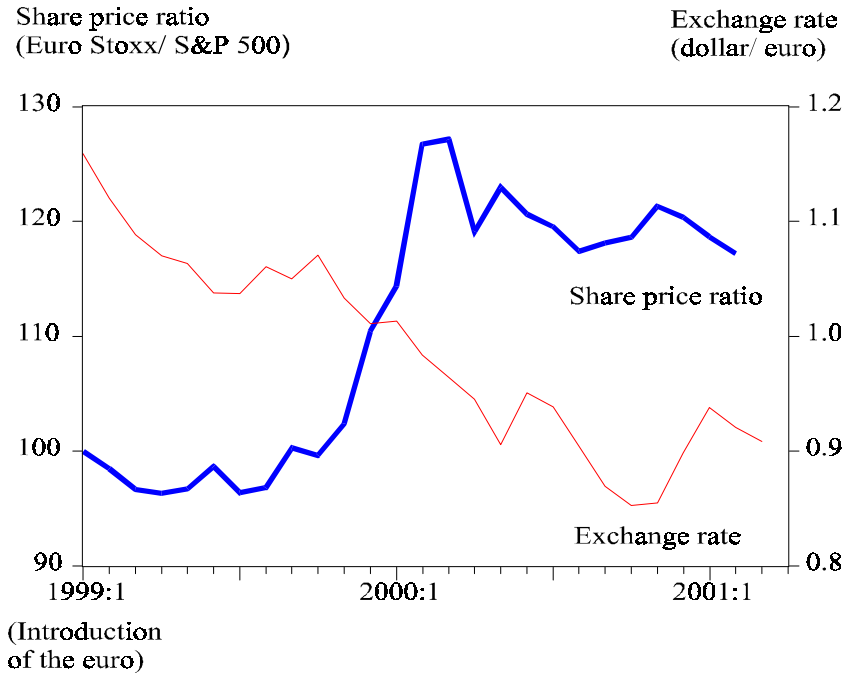
Figure 4: *Savings rates compared*



Source: OECD Economic Outlook, OECD Statistical Compendium, CD-ROM.
Note: The savings rate is defined as private household savings divided by disposable household income.

The second piece of information that supports a supply-side explanation is shown in Figure 5 : the poor performance of the US stock market. If the prosperous-economy view were true, not only the dollar, but also American share prices should have increased relative to European ones. But obviously this was not the case in the period since the introduction of the euro, as was already pointed out by De Grauwe (2000). Even before the first signs of an ending US boom were visible in the year 2000, the European stock market index had performed better than the American one. Since then the picture has turned slightly in favour of American shares, but the overall performance clearly cannot support the prosperous-economy view. Apparently, markets were not convinced about the eurosclerosis story and were more optimistic about European companies than about American ones despite the fact that they lost their interest in the euro. This is De Grauwe's puzzle mentioned in the introduction.[10]

Figure 5: *The relative performance of US and European shares compared with the exchange rate*



Source: Federal Reserve Bank of St. Louis and ECB, Monthly Bulletin, March 2001, Table 3.3.
Note: The data are given in a monthly frequency. The ratio between the Euro Stoxx and the Standard and Poor's S&P 500 index is set equal to 1 on 1 January 1999.
Note: Following De Grauwe, we compare the exchange rate with the ratio of European and American share prices denominated in their respective national currencies. At first sight it might be tempting to correct this ratio for the exchange rate movement; i.e. to divide the European share price index by the US share price index converted at the going exchange rate. This would yield a different but meaningless picture, which would partly illustrate the correlation of the exchange rate with itself. The apparent correlation between the two curves in the diagram would be positive even if the respective national share prices stayed constant.

ii) A flaw in the theoretical argument

The second problem with the prosperous-economy view is that it may not even theoretically be true. After all, the exchange rate is the price of a currency, and not the price of shares or other interest bearing assets. It is true that the price of the dollar is a component of the price of American shares if seen from the viewpoint of European investors, but the US share price itself is another component. This is a trivial but important point which may ultimately contribute to unravelling the puzzle.

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[10] Cf. footnote 29.

Suppose the return on US investment rises because of the New Economy effect or for other reasons. This will increase the demand for US shares by European investors and the price of American shares in terms of European ones. But does this mean a revaluation of the dollar? Why is it not enough if the dollar price of American shares goes up relative to the euro price of European shares? Obviously, there are two relative prices for the same thing, and one is redundant.

The traditional portfolio balance approach downplays the redundancy problem by assuming that the rates of return for the trading countries' assets are fixed or determined by monetary policy.[11] The only way to reach a portfolio equilibrium, i.e. a situation where the aggregate of all investors is content with the assets they possess, is an exchange rate adjustment. However, if share prices are flexible, the exclusive focus on the exchange rate adjustment in the establishment of a portfolio equilibrium no longer makes sense.

The layman's argument for why a higher demand for US shares by European investors will drive up the share prices is not convincing either. It goes as follows. The investors sell their European shares in Europe against euros, and then they sell the euros obtained against dollars in the currency exchange market in order to use these dollars for the purchase of American shares. As this involves a demand for dollars and a supply of euros, so it is maintained, the value of the euro in terms of dollars must fall.

The fallacy of this variant of the prosperous-economy view is that it overlooks the implications of the additional demand for US shares on share prices and the repercussions on foreign exchange markets. In the short run, the volume of outstanding US shares is given. Thus, the portfolio reshuffling planned by European investors will be possible only to the extent that American investors are crowded out and give their shares to the Europeans. The

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[11] See Branson (1977), Henderson (1980) or Sinn. (1983a). For an overview of some of the literature and a comparison with the monetary approach see Murphy and Van Duyne (1980).

American investors, however, may not wish to keep the dollars they receive, but to buy other things instead. If it is shares, they have to go abroad because only there do they find the supply they need to satisfy their demand, and in particular they will go to Europe, where shares are cheap. Thus they will supply the dollars they received from the European investors in the currency exchange market and exhibit a demand for euros instead. If the original purchase of dollars drove up the dollar, this will instead drive up the euro and eliminate the effect on the exchange rate.

With the passage of time the crowding out effect will become weaker because the share price increase induces an additional flow of new issues of shares to finance more investment. However, as an increase in planned net investment is equivalent to an increase in the planned current account deficit, this will not generate a positive revaluation effect on the dollar. It will, however, imply a smaller share price increase.

The real possibility to generate a revaluation effect is if the crowded out American shareholders do not wish to go into foreign shares, because there is a home bias in their preferences. There are two alternatives.

One is that they wish to go into American bonds instead of European shares. If the central bank does not stabilise the interest rate by open market operations, this will drive down the interest rate and crowd out previous bond holders. If these then choose European bonds or shares instead of the American bonds they sold, there is again a countervailing supply of dollars in the exchange market. However, if the central bank stabilises the interest rate by selling bonds and buying the dollars which the crowded out shareholders do not want, the countervailing effect will be mitigated and an appreciation of the dollar will result.

The other alternative is that the crowded out American shareholders wish to go into US money instead of European shares. This is the clearest case where a revaluation of the dollar occurs, but it hardly supports the naive view that an increased demand for American assets drives up the dollar simply because there is a transitional demand for dollars in the

process of portfolio conversion. The dollar appreciates when more dollars are demanded or less dollars are supplied, not when more American interest bearing assets are demanded. It is surprising how frequently this simple fact has been overlooked in the literature on the determinants of the exchange rate, including that on the weakness of the euro.

