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OF FUNDAMENTALS: THE CASE OF
THE EURO-DOLLAR RATE**

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ABSTRACT

Exchange Rates in Search of Fundamentals: The Case of the Euro-Dollar Rate*

The decline of the euro against the US dollar during 1999–2000 was mostly unrelated to observable news about the underlying fundamentals. This corroborates a general finding from the empirical literature testing the traditional exchange rate models, i.e. that exchange rate movements are disconnected from the underlying fundamentals. We formulate an hypothesis allowing us to understand this phenomenon. The core of this hypothesis is that movements in the exchange rates ‘anchor’ agents’ beliefs and lead them to search for fundamentals that will justify these beliefs. We also analyse the implications of this view for the transmission of monetary shocks.

JEL Classification: F33, F36 and F42

Keywords: anchoring, exchange rates, monetary policy and rational beliefs

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NON-TECHNICAL SUMMARY

In the first part of the Paper we briefly survey the empirical literature of exchange rate models. We conclude from this survey that there is overwhelming empirical evidence that the exchange rates of the major currencies are mostly unrelated to the fundamentals that economic theory has identified.

In the second part we illustrate this scientific discovery by a case study of the euro-dollar exchange rate during 1999–2000. Since the start of EMU until May 2000 the euro lost 25% of its value against the US dollar. This decline was mostly unrelated to observable news about the underlying fundamentals. We found that, at least if we are willing to look at all the news that our economic models have identified as being of relevance, this news has been more favourable for Euroland than for the US.

We formulate the following interpretation of the lack of relation between the movements of the euro-dollar rate and its underlying fundamentals. There is great uncertainty among economists about how fundamentals affect the exchange rate. This uncertainty is due to the speculative dynamics of the exchange markets in which chartists interact with fundamentalists, producing complex movements of the exchange rate that are mostly unrelated to fundamentals. Because agents are so uncertain about the underlying fundamentals and their impact, the exchange rate movements themselves 'anchor' the market's beliefs and leads it to search for those fundamental variables that can explain the particular exchange rate movement. Thus, when at the start of 1999 the dollar started to move upwards, this became a signal of the fundamental strength of the US economy and the fundamental weakness of Euroland's economy. This set in motion a search for good news about America and bad news about Europe. This search is usually successful because there is often conflicting evidence of underlying strength and weakness. The result of this process was to create (positive) beliefs about the US economy and negative beliefs about the European economy. These in turn reinforced the exchange rate movements.

Such a creation of beliefs should not be considered irrational. It is a rational response in a world of extreme uncertainty about how the economy works and how future developments will affect it. These beliefs, however, work as filters that allow the market to select the news that fit the prevailing beliefs. This filtering process often takes the form of focusing on one (or only a few) fundamental variables. In the euro-dollar market during 1999–2000 the focus of analysts was almost exclusively on the growth performance. However, in other markets (e.g. yen-dollar) during the same period and in the same market during other periods (e.g. DM-dollar) economic growth does not seem to have attracted the analysts' attention at all. Thus, the filtering process leads to large shifts in the weight attached to fundamental variables. This also explains why

econometric models of the exchange rate are marred by frequent structural shifts.

Obviously this process of creating rational beliefs can only go on as long as the facts are not too inconsistent with these beliefs. If the gap between beliefs and facts become too large a turnaround in the exchange rate is imminent, and a new process of creation of rational beliefs is set in motion.

The view of the exchange market developed in this Paper has interesting implications for the way that monetary policies are transmitted in the economy. We argued that in a world where agents' forecasts are driven by beliefs, monetary policies could have very different effects on the exchange rate and the price level depending on the nature of these beliefs. For example, when the market focuses on economic growth as a measure of strength of a currency, a restrictive monetary policy has a very different transmission to the exchange rate and the rate of inflation than when the measure of strength is inflation. We used this insight to claim that under the present set of beliefs that dominate the foreign exchange market, the ECB will find it difficult to control its main policy objective, i.e. the rate of inflation.

1. Introduction

The decline of the euro during 1999 -2000 has come as a surprise to most observers. Few people would have believed when the euro was launched on January 1, 1999, that in less than one and a half year it would lose 25% of its value against the dollar.

Many explanations have been given for this surprising phenomenon. Most of these explanations have invoked fundamental variables, in particular the stronger economic growth performance of the US economy in comparison with the European growth record. We cast doubt on this explanation. Our doubt is influenced by the empirical literature of exchange rate models, which we survey in section 2. We then analyse how important observable fundamentals have been in explaining the movements of the euro-dollar exchange rate, we interpret the results, and we formulate an hypothesis explaining the weak link between the exchange rate and the fundamentals. We conclude with an analysis of the implications of this alternative view for the conduct of monetary policy and for the future of the euro.

2. Exchange rate models: theory and empirical evidence

Economists have developed several models that can guide us to identify the fundamentals that matter for the determination of the exchange rate. We briefly review these models¹.

The flexible price monetary model

This model is built on the assumption that prices are flexible and that purchasing power holds continuously. It is usually written in the following form:

$$s_t = a_1 (m_t - m_t^*) - a_2 (y_t - y_t^*) + a_3 (i_t - i_t^*) + u_t \quad (1)$$

where s_t is the exchange rate in period t , m_t and m_t^* are the domestic and foreign money stocks, y_t and y_t^* are the domestic and foreign output levels and i_t and i_t^* are the domestic and foreign interest rates. All variables (except the interest rates) are expressed in logarithms.

Invoking the Fisher relation

$$i_t = r_t + E_t \pi_{t+1} \quad (2)$$

$$i^*_t = r^*_t + E_t \pi^*_{t+1} \quad (3)$$

where r_t and r^*_t are the domestic and foreign real interest rates and $E_t \pi_{t+1}$ and $E_t \pi^*_{t+1}$ are the expected future rates of inflation in the home and foreign countries. Substituting (2) and (3) into (1) yields

$$s_t = a_1 (m_t - m^*_t) - a_2 (y_t - y^*_t) + a_3 (r_t - r^*_t) + a_3 (E_t \pi_{t+1} - E_t \pi^*_{t+1}) + u_t \quad (4)$$

This simple model says that the fundamentals that matter for the exchange rate determination are the relative money supplies, the relative output levels, the real interest rate differentials and the differentials in the expected rate of inflation.

As it stands, the model does not specify how expectations are formed. The academic consensus is that these expectations should be modelled in the context of rational expectations. Implementing this idea in the monetary model, leads to the conclusion that the exchange rate is determined by the current fundamentals and by the current expectations about the future fundamentals². This analysis also leads to the important insight that changes in the exchange rate today can only come from ‘news’ about the underlying fundamentals. Put differently, since the exchange rate today is determined by the current and expected future fundamentals, it will only change from today to tomorrow if new information about these fundamentals reaches the market.

The sticky-price monetary model (Dornbusch model)

This model has essentially the same underlying fundamentals as the previous one. The only difference is that the assumption of flexible prices is dropped, so that also the purchasing power parity does not hold at each instant in time. It only holds in the long run. The assumption of price stickiness in this model implies that not only the expected future inflation matters but that also past price changes can affect the current exchange rate. All the other conclusions derived from the previous models apply to the sticky price version of the monetary model, in particular the importance of news in the fundamentals for the explanation of changes in the exchange rate.

¹ For a more detailed discussion see e.g. Hallwood and MacDonald(1994), Isard, (1995), Copeland(2000) or any good textbook of international economics.

² For a proof see e.g. Hallwood and MacDonald(1994), p. 161-64.

The *portfolio balance model*

This model has a different starting point than the monetary model. It recognises that the decisions of portfolio holders should be introduced in the analysis. In these models the desire to diversify plays an important role in the determination of the exchange rate. As a result, in addition to the macroeconomic variables included in the monetary models, the portfolio balance models introduce measures of risk premia and stocks of assets expressed in different currencies. In these models the current account has a prominent role because it measures the change in the net foreign asset position of nations and therefore influences the risk premia attached to investments in different currencies³.

The previous exchange rate models have been thoroughly tested since at least twenty years. Three major conclusions stand out from this vast empirical literature.

First, even if economic agents were able to perfectly forecast the future path of the fundamentals, this would not produce a better forecast of the future exchange rate compared to a forecast that does not rely at all on the fundamentals (e.g. random walk). This result was dramatised by the famous Meese and Rogoff studies of the early 1980s who found that the random walk forecast typically works better than a forecast based on an economic model even when that model has access to perfectly anticipated future fundamentals. Although occasionally some researchers have claimed that their model could beat the random walk, the scientific consensus today is that the Meese&Rogoff results still stand.

There is some evidence that when forecasting over a longer horizon, say, more than one year, fundamentals based models sometimes outperform the random walk. It should be borne in mind though, that these fundamentalist forecasts (based on perfect foresight of future fundamentals) use an information set that is much larger than the information set needed to make random walk forecasts. This also implies that the long term forecasts based on the economic models use more information than the short-term forecasts. It is therefore not really surprising that they perform better.

³ For more detail see Hallwood and Macdonald(1994), Copeland(2000).

Independent evidence on PPP also suggests that if there is a long term mechanism driving the exchange rate, it is indeed a very long one⁴.

A second conclusion from the empirical literature is the following. Since the start of the floating exchange rate regime the variability of the exchange rates (both nominal and real) has increased dramatically. At the same time there is no evidence to be found that the variability of the fundamentals identified by the theoretical models has increased compared to the fixed exchange rate period (see Baxter and Stockman(1989) and Flood and Rose(1995)). This is in contradiction with the models we have surveyed, which imply that the variability of the exchange rate can only increase when the variability of the underlying fundamental variables increases. This result has led to the view that the variability of the exchange rates is largely disconnected from the variability of the underlying fundamentals. In their recent paper Obstfeld and Rogoff(2000) have identified this phenomenon to be one of the six major puzzles in international macroeconomics.