One of the reasons why the layman's argument overlooks the possible repercussions resulting from the actions of crowded out shareholders is that it focuses on transitional demand and supply flows in the currency exchange markets rather than ultimate preferences for stocks of assets such as shares, bonds and currencies. It is much easier to understand what is happening to the exchange rate if a portfolio balance approach to the problem is taken. According to this approach, the interest rate, the price of shares and the exchange rate are determined by the need to equate desired with actual wealth portfolios. At any point in time, the actual portfolio of assets is given in the aggregate, and thus a desire to restructure this portfolio cannot be fulfilled. Instead, asset prices, rates of return and exchange rates have to adjust until people's preferences fit the given actual stocks of assets available, notwithstanding the fact that, from a microeconomic point of view, it is always possible to adjust the portfolio to the preferences.

A Friedmanian thought experiment exemplifies the merits of a properly interpreted portfolio balance approach in the present case. Suppose the European investors who wish to replace their European interest bearing assets with American ones pack these assets into coffers, fly to the US and negotiate directly with the American asset holders. They will then find an exchange rate between European and American shares and relative rates of return at which the American asset holders are willing to participate in the deal. In general equilibrium this direct deal cannot result in another exchange rate than the one brought about by a transitional conversion of European interest bearing assets into euros, of euros into dollars and of dollars into US interest bearing assets. Thus the thought experiment confirms that the dollar-euro exchange rate cannot be affected if the American wealth owners who sold their

interest bearing assets are happy to hold European assets instead. If the dollar appreciates, it must be because American asset holders are not happy with all the European interest bearing assets they received but try to convert them primarily into American money or American bonds inducing the Fed to supply more bonds and reduce the stock of currency in circulation. Only an increase in the demand for American money or a reduction in the supply of such money will be able to imply an appreciation of the dollar.

3. WHY MONEY MATTERS

To clarify the issue more formally, we now specify a simple two-country portfolio balance model with a representative international investor who chooses among three types of assets in each of the two countries: shares *S*, bonds *B* and money *M*.[12] The two countries are the US and Europe. In a market equilibrium, the share prices, the exchange rate and the interest rates are determined so as to equate the desired portfolio structure resulting from the investor's optimisation to the actual one which is taken as given.[13]

The units of account for measuring the volumes of shares, bonds and money are the respective national currencies. The volume of shares S is expressed in terms of the nominal share value. The market value of a share is a multiple *P* of the nominal value. We call this multiple the share price. When *r* denotes the rate of return on nominal share values, $r \cdot S$ is the dividends distributed and *r/P* is the effective rate of return on shares (without a potential return from share appreciation). Let *i* denote the rate of interest on bonds. Variables that refer

[12] We also formulated a more elaborate model distinguishing, among others, between American and European investors, but prefer to phrase our discussion in the more parsimonious model presented here, because this model is sufficient for the points we wish to make.

[13] An increase in the portfolio volume will not affect share prices, interest rates and the exchange rate if preferences are homothetic and growth does not change the actual portfolio structure. For simplicity we assume that this is the case.

to the US are labelled with an asterisk, variables without an asterisk refer to Europe and are expressed in terms of euros. The exchange rate e is the price of euros in terms of dollars.

The representative international investor is meant to reflect the aggregate of all American and European wealth owners. He optimises his portfolio for a given investment period which may or may not be part of a multi-period setting. At the beginning of the period he has a given endowment of assets which constitute his total wealth W in terms of euros, but re-optimises his portfolio structure, taking the two share prices, the exchange rate and the two interest rates as given.[14] The investor's budget constraint in terms of euro expenses for the six types of assets available is

$$W = S^* \frac{P^*}{e} + B^* \frac{1}{e} + M^* \frac{1}{e} + SP + B + M \ . \tag{1}$$

Note that the choice of numeraire is arbitrary but meaningless. Nothing would change by choosing the dollar as the numeraire.

Among other things, the investor's decisions depend on expectations of end-of-period share prices and of the end-of-period exchange rate which we denote $\widetilde{P}$ and $\widetilde{e}$. The model predicts that changed expectations about these variables will immediately translate into their current counterparts, but we fix the expectations throughout the paper in order to be able to concentrate on the fundaments affecting the exchange rate. Our discussion focuses on changed stocks of assets due to government policies, changed real returns and changed preferences for certain types of assets, given the expectations. The investor's utility is assumed to be given by the sum of end-of-period wealth plus a liquidity service

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[14] This is the general structure of a multi-period stochastic portfolio decision problem. See Sinn (1983b) for an extensive elaboration on this problem. Here we cut things short by considering one period only and simplifying the utility function.

$$U\left(\sigma^* S^* \widetilde{P}^* / \widetilde{e},\ \beta^* B^* / \widetilde{e},\ \mu^* M^* / \widetilde{e},\ \sigma S \widetilde{P},\ \beta B,\ \mu M\right)$$

which depends on the respective expected stock values $S^* \widetilde{P}^* / \widetilde{e}$, $B^* / \widetilde{e}$, $M^* / \widetilde{e}$, $S \widetilde{P}$, B and M.[15] The liquidity service is meant to capture all considerations important for the choice of assets other than their contribution to the pecuniary return, including risk characteristics, Baumol-Tobin type transactions costs, the timing of planned commodity purchases and the like. The Greek symbols σ^*, β^*, μ^*, σ, β and μ denote parameters of the utility function which allow us in a simple fashion to represent arbitrary preference changes including ones that generate cross price effects among different assets. We assume that U is an increasing, separable and strictly concave function and that the parameters are unity before a preference change takes place.

Formally, the investor's decision can be depicted by maximising the Lagrangean

$$\begin{aligned} L = {} & S^* \frac{1}{\widetilde{e}} (\widetilde{P}^* + r^*) + B^* \frac{1}{\widetilde{e}} (1 + i^*) + M^* \frac{1}{\widetilde{e}} + S(\widetilde{P} + r) + B(1 + i) + M \\ & + U\left(\sigma^* S^* \widetilde{P}^* / \widetilde{e},\ \beta^* B^* / \widetilde{e},\ \mu^* M^* / \widetilde{e},\ \sigma S \widetilde{P},\ \beta B,\ \mu M\right) \\ & + \lambda \left(W - S^* \frac{P^*}{e} - B^* \frac{1}{e} - M^* \frac{1}{e} - SP - B - M \right) \end{aligned}$$

with respect to the six different asset volumes considered in the model. Here, the first line is end-of-period wealth in terms of euros, the second gives the liquidity services and the third contains the investor's budget constraint where λ is the Lagrangean multiplier. The marginal conditions resulting from this optimisation approach are:

$$(2) \qquad \frac{e}{\widetilde{e}} \cdot \frac{\widetilde{P}^* (1 + \sigma^* U_{S^*}) + r^*}{P^*} = \lambda ,$$

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[15] See Fried and Howitt (1983) for a discussion of the potential liquidity services and a formulation along these lines.