A third conclusion relates to the 'news' aspect of the models. As was stressed earlier, the theoretical models of the exchange rate use rational expectations. One important implication is that the exchange rates can only change at any given moment of time as a result of 'news' in the fundamentals. It is fair to conclude now that this feature of the existing models has also been rejected by the data. There is evidence that a large part of the movements of the exchange rate cannot be associated with news (see Goodhart(1989) and Goodhart&Figliuoli(1991)). More recent analysis using structural VARs comes to a similar conclusion. Unanticipated shocks in the fundamental variables explain only a small fraction of the unanticipated changes in the exchange rates. Typically over forecast horizons of up to one year, news in output, inflation, and interest rates explains less than 5% of the total unanticipated variance of the exchange rate. About 95% of the latter is attributable to the news in the exchange rate itself (De Boeck(2000))⁵.

From this scientific evidence only one conclusion can be derived. The models linking the exchange rate to fundamental variables like inflation rates, output growth, interest

⁴ See Rogoff(1996). In this large literature on PPP it is found that it takes 3 to 4 years for half of the adjustment towards PPP to be realised after a shock.

⁵ Again there is some evidence that over longer forecast horizons, the news in fundamentals becomes more important. It remains relatively low, however, remaining far below explaining 50% of the total variance.

rate differentials do not stand when confronted with the empirical evidence. There is little scientific basis for a theory based on the idea that these fundamentals drive the exchange rate⁶. Instead the empirical evidence strongly suggests that the exchange rates of the major currencies are disconnected from fundamental economic variables most of the time. Only over the very long run is there some weak evidence that these fundamentals influence the exchange rate. But the long run is exceedingly long.

In the next section we study a recent period that demonstrates rather spectacularly how disconnected an exchange rate can be from its fundamentals. We will do this in the context of a case study of the euro-dollar exchange rate since 1999. Our analysis of the 1999-2000 period does not have the ambition to prove, but rather to illustrate what others have proved using more rigorous methods.

3. A Case study: the euro-dollar rate during 1999-2000 and the fundamentals.

As argued in the previous section, standard exchange rate models have identified a number of fundamental variables that are potentially capable of influencing the exchange rate. Applying this theory to the euro-dollar rate the following set of fundamentals were selected: the growth rate of the US economy versus Euroland's economy, the inflation differential between the US and Euroland, the relative rates of return of US versus Euroland assets (both short and long term), the current account of the US and of Euroland. Typically these models also stress that it is the *unexpected* part of these variables that affect the change in the exchange rate. In other words, it is the news component in the fundamental variables that lead to changes in the exchange rate. Thus, if the US economy grows unexpectedly faster than Euroland's economy this leads to an appreciation of the dollar versus the euro⁷. Similarly, if the US inflation accelerates unexpectedly relative to Euroland's this leads to a depreciation of the dollar. A similar story can be told about the other fundamental variables. The role of the current account, however, is a little more problematic. An unexpected increase

⁶ Note that this conclusion can only be drawn for the exchange rates of the major currencies. There is evidence that the exchange rates of currencies experiencing very high inflation are responding to inflation differentials. This link, however, between inflation differentials and exchange rates tends to be extremely weak in low inflation environments that has been typical for the dollar, the German mark and the Yen since the last twenty years.

⁷ Note that we follow the models discussed earlier when concluding that an increase in domestic output leads to an appreciation of the currency. If the output increase is the result of a supply shock we may get different results.

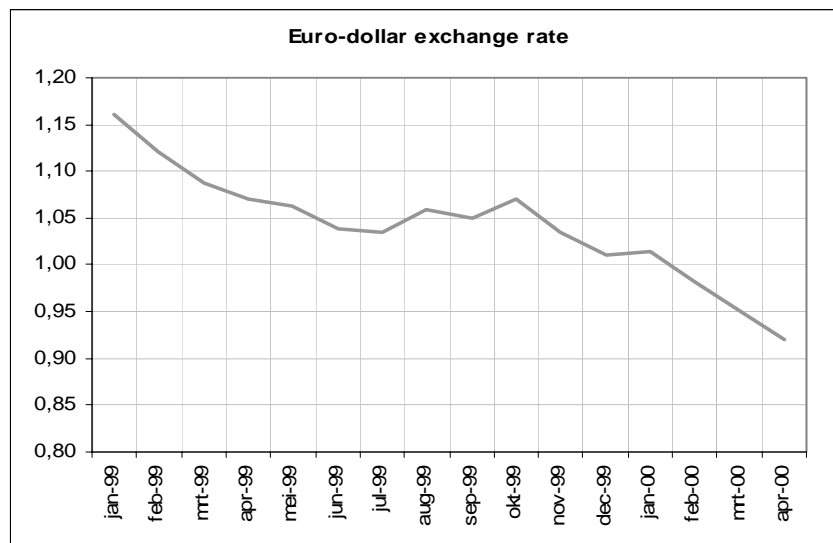
in the current account deficit can lead to an increase in the risk premium and thus to a depreciation of the domestic currency. Alternatively, it can be the result of a capital inflow induced by higher expected returns. In this case the current account deficit will not be associated with a depreciation of the currency. We have to keep this in mind when interpreting the results.

We first present the data about these fundamental variables. Next we estimate the news component in these data and compare these with the change in the dollar exchange rate.

4.1 The data

Figure 1 presents the euro-dollar rate illustrating the steady decline of the euro since the start of 1999 until May 2000. The next figures present a number of fundamental variables. We first concentrate on variables relating to real economic activity. According to the monetary model, strong economic activity (relative to the rest of the world) leads to a strengthening of the domestic currency⁸. We observe that the growth rate of GDP has been consistently higher in the US than in Euroland, but that Euroland's growth rate accelerated faster than the US growth rate so that at the end of 1999 the growth gap had narrowed considerably (Figure 2). This trend seems to have continued in 2000. The data on industrial production confirm this picture. Although at the start of EMU the growth gap of industrial production was almost 3% in favour of the US, this growth differential had completely disappeared in early 2000 (Figure 3).

⁸ We realise that this is a *ceteris paribus* statement. For a fully satisfactory analysis the effects of other variables should be controlled for.

Figure 1:

Source: ECB, Monthly Bulletin, May 2000

Other measures of the real economy tell a similar story. The unemployment rate in the US has been far lower than the unemployment rate in Euroland (Figure 4). However, the differential narrowed somewhat throughout the period. Finally, the US current account was significantly less favourable than Euroland's, and in addition it deteriorated substantially during the period (Figure 5). As mentioned earlier, however, the underlying forces driving the current account deterioration in the US may have been a higher expected return which led to a capital inflow. The high US current account deficit then reflects the favourable investment climate in that country.

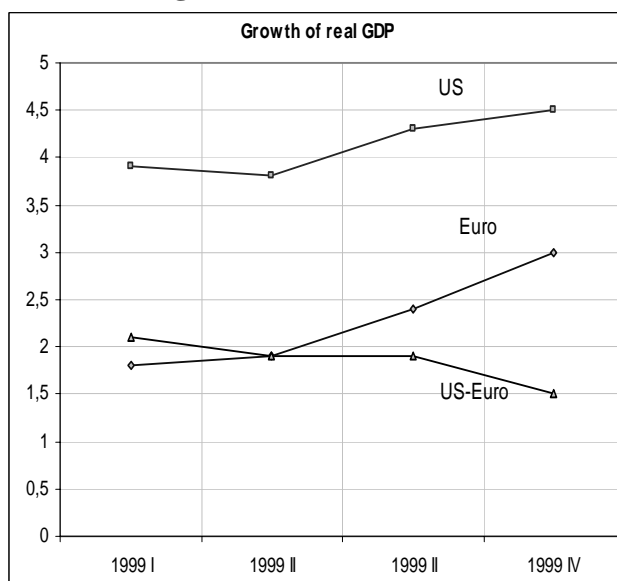
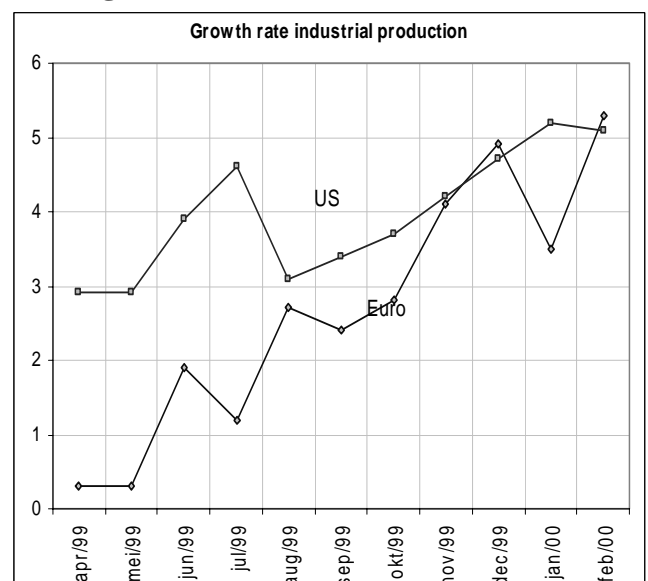
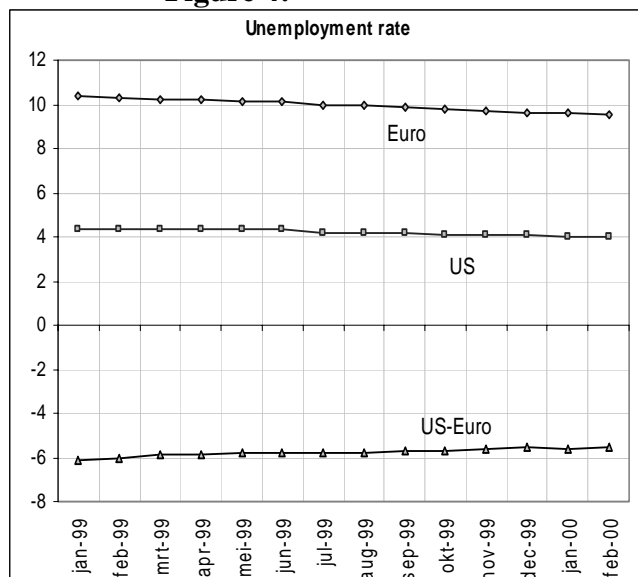
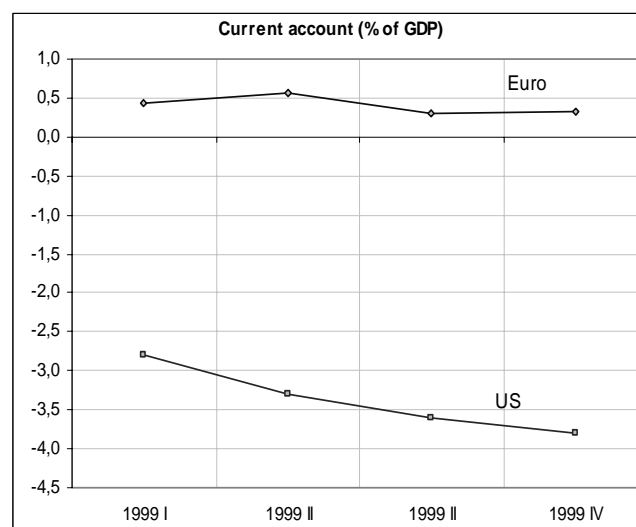
Figure 2:**Figure 3:**

Figure 4:**Figure 5:**

Source: ECB, Monthly Bulletin, May 2000

The next set of fundamentals relates to financial and monetary data. Figure 6 to 8 provide information on the short and long nominal interest rates. We observe that the US rates were systematically higher than the Euro interest rates, but that the gap narrowed towards the end of the period. The difference between the US and the euro rates was more pronounced at the short than at the long end. As a result, the euro yield curve (as measured by the difference between long and short rates) was steeper than the dollar yield curve. This could be interpreted to mean that the markets expected a stronger economic recovery in Euroland than in the US.

Figure 9 shows the rate of inflation. The US experienced a faster inflation than Euroland throughout the period, and this differential increased during 2000. This inflation acceleration also shows up in the real interest rates. The real yield on long term government bonds was approximately equal in both countries (see Figure 10). In 2000, however, the US long-term real yield declined significantly below Euroland's. This phenomenon is mostly associated with the acceleration of the US inflation. Finally the real short term interest rate (Figure 11) was higher in the US than in Euroland throughout the period. However since the end of 1999 the gap narrowed. This could be interpreted to mean that on average the US monetary policy stance was more restrictive in the US than in Euroland. This difference in policy stance narrowed considerably since the start of 2000, however.

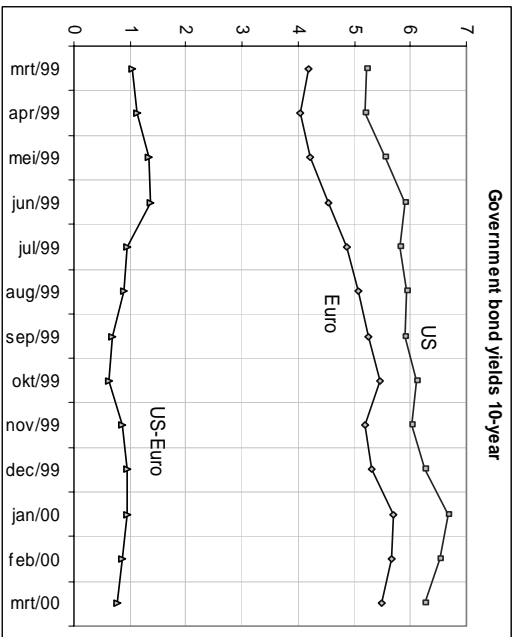


Figure 6:

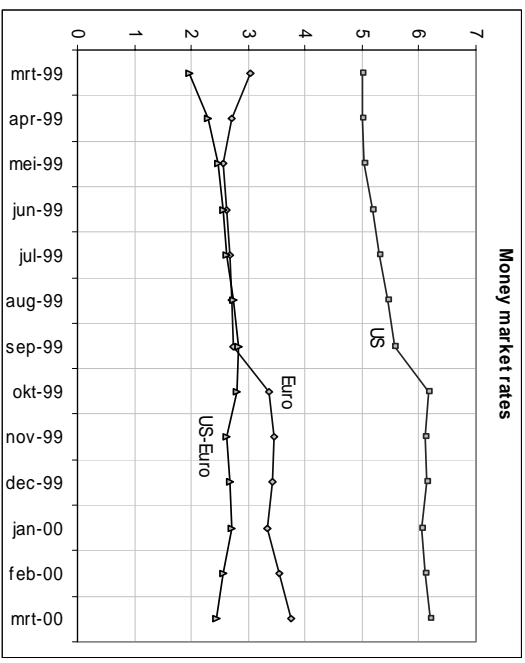


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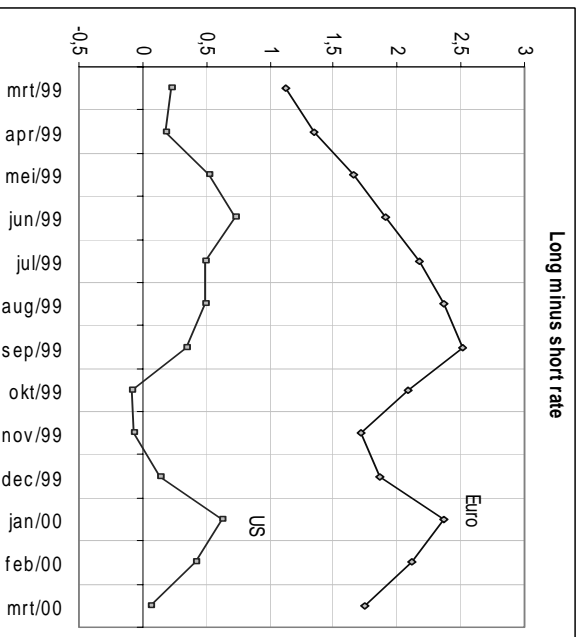