(3) $$\frac{e}{\widetilde{e}}(1+i^{*}+\beta^{*}U_{B^{*}})=\lambda,$$

(4) $$\frac{e}{\widetilde{e}}(1+\mu^{*}U_{M^{*}})=\lambda,$$

(5) $$\frac{\widetilde{P}(1+\sigma U_{S})+r}{P}=\lambda,$$

(6) $$1+i+\beta U_{B}=\lambda,$$

and

(7) $$1+\mu U_{M}=\lambda.$$

These equations are similar insofar as they all show that, in the optimum, the sum of each asset's own rate of return factor plus the marginal liquidity service, possibly corrected by a growth factor reflecting the expected exchange rate adjustment, equals a common yardstick, the Lagrangean multiplier λ. In the case of US shares (2), the rate of return factor is a combination of the growth factor of the dollar in terms of euros, $e/\widetilde{e}$, of the growth factor of the US share price, $\widetilde{P}^{*}/P^{*}$, and the effective rate of return on US shares, r^{*}/P^{*}. In the case of dollar currency (4), the rate of return factor is just the growth factor of the dollar in terms of euros, and in the case of euro currency it is simply one. The other cases should be self-explanatory. In general, an asset's pecuniary rate of return factor is smaller, the larger this asset's marginal liquidity service. As the rate of return on shares tends to be higher than that on bonds and the latter higher than that on cash, the marginal liquidity services will presumably follow the adverse ordering.

Let a bar above a variable indicate the given asset stocks in the economy. The investor's wealth in terms of euros with which he enters the period is then determined by

$$(8) \qquad \overline{S} * \frac{P*}{e} + \overline{B} * \frac{1}{e} + \overline{M} * \frac{1}{e} + \overline{S}P + \overline{B} + \overline{M} \equiv W \, .$$

Equations (1) – (8) define the demand functions for all six assets. The asset prices, the exchange rate and the interest rate follow by assuming that for each asset, demand equals supply:

$$(9) \qquad S* = \overline{S}*, \; B* = \overline{B}*, \; M* = \overline{M}*, \; S = \overline{S}, \; B = \overline{B}, \; M = \overline{M}.$$

In total, there are now 14 equations, one of which is redundant. They explain six asset stocks, two interest rates, two share prices, one exchange rate, the Lagrangean multiplier and the wealth level, i.e. a total of 13 variables.

There is no need to explicitly solve for all of these variables, because a number of useful observations can easily be derived by inspecting the equations. One concerns the prosperous-economy view. Suppose $\sigma*$ in equation (2) increases and/or σ in equation (5) declines while the marginal utilities of money holding remain constant. Equations (4) and (7) then fix the exchange rate *e* and the Lagrangean multiplier λ. As U_{S*} and U_S are fixed by the given levels of $S*$ and *S*, it follows from (2) and (5) that the changed preferences for share holdings will be accommodated only with an increase in the price of US shares $P*$ and/or a decline in the price of European shares *P*. No exchange rate movements are necessary to maintain a portfolio equilibrium.

Changes in the nominal rates of return *r* and *r** in favour of American assets would, as the reader can easily verify form himself, have very similar effects. If the money demands do

not change, they would not, as the prosperous-economy view predicts, result in an appreciation of the dollar, but once again only in an increase in the US share price relative to the European one.

A similar remark applies to the rates of interest on bonds. Again the exchange rate e and the Lagrangean multiplier λ are fixed by (4) and (7) independently of these interest rates. An increase in the preference for US bonds as reflected by an increase in β^* will, according to (3), only result in a fall in the US interest rate, and similarly, an increase in the preference for European bonds will reduce the European interest rate according to (6) without affecting the exchange rate.

The crucial equations for the determination of the exchange rate are (4) and (7). Together they imply that the value of the euro is explained by the marginal liquidity services of euros and dollars in the international wealth portfolio:

$$e = \tilde{e} \cdot \frac{1+\mu U_M}{1+\mu^* U_{M^*}}. \tag{10}$$

No pecuniary rates of return of the assets on which the portfolio balance approach focuses enter this formula, since these rates are endogenous to the market equilibrium. This reiterates the point made above, which is less trivial than it sounds, that the currency exchange rate is the exchange rate between two types of money, and not the exchange rate between interest bearing assets.

The remarkable aspect of these neutrality results is that preference changes concerning interest bearing assets will result in price and rate of return changes that are large enough to compensate for these changes, but will not affect the exchange rate. In order for exchange rate movements to come along with such preference changes it would be necessary that preference changes for money balances are involved, too. Consider for example, the home bias discussed

in the previous section implying that crowded out American shareholders wish to go into American money. In the aggregate model considered here, this could be captured by the assumption that the increased preference for American shares comes along with an increased preference for US money, i.e. an increase of μ^*. According to equation (10) this would indeed imply a weakening of the euro.

Thus far we assumed that the stocks of assets are given in the portfolios and that the pecuniary rates of return are flexible. Rate of return adjustments will then be able to accommodate the preference changes with regard to bonds and shares, but not with regard to money holdings, because the pecuniary return of money is fixed at zero. Only a changed preference for money holding needs an exchange rate adjustment to keep the desired portfolio structure in line with the given actual one.

Things are different though when other rates of return are fixed, too. The relevant case here is that the two central banks fix the national interest rates and accommodate any changes in preferences for money and bonds with appropriate open market policies which change the composition of the outstanding stocks of bonds and money balances. This will affect the marginal liquidity services of money balances and will have repercussions on the exchange rate according to equation (10).

From equations (3), (4), (6) and (7) it follows that the national interest rates are given by

(11) $$i^* = \mu^* U_{M^*} - \beta^* U_{B^*} \quad \text{and} \quad i = \mu U_M - \beta U_B \ .$$

Given the stocks of money and bonds and hence given U_{M^*}, U_{B^*}, U_M and U_B , a national interest rate obviously decreases with a decrease in the preference for the respective national money (decrease of μ^* or μ) and/or an increase in the preference for national bonds (increase of β^* and β), as was explained. To prevent this from happening and fix the interest rates the

central banks have to accept any exchange between the national stocks of money and bonds which the public wants to carry out at the given interest rates, i.e. they have to intervene passively by supplying more of the respective stock in demand and withdrawing the other one from the market.

Passive intervention of this type will make the exchange rate reactive to changed preferences for bond holdings and protect it partly from changes in the preference for money holdings. Consider for example the case of an increased preference for US bonds, as is reflected by an increase in β^*. To avoid a decrease in the US interest rate, the Federal Reserve Bank will react by selling bonds against US currency which increases U_{M^*} and lowers *e* according to (10). The dollar appreciates after an increase in the demand for US bonds. Similarly, a depreciation of the euro, *e*, could be brought about by a reduced preference for European bonds if the European Central Bank fixed the interest rate by buying bonds and selling euros – or, as discussed in the previous section, by an increased preference for American bonds which the Fed accommodates with a contractionary open market policy.

Things would be similar if the central banks intervened also to keep the effective rate of return on shares constant, but of course they don't. This is the crucial point overlooked in most of the existing portfolio balance literature. If the central bank intervenes only to keep the interest rate constant and if no more than the preference for shares changes as is reflected by σ^* and σ, equations (2)-(7) continue to ensure an isolation of the exchange rate. This confirms the above criticism of the prosperous-economy explanation of the euro's weakness and of the traditional portfolio-balance approach as such. Even when the central bank intervenes passively to keep the interest rate constant, changes in profit expectations, in preferences for share holdings or in preferences for direct investment cannot influence the exchange rate unless they also imply changes in preferences for bonds or money balances.