Figure 8

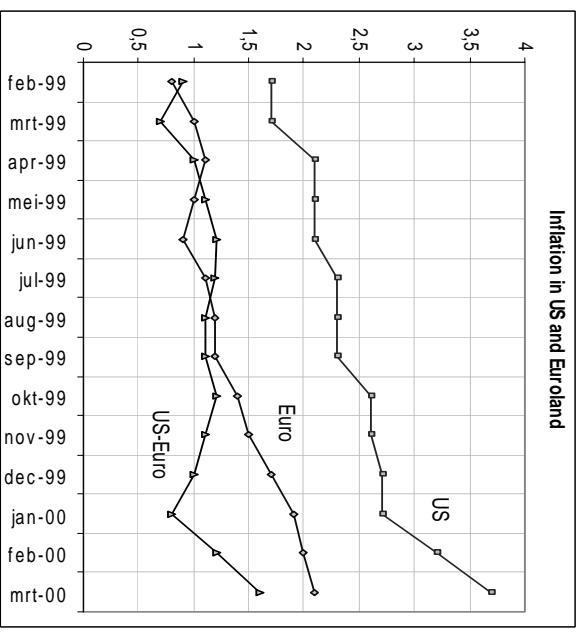


Figure 9

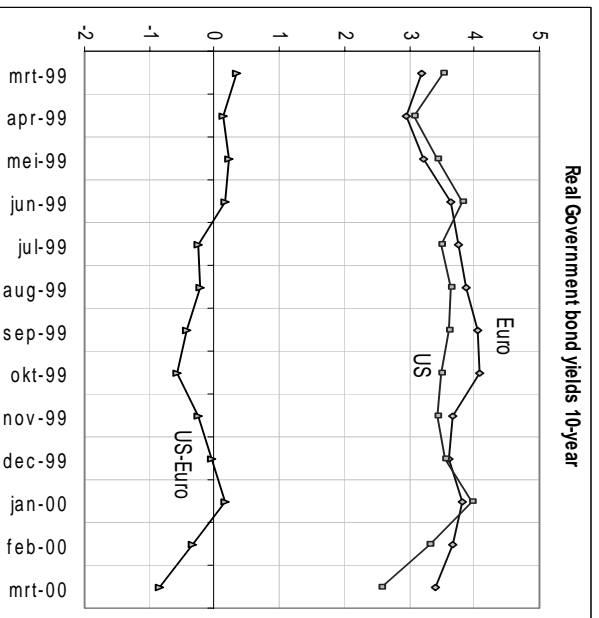


Figure 10

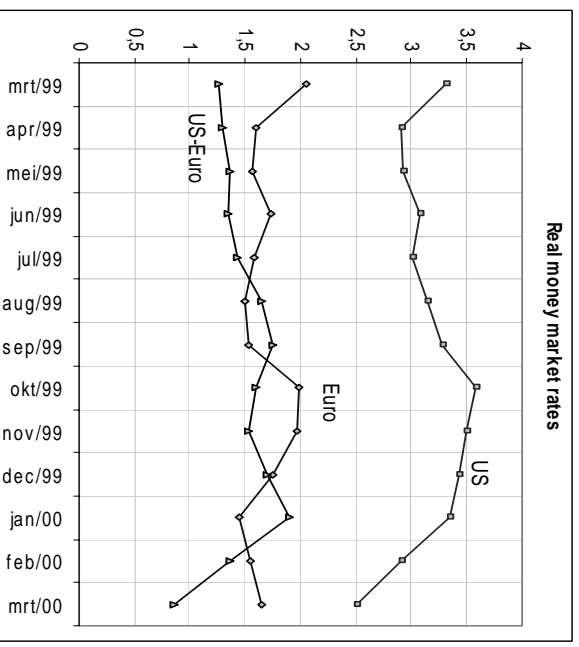


Figure 11

Source: ECB, Monthly Bulletin, May 2000

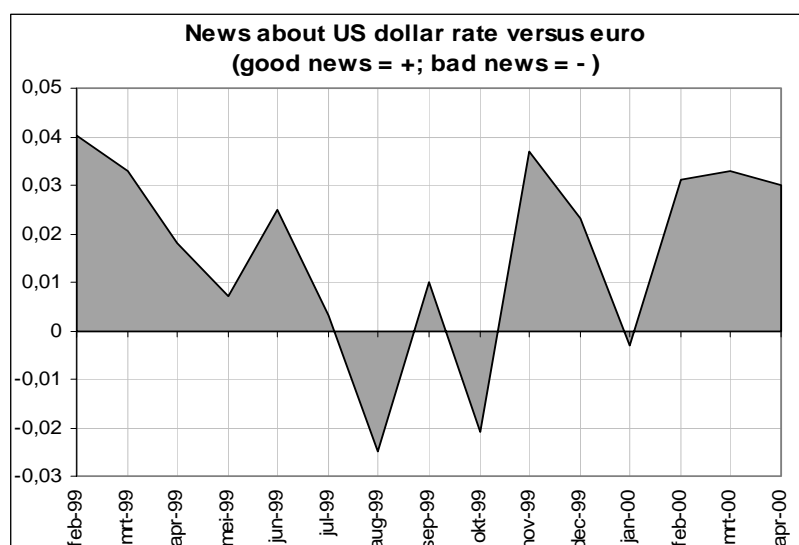
4.2 The news component in the fundamentals.

As argued earlier, traditional exchange rate models tell us that changes in the exchange rates are driven by news in the fundamental variables. Given the limited number of observations about the euro-dollar rate and its determinants, it is not easy to estimate the news component. We took the view that these variables (i.e. the variables presented in the previous section) move pretty much like random walks. In that case the changes in the variables can be considered as expressing news, i.e. we assume that the changes in the exchange rate and in its fundamentals (e.g. the change in the growth rates of GDP and industrial production, the change in the rate of inflation and in the real interest rates, the change in the current account) occurring at time t , are unanticipated. Admittedly, this is a crude assumption, which may affect our results. A more sophisticated analysis will have to wait until we have more data on the euro-dollar rate and its underlying fundamentals⁹.

We first show the news in the euro-dollar rate. An increase in the dollar relative to the euro is labelled *positive news* about the dollar, a decline is called *negative news*. Figure 12 confirms that there has been mostly positive news about the dollar since 1999, i.e. the dollar increased unexpectedly most of the time.

Can the good news about the dollar that prevailed during 1999-2000 be linked to comparable good news about the underlying fundamentals? We show the evidence in the figures 13 to 14. We present the changes in the fundamental US variable relative to the Euro fundamental variable. We identify positive news about the US when the US variable improves relative to the Euro variable and negative news when the opposite happens. Thus, the news about the US is always relative to the news about Euroland.

⁹ Other measures of news require longer time series than those available. For example, we could have taken deviations from trend, or from a moving average. Given the short sample, such measures would not be meaningful. This holds even more strongly for news measures based on VAR. We find comfort from the fact that our results are perfectly consistent with the empirical evidence discussed in section 2.

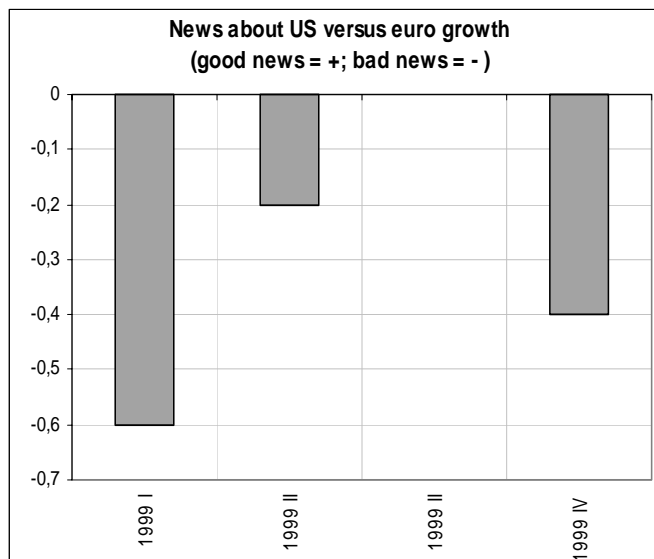
Figure 12

Source: Computed from ECB, Monthly Bulletin, May 2000

The evidence confirms the general conclusion derived from our survey of exchange rate models. Take the relative growth rates of GDP (Figure 13). We find that during the first, second and fourth quarters of 1999 the GDP growth rates in Euroland increased faster than the US growth rates, producing negative news about the US (positive news about Euroland). During the third quarter both growth rates changed by the same percentage, producing no news. Note that this evidence is not in contradiction with the observation that during most of 1999 the news about the US growth rate, considered in isolation, was mostly positive. However, the news about Euroland's growth rate was even more positive. It is the comparison of the two that matters for the exchange rate. For some reason (to which we will return) market participants only seem to have looked at the positive US news¹⁰.

The news about the growth rates of industrial production is somewhat more mixed, although the negative US news is more prevalent than the positive news (Figure 14). This has to do with the observation made earlier that Euroland's industrial production recovered spectacularly during 1999 and 2000 so that in 2000 Euroland's growth rate of industrial production caught up with the buoyant US rate.

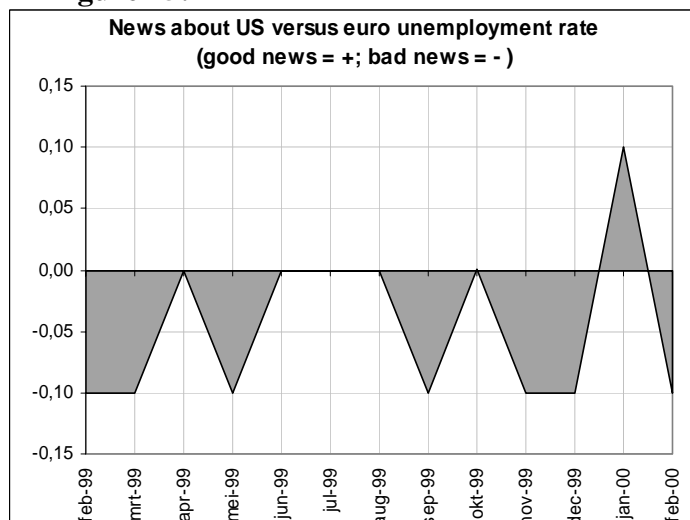
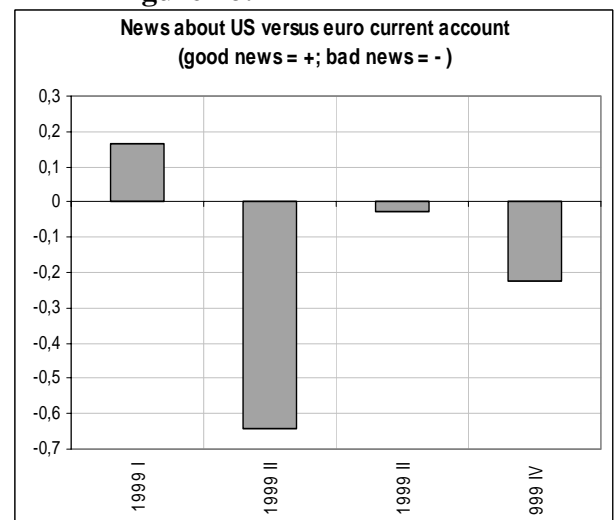
¹⁰ There is evidence that the random walk hypothesis we use to estimate the news component in the US data on economic growth has a negative bias. The general consensus of forecasters was that the US growth rate would go down in 1999 (see BIS(2000)). This did not materialise, however, so that there was a large positive surprise about the US growth performance during 1999. This bias seems to have been limited to the growth data and does not seem to have occurred in our estimates of the news in the other fundamental variables.

Figure 13:**Figure 14:**

Source: Computed from ECB, Monthly Bulletin, May 2000

Something similar happened with unemployment (Figure 15). Despite the fact that the levels of unemployment were much lower in the US than in Europe, the unemployment in Euroland declined (marginally) faster than in the US, producing positive news about Euroland, (negative news about the US).

As mentioned earlier, the news about the current account is more difficult to interpret (figure 16). We have identified an increase of the US current account deficit as bad news for the dollar. But this may not be the correct interpretation. Part of the current account deficit may reflect capital inflows induced by better prospects for rates of return on investment. In that case the deteriorating current account deficit may not be all bad news. There is evidence, however, that the deteriorating current account deficit is also related to a demand led economic recovery. On the whole the current account news remains difficult to interpret.