Let us now discuss the reason why a passive intervention might partially protect the exchange rate against changes in liquidity preferences. Suppose that the preference for euro

currency declines as is represented by a reduction of μ. According to (10) this will depreciate the euro and according to (11) it will reduce the European interest rate. To prevent the interest reduction, the European Central Bank will buy back money balances against private bonds. In itself, this will increase U_M and increase e ; i.e. it will stabilise the exchange rate. The stabilisation will not be perfect, though, because the increase in the stock of bonds results in a reduction in the marginal utility from bond holding, U_B. According to (11), a constancy of the interest rate therefore implies that the marginal utility form money holding, μU_M, will not be pushed back to where it was before the preference change and that there is a negative net effect on the euro.

This can also be seen by deriving a modified interest parity condition from equations (3) and (6), which relates the exchange rate to the national interest rates and the marginal liquidity premia for bonds:[16] [17]

$$e = \tilde{e} \cdot \frac{1 + i + \beta U_B}{1 + i^* + \beta^* U_{B^*}} . \tag{12}$$

As the passive intervention triggered off by the decline in μ increases the stock of bonds held by the public, B, and thus reduces the bonds' marginal liquidity service U_B, equation (12) ensures that the net effect on the exchange rate is negative. A similar result holds for an

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[16] Equation (12) specifies the interest rates rather than the exchange rates when the respective asset stocks are given and the ECB does not intervene. According to (3) and (6), in equilibrium the interest rates on American and European bonds have to adjust such that they complement the marginal liquidity services of bonds to generate the required overall return factor λ. This will then automatically satisfy the interest parity condition without giving equation (12) much explanatory power for the determination of the exchange rate. The explanatory power increases when passive interventions by the central banks are taken into account which fix the interest rates.

[17] Note that, while (12) refers to the spot rate *e*, it also determines the forward rate $\tilde{e}_f$ according to the covered interest parity condition $\tilde{e}_f = e \cdot (1 + i^*)/(1 + i)$. The forward rate is not the same as the expected future spot rate. The relationship between these rates follows by inserting (12) into the previous equation: $\tilde{e}_f = \tilde{e} \frac{1 + \beta U_B/(1 + i)}{1 + \beta^* U_{B^*}/(1 + i^*)}$. This expression shows that a reduced preference for euro currency combined with

increase in μ^*. As the reader may verify for himself, a negative net effect on *e* and a decrease of M^* could also result from an increase in the preference for dollar currency if the dollar interest rate is given.

The effect has a certain similarity with an active intervention in the exchange market. If such an intervention is sterilised in the sense that it leaves the interest rates fixed in the two countries, it will involve a sale of dollar currency and dollar bonds against euro currency and euro bonds so as to keep the respective national differences in the marginal liquidity services of money and bonds constant as is indicated by (11). The decline in the marginal utility of US bonds and the respective increase in the marginal utility of European bonds which results from this change in the structure of the market portfolio raises the fraction on the right-hand side of (12) and hence the value of the euro.[18]

It is a common feature of the active and passive interventions that a decline in the stock of euro currency exhibits a positive effect on the value of the euro. However, the distinguishing feature is that this effect comes independently when the central bank intervenes actively in the foreign exchange market while it is only an induced compensating effect which cannot offset the primary effect when the central bank intervenes passively by fixing the interest rate. Thus, the correlation between the stock of euro currency and the value of the euro should be negative in the case of active intervention with a given interest rate, and positive in the case of passive intervention after a change in the currency preference. As we showed above that a negative correlation would also characterise the case of passive intervention after a change in bond preferences, it seems that the sign of the correlation between the currency stocks and the exchange rate might be a clue for finding the causes of the weak euro.

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passive intervention which fixes the interest rates reduces the euro's forward rate relative to its expected future spot rate without affecting the forward premium or the swap rate.

It is essential for our theory that American and European bonds are imperfect substitutes in the international portfolio. If they were perfect substitutes, a preference shift from European to American currency which is accommodated by a contractionary open market policy in Europe and an expansionary one in the US so as to keep the interest rates constant would not be able to affect the exchange rate. The simplest way to depict this possibility in our model would be to assume that bonds do not deliver marginal liquidity services in addition to their pecuniary return such that $\beta^* U_{B^*} = \beta U_B = 0$. Equations (10) – (12) would then imply that fixing the interest rates eliminates any effect of a changed preference for money holding on the exchange rate. Similarly, equation (12) would imply that the ECB tried the impossible when it intervened in the foreign exchange market to stabilise the euro without changing the European interest rate. However, we find it hard to believe that bonds denominated in different currencies and separated by a flexible and risky currency exchange rate will even come close to being perfect substitutes. This is the old dichotomy between the portfolio balance and the monetary approaches, which can only be solved empirically. Feldstein and Horioka (1980) and Dooley, Frankel and Mathieson (1987) have argued that a high correlation between savings and investment points to a rather limited international substitutability of assets, and within our model we will also be able to provide supporting evidence for a limited substitutability. If American and European bonds are perfect substitutes, the value of the euro and the stock of euro currency should be uncorrelated both in the presence of demand and supply shocks if one controls for the interest rates. On the other hand, if they are imperfect substitutes, then, controlling for the interest rates, there should be a negative correlation when supply shocks dominate and a positive correlation if demand shocks dominate. These are clear cut predictions, and we will show that during the historical period considered there is indeed a very significant positive correlation.

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[18] In practice, the interventions by the ECB involved the sale of US treasury bonds which required the Fed to

4. BLACK MONEY AND DEUTSCHMARKS CIRCULATING ABROAD

There is a particularly alarming piece of information that gives the impression of a positive correlation: the sharp increase in the velocity of German money circulation in the last few years that paralleled the decline of the euro. In the late eighties and early nineties the Bundesbank and the public had regularly been surprised if not alarmed by the fact that the German monetary base grew much more rapidly than was anticipated, typically exceeding the projection corridor the Bundesbank had published. During this period there was a persistent revaluation pressure for the deutschmark, as the passive intervention view would have implied. The pressure even led to the collapse of EMS in 1992, which implied a sudden revaluation of the deutschmark relative to most of the European currencies and the dollar. Since 1997, however, this trend of the money growth rate has been reversed. The growth rate of the German monetary base has been declining relative to that of GDP, and during a couple of quarters it even fell in absolute terms. As Figure 2 reveals, this reversal of the growth trend matched that of the euro surprisingly well.

To see whether these developments can be interpreted as significant preference changes, we estimated a quarterly log-linear demand function for the deutschmark currency in circulation, *M*, covering the period 1966:1 through 2000:4 where the usual ingredients were taken as explanatory variables, i. e. the short term interest rate, *i*, gross domestic product, *Y*, calendar time, *t,* and a constant, *c*:

$$\ln M_t = \alpha_0 c + \alpha_1 \ln t + \alpha_2 \ln Y_t + \alpha_3 \ln i_t \ . \tag{13}$$

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react with an expansionary open market policy increasing the money supply so as to avoid an increase in the US interest rate.

The interest rate and GDP were included as explanatory variables to eliminate changes in the stock of money balances brought about by deliberate open market policies aiming at changing the interest rate and by changes in the liquidity services from money balances in the course of the business cycle. Calendar time was included to capture gradual changes in payment habits and the systematic velocity increase resulting from the Baumol-Tobin explanation of the liquidity services. [19]

The estimate generated coefficients with the expected signs which, except for the interest rate, were highly significant. The estimation results are summarised in Table 1.