Figure 15:**Figure 16:**

The empirical evidence about the news in the financial and monetary fundamentals is shown in Figures 17 to 21. Good news in the interest rates means that the interest rate differential favouring US assets increased unexpectedly, while bad news means that this differential declined unexpectedly. As far as the short rates are concerned, we observe that the good news for the US of the early part of the period turned into bad news in 2000. The results for the long-term bond yields are not as clear-cut.

The news about the inflation differential is shown in Figure 19. (Note that an unexpected increase in the inflation differential between the US and Euroland should be interpreted as bad news for the US). On the whole bad news about the US dominates the good news. The striking fact here is the strong negative news for the US since the start of 2000, reflecting the acceleration of the US inflation rates. The evidence about the real rates (Figures 20-21) reveals a similar picture. Alternation of good and bad news (with somewhat more bad news as far as the long term real rate is concerned), and a movement towards strong negative news since the start of 2000.

Figure 17

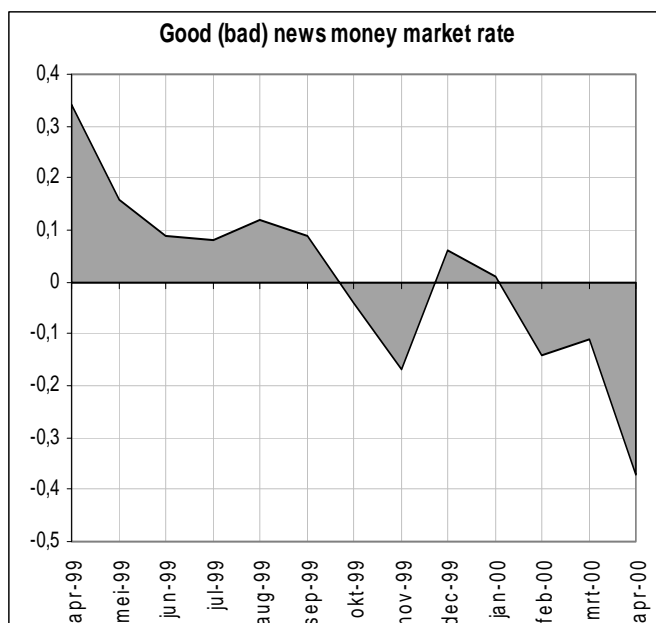
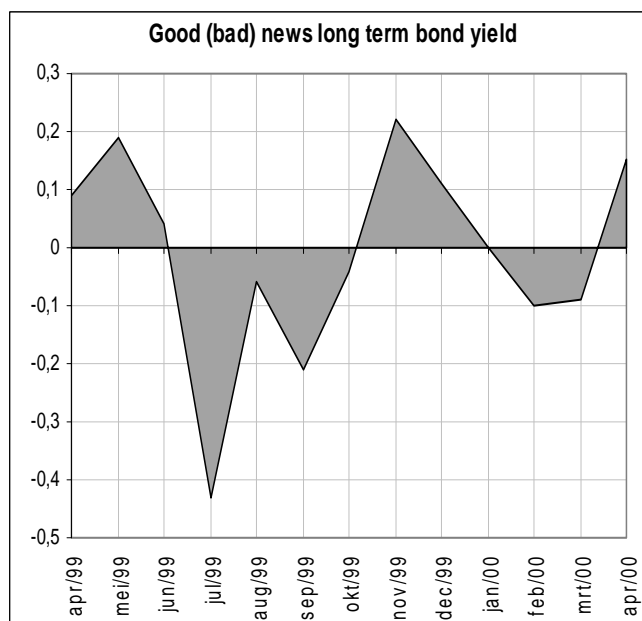
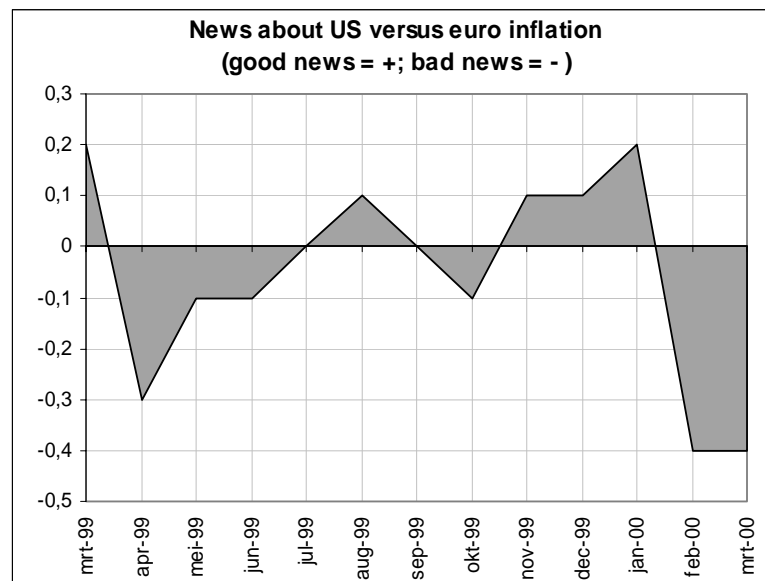
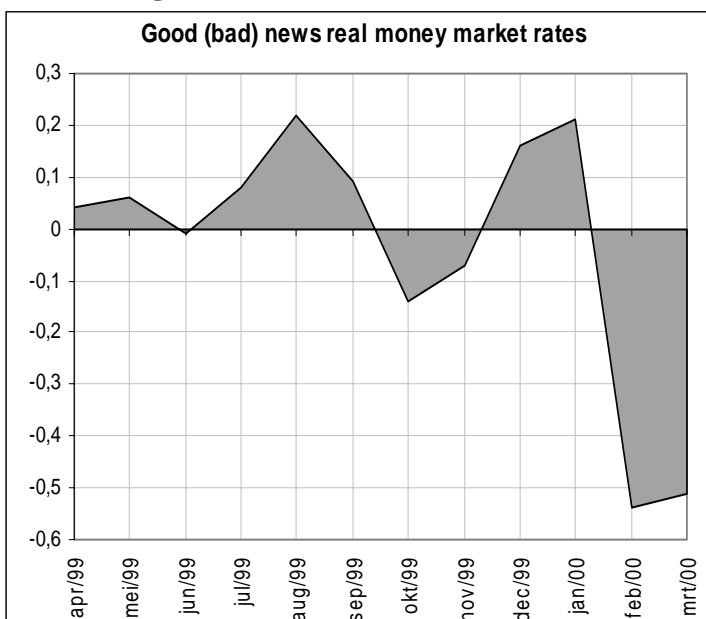
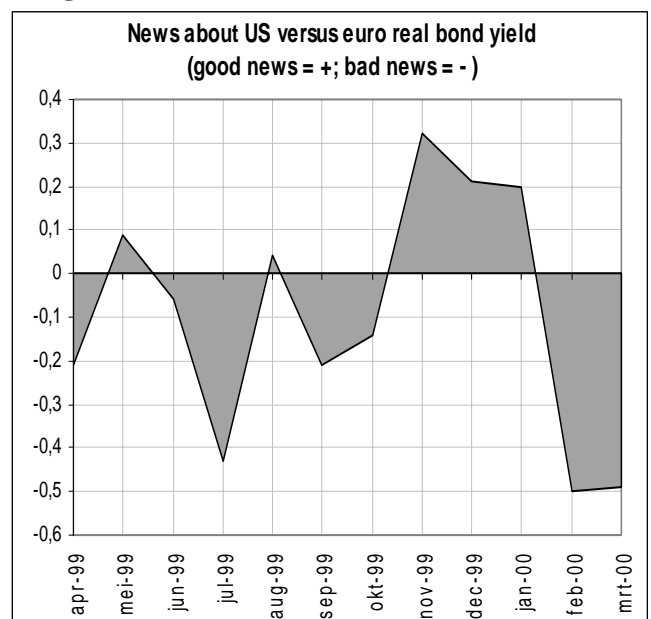


Figure 18:



Source: Computed from ECB, Monthly Bulletin, May 2000

Figure 19:**Figure 20:****Figure 21:**

Source: computed from ECB, Monthly Bulletin, May 2000

The previous evidence confirms the scientific evidence about the weak link between the exchange rate and the fundamentals as discussed in the previous section. Since the start of EMU the news about the dollar has been mostly positive, i.e. the dollar has appreciated quite unexpectedly. This positive news about the dollar cannot be associated with corresponding good news about the underlying fundamentals that the theory tells us drives the dollar. We found that on the whole the observable news

about the US fundamentals has not been more favourable than the news about Eurolands's fundamentals.

The broader scientific evidence discussed in the previous section, together with the case study evidence about the recent movements in the euro-dollar rate raise a number of issues. On the one hand, the scientific evidence overwhelmingly rejects models that explain the movements of the exchange rates by the movements of underlying fundamentals. It is now a well-established scientific truth that the exchange rate is disconnected from fundamentals. If there is a relation between the exchange rate and the fundamentals it is a fuzzy and unstable one, that cannot be used to explain exchange rate movements, let alone to predict these.

On the other hand we observe that analysts and practical men continue to rely on these models (or fractions of these models) to explain the movements of the exchange rates. This raises the following question. Why is it that these practical men almost invariably explain exchange rate movements based on fundamental economic variables, while science tells us that there is no observably stable link between exchange rates and fundamentals? In the next section we deal with this issue, focusing on the euro-dollar exchange rate.

4. The exchange rates in search of fundamentals

We propose the following explanation. There is great uncertainty about the true equilibrium value of the exchange rate. This uncertainty has two sources. The first one arises from the fact that it is very difficult to forecast the future value of the fundamentals. The other source of uncertainty comes from our lack of knowledge of the transmission process from the fundamentals to the exchange rate. The latter source of uncertainty has been underestimated in the academic literature which has focused mainly on our poor capacity to forecast future fundamentals.

The uncertainty about the nature of the transmission process from the fundamentals to the exchange rate can be called an endogenous uncertainty. It arises as a result of the speculative dynamics in the foreign exchange markets. In De Grauwe et al.(1993) it was shown that relatively simple models incorporating the interaction between chartists and fundamentalists create a complex (chaotic) dynamics of the exchange

rate¹¹. This dynamics has two features. The first one is that the exchange rate is dissociated from the underlying fundamentals. The second one is that for all practical purposes it is impossible to recover the economic structure underlying this dynamics with econometric techniques.

This endogenous uncertainty about the link between the fundamentals and the exchange rate has an important implication. The human mind does not easily accept agnosticism. It will try to fill the void. The movements in the exchange rate, when sustained in one or the other direction, set in motion a search of fundamental variables, including unobservable ones, that can explain this movement in the exchange rate. Thus, when the dollar starts moving up, this will be considered as evidence of strength of the US economy. Analysts will start a search of good news about the American economy, thereby carefully disregarding the bad news. Sure enough, good news will be found (high growth rates, new economy, US flexibility), and bad news will be erased (unsustainable consumer debt accumulation, large current account deficits, increasing inflation). This selection process makes sense. In a very uncertain world in which we do not know much about the link between (present and future) fundamental variables and the exchange rate, the movement in the latter becomes *prima facie* evidence that the fundamentals must be moving in the right direction. If some don't, they can't be important, and they are eliminated. Thus, the upward movements of the dollar create beliefs about the strength of the US economy that can always be illustrated by a careful selection of fundamentals, observable and unobservable ones. This selection process is not irrational. It is a rational response in a world of great uncertainty¹².

This information processing is akin to what economic psychologists have called "anchoring" (see e.g. Kahneman and Tsversky(1981), (1984), Thaler(1994))¹³. In an uncertain world, agents are very much influenced by recent memories or readily

¹¹ Chartists make forecasts based on past movements of the exchange rate, while fundamentalists compute the equilibrium rate (based on fundamentals) and assume that the market exchange rate will return to the equilibrium value when it deviates. For empirical evidence on the importance of chartists, see Taylor and Allen(1992). For a well-known formalisation see Frankel and Froot (1986). For other formalisations of the same idea see De Long et al.(1990).

¹² See M. Kurz(1994) who formalised the idea of rational beliefs as an alternative to rational expectations. See also Kurz and Motolese(2000).

available information. The movements of the exchange rate perform this function: recent increases in the dollar influence agents' beliefs about inherent strength of the US. The belief that is created by this anchoring mechanism then leads agents to confirm these beliefs by carefully selecting corroborating evidence.

The mirror image for the euro can easily be told. When the euro starts declining this becomes evidence that there are fundamental problems with the European economy. The decline of the euro, therefore, triggers a search for bad news about the European economy. Sure enough, bad news about European rigidities has been around for thirty years, waiting to be rediscovered in bad times by young analysts. At the same time the good news (unexpected high growth rates, better inflation record than the US) cannot be important because the euro is weak, and is disregarded. The declining euro creates rational beliefs of a weak European economy.

These beliefs then reinforce the movements of the exchange rate. The dollar increases further and the euro continues its decline, which in turn adds to the conviction that the beliefs are the true representations of reality. The increase in the dollar is treated as accumulating evidence in favour of the prevailing optimistic beliefs about the US economy. Exactly the reverse happens in Europe.

In a sense one can say that the market operates pretty much in the way scientific discoveries are made. Based on the movements of the exchange rate, theories (rational beliefs) are developed about the underlying economic structure. These theories are then confronted with the data. As long as no glaring inconsistencies between the data and the theories are detected the beliefs are maintained. The big difference between the market process of finding truth and science's way is that the former affects the observed data. Thus, as mentioned earlier, the optimistic beliefs about the US economy actually affect the dollar and reinforce the belief about the good health of the US economy.

This process can last for a while, like during 1980-85 when optimistic beliefs about the US economy (Reagonomics and all that) and pessimistic beliefs about Europe (Eurosclerosis) were driving the market for five years. At some point too many discrepancies between facts and beliefs accumulate, reducing the credibility of the

¹³ This effect is also called "framing", i.e. the last available information works as a frame within which information is interpreted. Steil(1992) has applied this idea in the context of corporate foreign exchange risk management.

latter. A small trigger that leads to a turn in the market can then reverse the process, leading after a while to a new process of rational construction of opposite beliefs.

During the 1980s, the small trigger may have been the agreement in early 1985 to intervene in the foreign exchange market, which initiated the decline of the dollar. After a while stories about weaknesses of the American economy started to appear on the Reuters screens and in the financial press. The main story of that day was the “short-termism” of the American financial markets that led American managers to care only about this quarters’ profit. This then prevented them from making long term strategic decisions. The reverse was told about Japan and Germany. Japanese and German managers were shielded from the pressure of short-term profitability because of their close relationship with banks and financial institutions. As a result, they made decisions that duly took into account the long-term interests of the companies. This “superior” model of finance and management became the rational belief of the day which “explained” the increasing strength of the mark and the yen.

The core of the explanation we propose here is that it is not the news in the fundamentals that drives the exchange rate changes, but rather the other way around. Changes in the exchange rate “anchor” the beliefs of market participants and lead them to a selection of news about the fundamentals (present and future) that is consistent with the observed exchange rate changes. All this does not mean that the fundamentals don’t matter. They do. Europe has a lot of rigidities; the European Central Bank still has to establish its credibility; conflicts within EMU could become a problem. But there is also a lot of good fundamental news about Europe that remained dormant during the first one and a half year of the existence of the euro, but that will be re-activated when a turnaround in the exchange rate occurs. The market will then start giving a much higher weight to this news than it was willing to do before when the prevailing beliefs prevented it from doing so.

5. Exchange rates and stock prices

Theory tells us that like exchange rates, stock prices are driven by expectations about present and future fundamentals. When news about these fundamentals hit the market, the stock prices will change. In the case of stock prices these fundamentals are measures of profitability. The latter in turn are influenced by macroeconomic

fundamentals such as the state of economic activity, inflation, interest rates. To a certain degree, therefore, stock prices, especially stock price indices, are influenced by the same fundamentals as the exchange rates.

In figure 22 we show indices of share prices in Euroland and in the US. The most striking feature is the fact that while in the first part of the sample period both indices evolved in a similar way, things were very different in the second half, when the Euroland stock prices experienced much higher increases than the US stock prices.

It is useful to compare the trend in the stock prices with the euro-dollar exchange rate. This is done in figure 23, where we show the euro-dollar exchange rate together with the ratio of the share price indices of Euroland versus the US. We observe that from October 1999 to March 2000, when the euro experienced a steep decent, the correlation with the relative stock price index was negative, i.e. while the euro was declining sharply the stock markets in Euroland were booming much more strongly than in Wall Street. This is a puzzling phenomenon. The relative stock market index suggests that the stock markets were more optimistic about the European economy than about the US economy, while at the same time the euro-dollar exchange rate suggests that the exchange market was more optimistic about the US economy than about the European one. We leave it to future research to unravel this puzzle.

Figure 22:

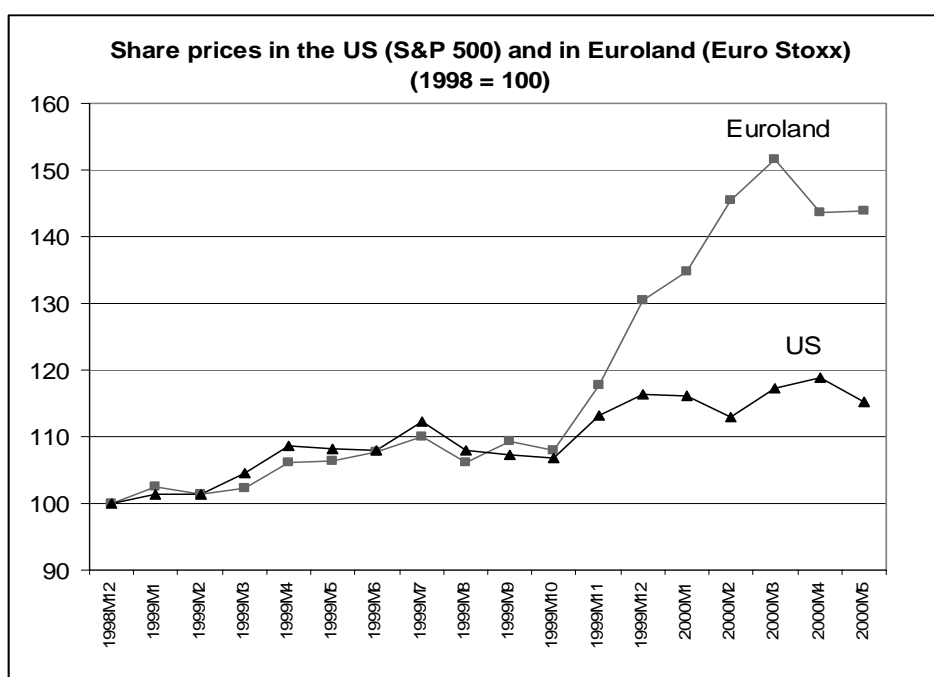
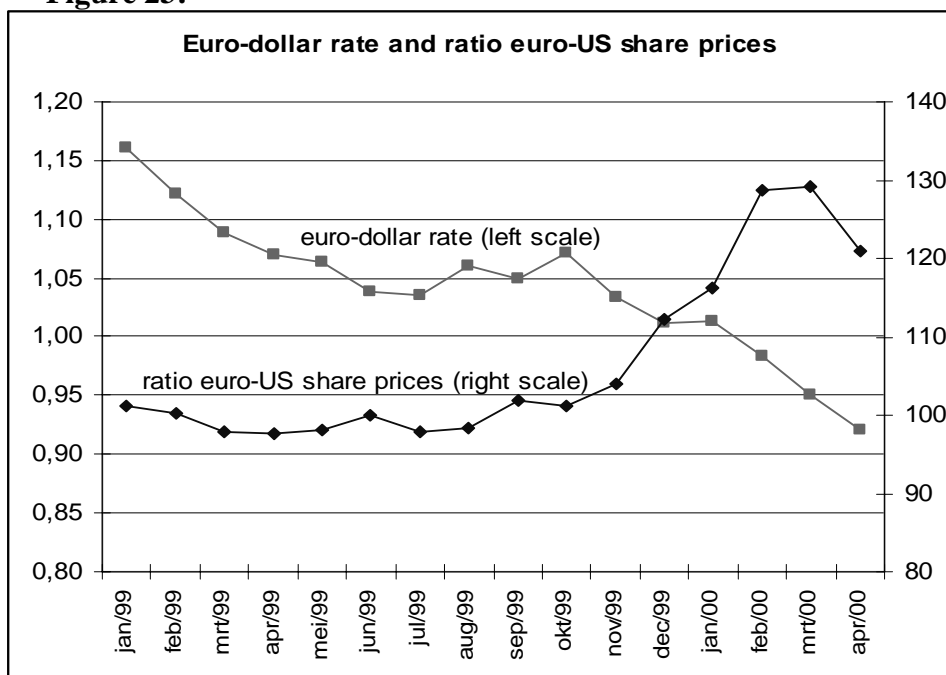