Table 1: *The demand for German currency in circulation (1966:1-2000:4)*

Variable	Coeff.	Std. Error	t-Statistic	Prob.
Constant	2.757	0.291	9.459	0.000
t (Time trend)	0.009	0.001	7.928	0.000
Y (GDP)	0.447	0.077	6.151	0.000
i (Interest rate)	-0.013	0.010	-1.251	0.212
R^2	0.994			

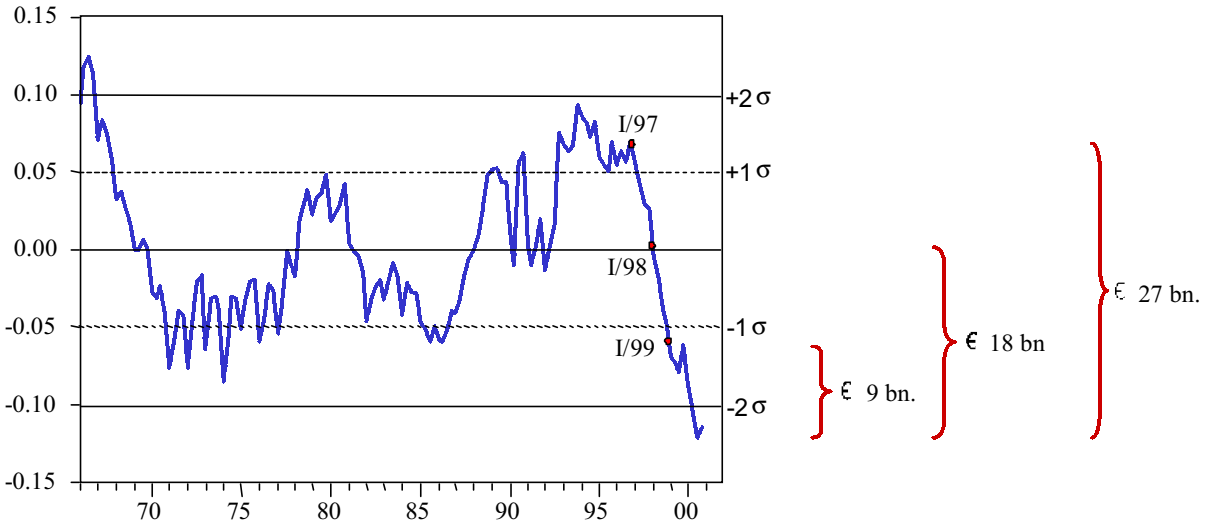
Note: The estimate refers to quarterly data, where the GDP figures are taken from the International Financial Statistics (IFS) CD-Rom of the International Monetary Fund (IMF) (time series code: 13499b.CZF). The interest rate is the money market rate, also taken from the IFS (time series code: 13460b.ZF) and the stock of German money in circulation is taken from the IFS CD-Rom up to 1998:4 (time series code: 13434A.NZF) and from the Landeszentralbank Bayern thereafter.

Despite the good quality of the estimates, the unexplained residuals were substantial as is shown in Figure 6. The figure demonstrates that there was an unusual growth in the German monetary base from 1989 to 1996, interrupted only in the year of the EMS collapse, 1992, which was followed by a very sharp decline in the years 1997 to 2000, the period during

[19] A more elaborate way to estimate a money demand function would be to specify the model in growth rates and to move to an error correction model. However, looking at the levels is simpler and more illustrative for our purposes. Estimating a vector autoregression with the variables of the model above (including 2 lags and an error correction term) yields qualitatively the same pattern in the residuals for the money equation as illustrated below.

which the currency union was finalised. While the money growth between 1992 and the first quarter of 1997 exceeded the upper one-sigma band and touched this band in the fourth quarter of 1993, it even fell below the lower two-sigma band in the year 2000. The probability for falling outside the two-sigma band is 0.05. Thus the recent decline of the monetary base must be seen as a highly significant event which cannot be explained with the usual determinants of the money demand function. What is the reason?

Figure 6: *The unexplained residual in the German money demand function*



A reason for the earlier increase, and also partly for the recent decline, in the demand for deutschmarks can be sought in eastern Europe. When the Iron Curtain came down in 1989, the deutschmark began to move east along with the dollar, replacing substantial fractions of the abundant and quickly depreciating currencies that were left over from communist times. While the dollar found more friends in the former Soviet Union, the deutschmark rapidly gained popularity in the countries neighbouring Germany, such as Poland, Hungary and in particular the former Yugoslavia, where it successfully rivalled the domestic currencies. Bosnia even made the deutschmark an official currency since August 1997.

At the same time there was an underlying growth trend for the stocks of deutschmarks held in Turkey, because the number of Turkish guest workers was growing steadily and the Turkish lira continued to depreciate at dramatic rates at times. Moreover, the deutschmark had been gradually acquiring the role of a second reserve and transactions currency next to the dollar throughout other parts of the world.

The Bundesbank reported the accumulation of deutschmarks outside Germany at an early stage. In 1992 when it rigorously tried to keep the money growth under control (see Figure 6) and may thus have triggered off the break-down of the EMS as a number of observers had claimed,[20] it probably was not yet aware of what was going on because otherwise it might not have been as concerned as it was about the high growth rate of the German monetary base and might have not have pursued a policy of high interest rates. However, in a Bundesbank discussion paper published by Seitz (1995), the accumulation of currency outside Germany was clearly analysed and it was estimated that the stock of deutschmarks circulating abroad was between 60 and 90 billion deutschmarks, which is equivalent to 30 - 45 billion euros. At the time this number was between 25% and 35% of the German monetary base and between 10% and 15% of the monetary base of what later would be the Euro-11 countries.[21]

The outstanding deutschmarks were a source of a significant seignorage profit made by the Bundesbank, as was calculated by Sinn and Feist (1997, 2000). When the euro was introduced, the deutschmark constituted a much larger fraction of the Euro-11 monetary base than the share in the ECB profit remittances which was only 31%, according to the average of Germany's GDP and population shares. Sinn and Feist calculated that this implied a seignorage loss which was equivalent to a one-off capital levy of nearly 60 billion deutschmarks or 30 billion euros on the German Bundesbank. The excess stock of

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[20] See Eichengreen and Wyplosz (1993) and De Grauwe (1994).

deutschmarks now seems to be returning to the Bundesbank, and the seignorage wealth accumulated seems to be fading away. From the information underlying Figure 6 we calculate that the stock of circulating deutschmarks was 9 billion euros less by the end of the year 2000 than it would have been had the Bundesbank stuck to the trend growth of this stock from 1 January 1999 onwards and 27 billion euros less than it would have been had the Bundesbank stuck to the trend growth from 1 January 1997 onwards.

It can only be speculated about the reasons for the deutschmarks returning to the Bundesbank. We believe that it has do to with the fact that the euro has been only a virtual currency since its introduction, serving as the common denominator of the national European currencies but being unavailable in physical form. Physically the euro will not be launched before the first half of the year 2002, three years after it was legally introduced as a unit of account.

The first reason for the returning deutschmarks is the lack of information about the currency conversion in 2002 outside Germany, in particular in eastern Europe and Turkey. Even in Germany, many people are afraid of losing part of their wealth, despite the frequent advertising campaigns for the euro. The uncertainty of ordinary people elsewhere in the world must be much bigger, because they have not been informed about the conversion and wonder what all this euro business is about. They have heard that the deutschmark will be abolished in 2002 and witnessed the rumor that there will be a new currency replacing it. But they do not know who will carry out the conversion, what the exchange rate will be and what commission fees will be charged. So they are afraid of sustaining a loss by continuing to hoard deutschmarks and hurry into the dollar or other currencies which are free of this kind of uncertainty.