Figure 23:

Source: ECB, Monthly bulletin

6. Some additional evidence

In recent papers Corsetti and Pesenti(1999), and Corsetti(2000) presented intriguing evidence indicating that the euro-dollar exchange rate during 1999-2000 was very well explained by (survey based) revisions of the forecasts of the growth rates of output in the US and in Euroland. When the growth rate in the US was expected to increase relative to Euroland this had the effect of increasing the value of the dollar relative to the euro. Corsetti and Pesenti noted that the expected growth rate differentials were the most important variable explaining the euro-dollar rate during 1999-2000. They also found, however, that this tight link between growth forecasts and exchange rates does not hold for other currencies during the same period (e.g. the yen-dollar exchange rate¹⁴). This tight link between growth forecasts and the dollar exchange rates in other periods does not seem to have been observed either.

This phenomenon can easily be explained by the hypothesis proposed in the previous section. Since the end of 1998 the markets have been increasingly influenced by

positive beliefs about the growth potential of the US economy, which in turn have been very much influenced by stories concerning the marvels of the new economy. As a result of such beliefs, agents have focused on the one variable that provides evidence about these beliefs, i.e. the growth rate of output. At the same time, these agents have almost totally disregarded other fundamental variables that according to the theory are equally important to determine the exchange rate, e.g. inflation differentials, current accounts, and other variables. These have received close to zero weight. Thus, the tight fit between growth forecasts and the exchange rate is not the result of an immutable law that links the exchange rate to economic growth differentials, but rather to a passing belief that this is the only variable that matters. In other exchange markets (e.g. the yen-dollar market) or in other periods when beliefs were different, this strong link breaks down. During the 1970s for example the markets focused almost exclusively on inflation differentials and the growth rates of the money stock. They could not care less about growth differentials. Something similar happened during the 1990s with interesting results. During 1992-96 the US economy grew at twice the rate observed in Germany (3.0% versus 1.5% per year). This did not prevent the dollar from depreciating vis-à-vis the German mark (from 2 to 1.9 DM). During that period nobody talked about new economy wonders and thus few observers cared to attach importance to a major differential in economic growth between the US and Germany.

This shifting selection of the variables that market participants care to look at, goes a long way in explaining the observed instability of the link between the exchange rate and the fundamental variables. This unstable relationship was dramatised by the empirical studies of Meese and Rogoff. Our explanation allows us to better understand this result.

7. Implications for monetary policies and for the future of the euro

The hypothesis formulated in this paper about how the exchange rates are determined has a number of implications. It should be stressed that much of the discussion that follows is speculative, as the main hypothesis requires further testing. Nevertheless it

¹⁴ One of the greatest puzzles of the 1999-2000 period is the fact that the growth rate of Japanese output was dismally low both compared to the US and to Europe, and yet the yen appreciated against the dollar.

is interesting to speculate about the possible implications of a theory that puts great emphasis on agents' beliefs. We will look first into the implications for monetary policies in general and then for foreign exchange market interventions. This analysis will also lead to some thoughts about the future evolution of the euro-dollar exchange rate.

7.1 Monetary policies and rational beliefs.

The selection of particular variables by market participants to judge the economic success of a country has important implications for the transmission of monetary policies. To illustrate this, let us take the current focus of the markets on economic growth. The implication for the transmission of monetary policies can then be described as follows. Suppose the ECB raises the interest rate in order to bring back the rate of inflation to its targeted level of (at most) 2%. This restrictive policy has a negative effect on output growth. Since market participants focus on the latter variable to make forecasts about the euro-dollar rate their beliefs about a weak Euroland are reinforced. This leads to a further depreciation of the euro. Thus a monetary restriction leads to both a reduction of economic activity and a depreciation of the currency¹⁵. The effect on inflation is ambiguous. The reduction in aggregate demand produced by monetary restriction reduces inflation. However, the depreciation of the currency adds to inflation. In any case, one can conclude that the existence of beliefs that focus on economic growth performance reduces the effectiveness of monetary policies aimed at controlling inflation. Thus, as long as the beliefs in the foreign exchange markets are dominated by perceptions of strength in America and weakness in Europe, the ECB's policies aimed at keeping inflation in check will be handicapped. The latter conclusion can also be made clear by analysing monetary policies in an environment where the market focuses on inflation.

The transmission of the same monetary policy when the markets focus on inflation (like they did in the 1970s) is very different. An increase in the interest rate induced by monetary restriction now leads to an appreciation of the currency. The reason is that the market anticipates that the monetary restriction will reduce inflationary pressures. Since inflation is the measure of strength of the currency, the markets applaud and expect an appreciation of the currency. The appreciation of the currency now reinforces the anti-inflationary stance of the central bank.

All this leads to the conclusion that the effectiveness of the central bank's monetary policies depends on the existing beliefs about strength and weakness of the economy. It also leads to the conclusion that the transmission of monetary policies is very unpredictable. Its sign depends on beliefs. Since these beliefs change, the same policies in different periods and countries can have drastically different effects on the exchange rate and on the price level.

There is some empirical evidence that substantiates this conclusion. VAR analysis of the transmission of monetary policies has detected a so-called price puzzle and an exchange rate puzzle, i.e. it has been found that during some periods and in some countries a monetary contraction leads to an increase in the price level and a depreciation of the currency¹⁶. Whether this finding is strong enough to be used as evidence for the hypothesis formulated in this paper remains to be seen. Nevertheless the idea that rational beliefs matter does not seem to be inconsistent with a number of puzzles that have been detected empirically.

The previous analysis also leads to a more general conclusion. When markets and policy-makers focus on different variables, the quality of policy-making is reduced. Thus, when markets focus on economic activity as a measure of economic success, while the monetary authorities focus on inflation, it will be more difficult to keep inflation in check, than when both the market and the authorities focus on the same variables. In the latter case the quality of policy-making is high. This may be the situation in which the US monetary authorities have found themselves over the last few years. Both the market and the authorities have focused on economic growth¹⁷.

It has not always been this way. During the 1970s when the markets were focusing on inflation as their measure of success, the US monetary authorities were following Keynesian policies of demand management. The inconsistency of these policies with the markets' yardstick of success (inflation) led to a poor quality of monetary policy-making, i.e. accelerating inflation and a depreciating currency.

¹⁵ Marani(1999) has formulated a similar hypothesis.

¹⁶ Sims(1992), Grilli and Roubini(1996), Koray and McMillin(1999) and Marani(1999) found an exchange rate puzzle for some currencies. Christiano, Eichenbaum and Evans(1994) and Fuhrer(1997) found price puzzles.

7.2 Foreign exchange market interventions and rational beliefs

The preceding analysis has implications for the effectiveness of foreign exchange market interventions. The most obvious implication is that interventions in the foreign exchange markets only work if they affect prevailing beliefs. Since these interventions rarely do so, they are unlikely to have much effect. This conclusion holds whether or not interventions are sterilised or unsterilised. As will be remembered, sterilised interventions do not affect domestic monetary conditions (e.g. the interest rate) while unsterilised interventions do. This distinction has been very much stressed in the literature, leading to the consensus that unsterilised interventions are effective, while sterilised interventions are not. Our analysis makes clear that this distinction between sterilised and unsterilised intervention is irrelevant when the markets are guided by beliefs rather than facts. Paradoxically, unsterilised intervention in the present context in which the markets focus on economic growth to measure the strength of a currency, may be worse than sterilised intervention. If the ECB were to engage in unsterilised intervention to push up the value of the euro, this would mean that the euro-interest rates increase. The negative effect this would have on economic activity would then, given the prevailing beliefs, weaken the euro further. This leads to the conclusion that the best possible attitude of the ECB is one of benign neglect. Sooner or later, the prevailing beliefs, dissociated as they are from reality will change bringing about a turnaround in the exchange rate.

All this does not mean that foreign exchange market interventions never work. There are exceptional circumstances when they do. This will occur when the divergence between prevailing beliefs and economic reality becomes too great. This happened for example in 1985 when the dollar was pushed to record high levels. The concerted intervention by the US, the German and Japanese authorities led to a decline of the dollar and convinced the market that the high dollar rate was based on fiction. This then led to a precipitous decline of the dollar.

Something similar could happen in the future. It is likely, however, that the euro will have to decline even further for interventions to produce the trigger effect that finally

¹⁷ This does not mean that the Fed did not care about inflation. It did, but is surely has attached less importance to fighting inflation than the ECB, and has concomitantly been willing to stimulate the economy more than the ECB probably would have done.

brings the market to realise that there is more than the growth rates of output to watch as a yardstick for the strength of a currency.

7.3 Implications for the future of the euro

It is very hazardous to make predictions about the future of the euro. Nevertheless some general insights can be gained from the previous analysis. A first insight is that beliefs change. The present beliefs about the strength of the US economy relative to the European economies are temporary. They will change when it becomes obvious that the US economy presents weaknesses that make the present rate of growth of the economy unsustainable. The market will then rediscover these weaknesses of the US economy and by the same token the relative strength of the European economies. This will then lead to a turnaround in the euro-dollar rate. When this will happen, however, is impossible to say.

A second insight has to do with the gap between the measures of success the market is focusing on and those the monetary authorities watch. The main reason for the weakness of the euro has to do with the fact that the market focuses almost exclusively on the growth rate of the economy, while the ECB focuses almost exclusively on price stability. When the ECB acts to achieve its measure of success (price stability) it worsens the measure of success the market is concentrating on (output growth). As long as this inconsistency exists the euro is likely to remain weak. How can the ECB deal with this? One possibility would be for the ECB to be a little more relaxed about inflation, and to measure success of its policy by taking into account the growth rate of economic activity. Given its strong mandate for price stability enshrined in its statutes, however, this possibility is very much limited.

There seems to be very little left than “to sweat it out”. As argued earlier, the present beliefs are unsustainable. When new beliefs gain prominence, the market will also switch from its single-minded focus on growth rates to other measures of success. This will strengthen the euro and make life easier for the ECB.

8. Conclusion

There is overwhelming empirical evidence that the exchange rates of the major currencies are mostly unrelated to the fundamentals that economic theory has identified. We illustrated this scientific discovery by a case study of the euro-dollar exchange rate during 1999-2000. Since the start of EMU until May 2000 the euro lost 25% of its value against the dollar. This decline was mostly unrelated to observable news about the underlying fundamentals. We found that, at least if we are willing to look at all the news that our economic models have identified as being of relevance, this news has been more favourable for Euroland than for the US.

We formulated the following interpretation of the lack of relation between the movements of the euro-dollar rate and its underlying fundamentals. There is great uncertainty among economists about how fundamentals affect the exchange rate. This uncertainty is due to the speculative dynamics of the exchange markets in which chartists interact with fundamentalists, producing complex movements of the exchange rate that are mostly unrelated to fundamentals. Because agents are so uncertain about the underlying fundamentals and their impact, the exchange rate movements themselves “anchor” the market’s beliefs and leads it to search for those fundamental variables that can explain the particular exchange rate movement. Thus, when at the start of 1999 the dollar started to move upwards, this became a signal of fundamental strength of the US economy and fundamental weakness of Euroland’s economy. This set in motion a search for good news about America and bad news about Europe. This search is usually successful because there is often conflicting evidence of underlying strength and weakness. The result of this process was to create (positive) beliefs about the US economy and negative beliefs about the European economy. These in turn reinforced the exchange rate movements.

Such a creation of beliefs should not be considered irrational. It is a rational response in a world of extreme uncertainty about how the economy works and how future developments will affect it. These beliefs, however, work as filters that allow the market to select the news that fit the prevailing beliefs. This filtering process often takes the form of focusing on one (or only a few) fundamental variables. In the euro-dollar market during 1999-2000 the focus of analysts was almost exclusively on the growth performance. However, in other markets (e.g. yen-dollar) during the same period and in the same market during other periods (e.g. DM-dollar during 1992-96)

economic growth does not seem to have attracted the analysts' attention at all. Thus, the filtering process leads to large shifts in the weight attached to fundamental variables. This also explains why econometric models of the exchange rate are marred by frequent structural shifts.

Obviously this process of creating rational beliefs can only go on as long as the facts are not too inconsistent with these beliefs. If the gap between beliefs and facts become too large a turnaround in the exchange rate is imminent, and a new process of creation of rational beliefs is set in motion.

The view of the exchange market developed in this paper has interesting implications for the way monetary policies are transmitted in the economy. We argued that in a world where agents' forecasts are driven by beliefs, monetary policies can have very different effects on the exchange rate and the price level depending on the nature of these beliefs. We used this insight to claim that under the present set of beliefs that dominate the foreign exchange market, the ECB will find it difficult to control its main policy objective, i.e. the rate of inflation.

References

- Bank for International Settlements, (2000), *Annual Report*, Basle, June.
- Baxter, M., Stockman, A., Business Cycles and the Exchange Rate Regime. Some International Evidence, *Journal of Monetary Economics*, 23, may 377-400, 1989.
- Copeland, L., Exchange Rates and International Finance, 3rd ed., Prentice Hall, 2000.
- Corsetti, G., and Pesenti, P., (1999), Stability, Asymmetry and Discontinuity: the Launch of European Monetary Union, *Brookings Papers on Economic Activity*, 2, December, pp. 295-372.
- Corsetti, G., (2000). A perspective on the euro, Paper presented at the CFS research conference "The ECB and its Watchers II", Frankfurt, 26 June, 2000.
- Christiano, L., Eichenbaum, M., and Evans, Monetary Policy Shocks: what have we learned and to what end?, *NBER Working Paper*, no. 6400, 1998.
- De Boeck, J., The Effect of Macroeconomic 'News' on Exchange Rates: A Structural VAR Approach, mimeo, University of Leuven, 2000.
- De Grauwe, P., Dewachter, H., and Embrechts, (1993), M., *Exchange Rate Theories. Chaotic Models of the Foreign Exchange Markets*, Blackwell.
- De Long, J., Bradford, B., Schleiffer and Summers, L., Noise Trader Risk in Financial Markets, *Journal of Political Economy*, 1990.
- Frankel, J., and Froot, K., (1986), The Dollar as a Speculative Bubble: A Tale of Fundamentalists and Chartists, *NBER Working Paper*, no. 1963.
- Flood, R., and Rose, A., Fixing the Exchange Rate Regime: A virtual Quest for Fundamentals, *Journal of Monetary Economics*, 36, August 1995, 3-37.
- Fuhrer, J., The (Un)Importance of Forward Looking Behavior of Price Specifications, *Journal of Money Credit and Banking*, Vol, 29, no. 3, 338-350, 1997.
- Goodhart, C., News and the Foreign Exchange Market, LSE Financial Markets Group Discussion paper, 71, 1989.
- Goodhart, C., and Figliuoli, L., Every Minute Counts in the Foreign Exchange Markets, *Journal of International Money and Finance*, 10, 23-52, 1991.
- Grilli, V., and Roubini, N., Liquidity models in open economies: Theory and empirical evidence, *European Economic Review*, 40, 847-859, 1996.
- Gros, D., and Tabellini, G., (2000), Second Report of the CEPS Macroeconomic Policy Group, Centre for European Policy Research, Brussels.
- Hallwood, P., MacDonald, R., *International Money and Finance*, 2nd ed., Blackwell, Oxford, 1994.
- Isard, P., (1995) *Exchange Rate Economics*, Cambridge University Press.
- Kahneman, D., and Tversky, A., Choices, Values and Frames, *American Psychologist*, 341-351, 1984.
- Kurz, M., (1994), On the Structure and Diversity of Rational Beliefs, *Economic Theory*, 4, 877-900.

- Kurz, M., and Motolese, M., (2000), Endogenous Uncertainty and Market Volatility, mimeo, Stanford University.
- Marani, U., The Monetary Policy of the European Central Bank and the Euro-US Dollar Exchange Rate, *International Economics Research Paper* no. 148, University of Leuven, November 1999.
- Meese, R., and Rogoff, Empirical Exchange Rate Models of the Seventies: Do they Fit Out of Sample?, *Journal of International Economics*, 14, 3-24, 1983.
- Obstfeld, M., and Rogoff, K., The Six Major Puzzles in International Macroeconomics: Is there a Common Cause?, *NBER Working Paper* no. 7777, July 2000.
- Rogoff, The purchasing power parity puzzle, *Journal of Economic Literature*, 34, June 1996, 647-668.
- Sims, C., Interpreting the macroeconomic time series facts: The effects of monetary policy, *European Economic Review*, 36, 975-1011, 1992.
- Steil, B., Corporate Foreign Exchange Risk Management: A Study in Decision Making under Uncertainty, *Journal of Behavioral Decision Making*, vol 6, 1-31, 1993.
- Svensson, L., Inflation Targeting as a Monetary Policy Rule, IIES Seminar paper, no. 646, 1998.
- Taylor, M., and Allen, H., (1992), The Use of Technical Analysis in the Foreign Exchange Market, *Journal of International Money and Finance*, 11, 304-14.
- Thaler, R., *Quasi Rational Economics*, Russell Sage, New York, 1994
- Tversky, A., and Kahneman, D., The Framing of Decisions and the Psychology of Choice, *Science*, 211, 1981, 453-458.