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[21] No less than 60% of the monetary base of the US is said to circulate outside the US. See Porter and Judson (1996).

Using the Ifo Institute's Economic Survey International of the first quarter of 2001, we asked 150 economic experts in eastern Europe, typically economists working for international companies, about a potential shift in the interest of ordinary people from the deutschmark to the dollar. Of the 71 people from 15 countries who responded to the poll, a majority of 54% reported that the public showed a growing interest in the dollar, 78% thought that the public had not been sufficiently informed about the introduction of the euro, and another 54% said that the public was at least partly worried that they could suffer losses if they did not soon exchange their German marks into a permanent currency such as the dollar.

The second reason for the returning deutschmarks which also applies to the other European currencies refers to the European black economy. In western Europe there was no particular trend towards an accumulation of black money in the nineties, but there is nevertheless every reason to believe that much of the existing stock of black money is returning to the European central banks because of the virtual nature of the euro. According to the European laws against money laundering the official conversion of larger sums of cash will not be possible in 2002 without registration. People who hold stocks of black European monies therefore have to find ways to gradually convert their currencies outside the banking system before the official conversion date, but they cannot convert them into the euro, because this currency exists only in a virtual form. Thus they have to go into the dollar, the pound or other currencies which are not part of the euro group.

Some of the money returning from eastern Europe, predominantly deutschmarks, may also classify as black. After the Iron Curtain came down, the power vacuum the disintegrated communist states had left was quickly filled by the rapid growth of Mafia and gangster circles, and these are now afraid of having to officially convert their deutschmark denominated assets into euros. According to a recent Washington Post report on our findings, Interpol agents and intelligence officials have estimated that prostitution rings and drug smugglers in former Yugoslavia are currently channeling a sum of deutschmarks worth $600

billion through Europe's foreign exchanges.[22] While this figure refers to financial flows only, which as we argued will not in themselves affect the exchange rate, it does provide indirect evidence for a potential black demand for deutschmark stocks in eastern Europe.

To get an idea of the size of the black stock of money circulating in western Europe, a look a study by Schneider and Ernste (2000) may be useful. According to this study, the share of the black economy in the Euro-11 countries is about 14% of the actual GDP including the black activities. If the black economy used cash and bank money in the same proportions as the official economy does, this would put the share of the black currency in the joint monetary base of the Euro-11 countries also at 14%. In fact, however, the black economy uses only cash as a means of transactions. Thus the black currency share can be expected to be much larger than 14% of the joint monetary base, or larger than 50 billion euros.

Taken together the stock of deutschmarks circulating outside Germany and the stock of black money circulating in western Europe can be expected to be at least 24% of the European stock of currency or 80 billion euros, and possibly it is even much more than 30% of the European stock of currency or more than 100 billion euros. These numbers are not small if compared with previous intervention volumes. George Soros is said to have succeeded to tilt the EMS with only a few billion pounds, and the ECB's frequent interventions to stabilize the euro have probably not exceeded 4 billion euros in total.

It is not fully clear whether the west European black market effect or the effect resulting from the deutschmarks returning from abroad is the larger of the two. However, it does seem clear to us that the latter must have been substantial, for there is evidence that the stock of circulating money balances did not go down in the other Euro-11 countries in the same way as the deutschmark stock declined. We checked the residuals of the money demand function for France, Italy and Spain and unlike the case shown in Figure 6, we could not find

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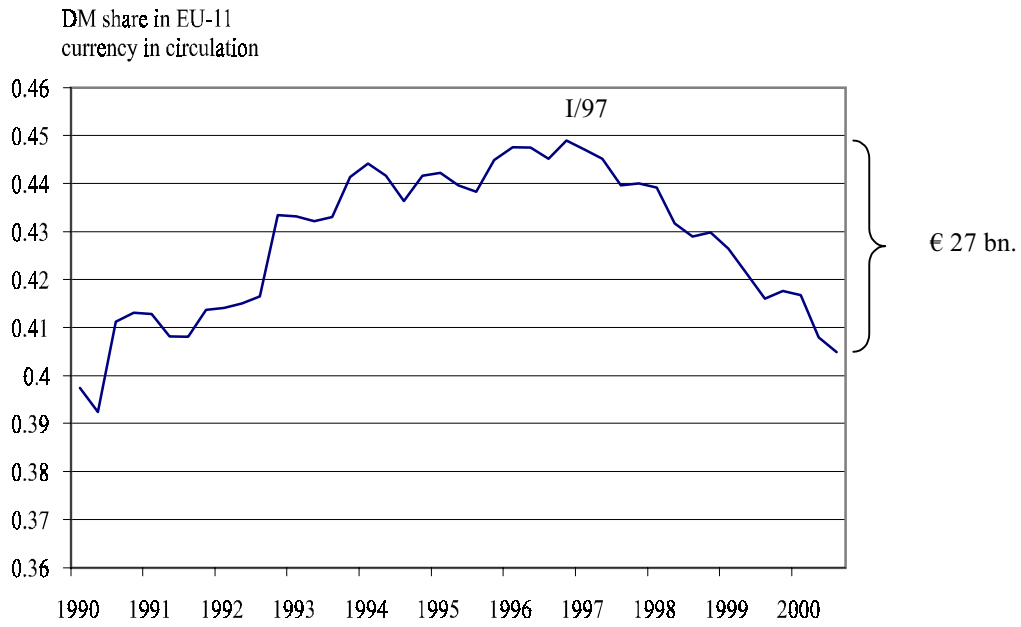
[22] Washington Post, 7 May 2001, also published in International Herald Tribune, same day.

any abnormal pattern. Moreover, as is shown by Figure 7, the share of deutschmarks in the joint Euro-11 stock of money in circulation has declined rapidly in recent years. In the first quarter of 1997, it was nearly 45%, and when the euro was introduced it was still 43%. Two years after the introduction of the euro it had declined to only 40%, and an end of the downward trend is not in sight at this writing. Since Germany's black market share in GDP is not above the European average according to Schneider and Ernste (2000), but the deutschmark is the only European currency that was extensively used in eastern Europe, we find no other explanation for this development than the deutschmarks returning from eastern Europe and other parts of the world.[23]

Figure 7: *DM share in Euro-11 currency in circulation*



Source: IMF, International Financial Statistics, CD-ROM March 2001.
Note: The graphs shows the currency in circulation in Germany as a share of currency in circulation of the EU 11 countries calculated at the official final exchange rate. The levels of the share differ from estimates of the Bundesbank. The time pattern however is similar.

[23] Only a small part of the reduction in the DM share is explained by a decline of Germany's share in aggregate GDP during the relevant period.

Whatever the relative importance of the two effects may be, the fact that ordinary people outside Germany and west European holders of black money have lost their interest in euro currencies is exactly the kind of reduced preference for euros which was modeled by a decline of the utility parameter μ in the previous section. Our theory predicts that this reduced preference would lower the value of the euro and the European interest rate if the ECB did not intervene. The euro and the interest rate would adjust such that the existing stocks of money balances would continue to be held in the international wealth portfolio. If, on the other hand, the ECB intervenes passively so as to stabilize the interest rate, the euro will still decline, although to a lesser extent, and the stock of circulating currency will fall. The mechanism through which this will actually happen is that the euro currency held by foreigners and black market agents goes to international financial agencies (banks and investors) which hold both euro and dollar currencies. Some of the dollars delivered by these agencies come from the Fed in exchange for US bonds and some of the euros received by them go the ECB in exchange for European bonds. In the end, the euro has declined, and there is less US currency and more European currency in the international portfolio of these financial agencies and more US currency and less European currency in the aggregate international portfolio of all private agents taken together, including eastern Europeans and black market agents. This prediction fits the observed decline of the stock of outstanding deutschmarks as shown in Figures 6 and 7 and the simultaneous decline of the euro as shown in Figure 2.

5. EMPIRICAL DETERMINANTS OF THE EXCHANGE RATE

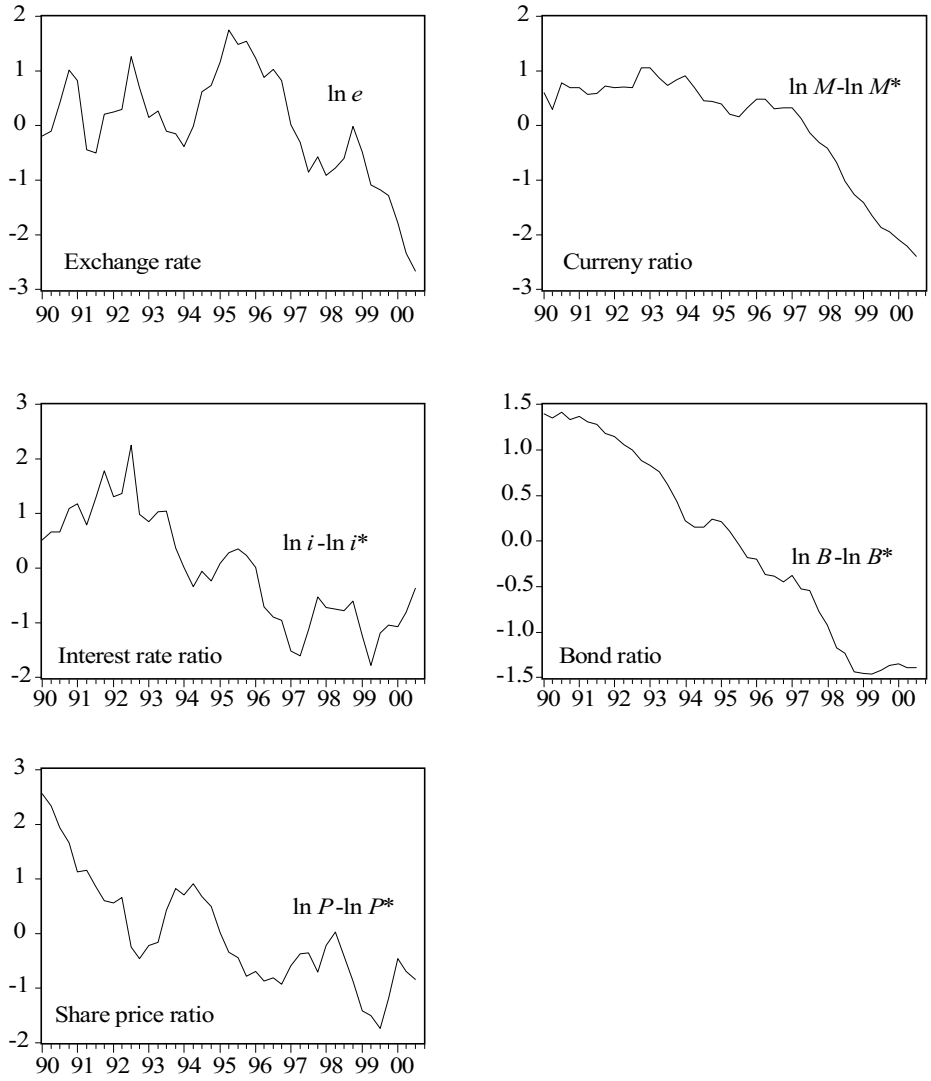
One prediction that fits is no compelling evidence for the truth of a theory. We therefore carried out a number of multiple regression analyses covering the historical episode since the fall of communism to which our theory applies. The question is whether the currency in circulation has a significant positive partial effect on the exchange rate of the euro in the presence of the other variables. We start with a log linear benchmark model whose empirical specification is given by

$$(14) \qquad \ln e_t = \phi_0 + \phi_1(\ln M_t - \ln M^*_t) + \phi_2(\ln i_t - \ln i^*_t) + \phi_3(\ln B_t - \ln B^*_t) + \phi_4(\ln P_t - \ln P^*_t) + u_t \ , \qquad u_t = \phi_5 u_{t-1} + \phi_6 u_{t-2} + \varepsilon_t \ .$$

All variables are defined as in the theoretical model above. The data used are from Germany rather than from the EU-11, because it is the German currency circulating abroad on which our explanation of the euro's weakness is focusing and because, as was mentioned above, we did not find abnormal movements of the other European currency stocks. As stocks of money balances we chose currencies in circulation, bonds we defined according to the IMF classification as including short and long term securities, and as interest rates we took the yields of long term government bonds.[24] Figure 8 shows the time paths of the variables used in the regressions:

[24] We also tried the money market rate, but the coefficient was not significant, possibly because this rate is too dependent on short term changes and speculative expectations. Our central variable, the stock of money in circulation remained significant, however. Overall, the empirical specification appears to be quite sensitive to different definitions of the interest rate.

Figure 8: *Variables included in the regression analysis*



Note: The data used in the regression are at a quarterly frequency. All variables in the graphs as well as in the regression are normalised.
Source: The currency in circulation in the US and the exchange rate data were taken from the Federal Reserve Bank of St. Louis, Economic and Financial database (http://www.stls.frb.org/fred/). All other data come from the IFS CD-Rom, of the IMF. (Time series codes: 13434a.NZF for German currency in circulation, updated with data from the Landeszentralbank Bayern after 1998:4, 11161.ZF and 13461.ZF for long term government bond yields, 11136AB.ZF, 13436N..ZF and 13436N..ZW for stock of bonds and 11162.ZF and13462.ZF for share price indices.)

After testing various specifications, we chose the model which had the best fit according to the Adjusted R^2 and which had reasonable values of the Durbin-Watson test statistic, which measures the autocorrelation in the residuals. The results of the benchmark model are reported in Table 1. The robustness of this model and some econometric issues are discussed thereafter.

Table 2: *A multiple regression*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
constant	0.14	0.29	0.48	0.63
ln *M*-ln *M**	0.94	0.29	3.26	0.00
ln *i*-ln *i**	0.66	0.12	5.27	0.00
ln *B*-ln *B**	-0.69	0.40	-1.72	0.09
ln *P*-ln *P**	-0.23	0.20	-1.16	0.25
u_{t-1}	1.24	0.13	9.15	0.00
u_{t-2}	-0.45	0.12	-3.51	0.00
Adjusted R^2	0.89	Durbin Watson statistic		2.10

Note: The table reports coefficient estimates from the OLS regression in (14). Standard errors and the covariance estimates are heteroskedasticity consistent using the procedure of Newey-West (1987). In order to account for the for the low Durbin Watson test statistic, we included an autoregressive structure for the error term.

The empirical results of the multiple regression confirm our impression from the data analysis and the discussion in the previous sections. The currency in circulation has a significant positive effect on the exchange value of the domestic currency, as predicted. As all variables were standardised, the point estimates are comparable across variables.[26] [27] The standardised coefficients in Table 2 therefore reflect the relative importance of the independent variables, and the currency in circulation has the largest effect on the exchange rate among all variables considered.[28] This firmly excludes the possibility that a policy of

[26] The mean was subtracted and each variable was divided by its standard deviation. The standardised coefficients adjust the regular parameters for the relative standard deviation of the independent variables and the standard deviation of the exchange rate.

[27] Note that a high coefficient does not imply that the contribution to R^2 is large. In fact, the marginal R^2 is fairly low for all variables, reflecting the correlation among exogenous variables as well as the fact that the variance in the exchange rate is much larger than the variance in fundamentals. Among the fundamentals, the contribution of the interest rate to the R^2 is the largest.

[28] The literature based on UIP estimates a similar regression with the growth rate of the exchange rate as the dependent variable. If we do so, the main results remain unchanged, although the effect of the currency in

fixing the interest rates eliminates the effect of currency demand changes on the exchange rate on the ground that American and European bonds are perfect substitutes.

The positive correlation between the monetary base and the foreign exchange value of the currency had also been observed in earlier work by Frankel (1982, 1993), who called it the "mystery of the multiplying marks" and attributed it to model misspecifications or wealth effects in the monetary model of the exchange rate. Indeed the positive correlation seems puzzling if the monetary base is seen as resulting from a supply policy of the central bank and active interventions. However, according to our model, the positive correlation has a straightforward explanation in the historical episode considered here if variations in the foreign and black market demand for a country's currency are taken into account.[29]

The other estimates are also in line with our theoretical model. The positive effect of the interest rate on the value of the domestic currency can have two explanations. One is that it results from an increased preference for the domestic currency which, as indicated by (10) and (11), will imply a revaluation and an increase of the interest rate if the central bank does not intervene. The other is that the central bank actively intervenes by tightening the money supply. According to (11) this increases the difference of the marginal liquidity premia of money and bonds and hence the interest rate, and according to (10) it implies a revaluation.

Bonds have a smaller negative effect, which is mildly statistically significant and may be the counterpart of the positive effect of money holdings since interventions imply that bonds and money balances vary inversely.

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circulation is somewhat weaker and that of the bond ratio is stronger. The effect of the relative stock prices turns positive, but remains insignificant. The specification we chose follows from the theoretical model set up above.

[29] Taylor and MacDonald (1993) have shown that a positive correlation was also observable during the seventies, but not during the eighties and early nineties. Our paper shows that in the nineties the overall correlation is significantly positive again. Over a longer time period this reversal in signs leads to an insignificance of the correlation which could be explained by the prevalence of both supply and demand shocks. The nineties, which are studied here, offer a unique historical experiment because this is clearly a period where the breakdown of the Iron Curtain and the collapse of the eastern European economies created strong demand shocks, as illustrated above.

The insignificance of a correlation between share prices and the exchange rate confirms once again our criticism of the prosperous-economy explanation of the exchange rate. If anything, the negative coefficient supports the impression gained from Figure 5 that the value of an economy's currency varies inversely with its prosperity which is the opposite of what the prosperous-economy view predicts.[30]

It is known from the work of Meese and Rogoff (1983) and Taylor (1995) that the empirical research based on Branson et al. (1977) suffers from instability of the parameters, and poor out-of-sample performance. This criticism is also applicable to our model with respect to the instability of parameters over time, as was pointed out in a footnote above. In order to evaluate our findings in the light of a potential criticism with regard to the estimation procedures, a set of robustness tests was performed, using several different estimation procedures that addressed econometric problems associated with this type of regression exercise.

As is well known, an OLS estimation requires the error terms not to be correlated over time. This was a problem for our first regression test, which showed a high value of the Durbin-Watson test statistic. We solved this problem by explicitly modelling an autoregressive structure of the residuals.[31] A second condition for an OLS regression to be justified is that the variance of the error term is constant over time. We therefore estimated jointly the mean of the exchange rate and the variance of the error terms, allowing for an autoregressive structure in the variance. However, none of the autoregressive terms in the variance equation were significant when autoregressive terms were present in the mean equation. We therefore omitted them in our benchmark regression reported in Table 2.

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[30] An explanation for the negative correlation could be that disappointed domestic shareholders whose preferences exhibit a home bias go into domestic money or domestic bonds forcing the central bank to supply more bonds and to contract the money supply. In both cases the marginal liquidity premium on money balances rises and according to equation (10) the domestic currency appreciates.

[31] A further issue is stationarity of the residuals. A unit root test of the residuals reject the presence of a unit root with an Augmented Dickey-Fuller test statistic of 3.77.

Finally, all of our independent variables are potentially endogenous. For instance the interest rate may react to changes in the exchange rate if the central bank has an external target when conducting monetary policy. In order to lessen the bias which arises from this fact, we used an instrumental variables approach in which lagged values of the exogenous variables were taken as instruments. The assumption here is that the lagged values are correlated with the variable itself, but not with the error term. Overall, our main variable of interest, the currency in circulation, proved to be very robust to alternative specifications of the model. The point estimates of other variables, however, changed in magnitude as well as in their level of significance. Other variables typically used to explain the exchange rate movements in the long run, such as relative GDP figures and relative prices levels, where not statistically significant in our regression, the reason being probably that their effect was already captured by the money demand variable. They were therefore omitted from the estimate.

The robustness tests that were implemented only estimated alternative specifications that address specific econometric problems in our benchmark regression. Certainly the model could be improved further by moving to a full time series specification, which is known to have better forecasting properties since Meese and Rogoff (1983), who contrasted several structural models of exchange rate behaviour to that of a pure univariate time-series specification. However, finding an optimal forecasting model is beyond the scope of this paper.[32]

[32] See Dooley and Isard (1982) for the use of the portfolio-balance model for forecasting purposes. Comparing the various variants of our model, resulting from the alternative emission of explanatory variables, we found that the most parsimonious model which only includes the ratio of currencies in circulation generates the best out-of-sample forecast for the time after the introduction of the euro. That model and the full model containing all explanatory variables proved able to predict the turning points in the exchange rate movement while it was not possible to predict these turning points when the currency in circulation was omitted.

6. CONCLUSIONS

In this paper we tried to explain the weakness of the euro and the strength of the dollar with the fading interest in the deutschmark among the eastern Europeans and the fear of holders of black currency to show their wealth at the bank counter, both effects being attributable to the virtual nature of the euro. We also criticized the prosperous-economy explanation of the strong dollar which used to be the predominant explanation before the American economy began to slump. Using an explicit two country portfolio model with money, bonds and shares, we showed that there is little reason to expect a country's profit expectations to translate into the exchange rate, because these are already reflected in share prices. Instead, we argued that the demand for money in the narrow sense of the word counts most. The exchange rate is the price of one type of money in terms of another and not the price of interest bearing assets, as both portfolio managers and economists who developed the portfolio balances approach have claimed. This theoretical result was confirmed by a number of empirical tests of the exchange rate which demonstrated a strong and robust positive correlation between Germany's stock of currency in circulation relative to the one in the US and the exchange value of its currency, or the euro, for that matter.

The policy implications of our findings raise doubts about the way the European Monetary Union was carried out. In our judgement it could have been a mistake to introduce the euro as a virtual currency, to leave the conversion procedure unclear to the east Europeans and to allow for an extended transition period between the announcement and the physical launch of the new currency. It is too late for corrections now, but at least there is some hope for the Europeans that their currency will appreciate once it is available in physical form, gaining a new standing among the east Europeans and finding its way back into the black markets of western Europe.

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