

FORWARD INTEREST RATES AS PREDICTORS OF EMU

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ABSTRACT

Forward Interest Rates as Predictors of EMU*

The use of forward interest rates with a settlement time after the start of EMU (1 January 1999) allows us to derive probabilities attached by the market to the occurrence of EMU. We use the DM/ECU forward interest rates as our central source of information. We arrive at the conclusion that the market attaches a very low probability to the ECU being transformed into the Euro, with an irrevocably fixed exchange rate with the other EMU member countries, by 1999. We also compute the probabilities of entry into EMU for individual currencies.

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NON-TECHNICAL SUMMARY

Much scepticism has recently arisen concerning the question of whether EMU will start in 1999. Many observers today doubt that EMU will happen before the end of the century. Are financial markets equally pessimistic? In this paper we analyse this question by studying the forward interest rates of the potential EMU members.

If EMU starts on 1 January 1999 two things will happen. First, the exchange rate between the Euro (previously the ECU) and the Deutsche mark (DM) will be irrevocably fixed from that date on. Second, the fluctuation margins around this irrevocably fixed exchange rate will be eliminated. This implies that the exchange risk between the Euro and the DM will vanish. The same applies to all pairs of currencies that will participate in EMU. As a result, the forward interest rates with a settlement time after 1 January 1999 of all the currencies that are expected to be in EMU, should be equal.

Any deviation between the forward interest rates on ECU and DM contracts (with a settlement time after 1 January 1999) implies that the market distrusts the promise, made in Maastricht and Madrid, that the ECU will be relabelled Euro and will be irrevocably fixed in terms of the DM and the other participating currencies. Similarly, any deviation between the forward interest rates of currency i and the DM (with a settlement time after 1 January 1999) should be interpreted as doubts existing in the markets that currency i will be in EMU after 1999. We also show that these deviations are not related to the uncertainty concerning the conversion rates that will be used at the start of EMU.

Does the market expect EMU to happen in 1999? The results of our investigation can be summarized as follows.

First, we find consistently that the market expects EMU to happen between the French franc (FF), the guilder and the DM. The market seems to have doubts that the Belgian franc (BF) will be in EMU, and surprisingly considers the entry of sterling in EMU not improbable. The probability that the other currencies (peseta, lira, Swedish and Danish kroner) will be in EMU is considered low by the market.

Second, we also find that the market attaches a very low probability to the ECU being transformed into the Euro, with an irrevocably fixed exchange rate with the other EMU member currencies. Since this transformation is one of the

cornerstones of the start of EMU on 1 January 1999, this evidence should be interpreted as a disbelief existing in the market that EMU will start on that date.

This leads to a puzzle. On the one hand, the market seems to be quite sure that the DM, the FF and the guilder will be in EMU (and possibly the BF and sterling). On the other hand, it does not believe (in 1996) that the Euro will be part of this monetary union. How can this apparent inconsistency be resolved? One interpretation is that the market attaches a very low probability to EMU (including the Euro) starting in 1999, as envisaged in the Maastricht Treaty and in the Madrid Council resolution. At the same time, however, it believes that in the absence of a monetary union, France and Germany (together with the Netherlands) will fix their exchange rates from 1999 onwards, and will be successful in keeping these exchange rates fixed. Such a successful fixing of exchange rates also produces equality of interest rates, without having a real monetary union.

Another possible interpretation is that the market is confident that some sort of monetary union will exist between the DM, the FF and the guilder. A lot of uncertainty still exists concerning the status of the Euro, however. Will it really be a currency in its own right with an irrevocably fixed exchange rate? Will the transition from the ECU to the Euro be possible without creating legal problems of enforcing contracts originally made in ECU? Doubts about these issues may create the spreads we have observed. Even with this interpretation, however, the market seems to distrust the decisions that have been made in Maastricht and in Madrid about what, exactly, the future monetary union will look like.

1. INTRODUCTION

A lot of scepticism has arisen recently concerning the question of whether EMU will start in 1999. Many observers today doubt that EMU will happen before the end of the century. Are financial markets equally pessimistic? In this paper we analyse this question. We do this by studying the forward interest rates of the potential EMU-members. In section 2 we use the interest parity condition to show how the forward interest rates reflect the market's expectations about EMU. In section 3 the data are presented, and in sections 4 to 6 we compute the probabilities the market attaches to the occurrence of EMU.

2. FORWARD INTEREST RATES AS PREDICTORS OF EMU

In this section we analyse how the information embodied in the forward interest rates can be used to find out whether the markets expects EMU to start on January 1, 1999. We apply the analysis to the ECU and the DM interest rates. We could equally have chosen any other pair of potential EMU-members.

We start from the well-known interest parity theorem which can be written as follows

$$\frac{\left(1 + RE_{t,t',T}\right)^{T-t'}}{\left(1 + RD_{t,t',T}\right)^{T-t'}} = \frac{F_{t,T}}{F_{t,t'}} \quad (1)$$

where $RE_{t,t',T}$ is the forward ECU interest rate observed in period t for contracts with settlement time t' and with a maturity time T . In general $T > t'$. $RD_{t,t',T}$ is the forward DM interest rate observed in period t for contracts with settlement time t' and with a maturity time T . $F_{t,t'}$ and $F_{t,T}$ are the forward exchange rates of the ECU in units of DM observed in period t for contracts with settlement time t' and T , respectively. Note that if $RE_{t,t',T}$ and $RD_{t,t',T}$ are the spot interest rates, then $t = t'$. In that case $F_{t,t'}$ is the spot exchange rate, and (1) is the conventional interest parity relation.

These forward exchange rate can also be written as

$$F_{t,t'} = E_t(S_{t'}) (1 + \pi_{t,t'}) \quad (2)$$

and

$$F_{t,T} = E_t(S_T) (1 + \pi_{t,T}) \quad (3)$$

where $E_t(S_{t'})$ and $E_t(S_T)$ are the expectations held in period t about the exchange rate of the ECU relative to the DM at time t' and T respectively; $\pi_{t,t'}$ and $\pi_{t,T}$ are the risk premia involved.

If the EMU starts on January 1, 1999 two things will happen. First, the exchange rate between the Euro (previously the ECU) and the DM will be irrevocably fixed from that date on. Let us represent this irrevocably fixed exchange rate by \bar{S} . Second, the fluctuation margins around this irrevocably fixed exchange rate will be eliminated. This implies that the exchange risk between the Euro and the DM will vanish. The same applies to all pairs of currencies which will participate in EMU.

The previous discussion implies that after January 1, 1999, equations (2) and (3) can be rewritten as follows:

$$F_{t,t'} = F_{t,T} = \bar{S} \quad (4)$$

for all t' and $T \geq$ January 1, 1999

This follows from the fact that in the monetary union the exchange rate cannot be changed anymore, and thus the future expected exchange rate is invariably \bar{S} . In addition, since the exchange risk disappears, $\pi_{t,t'}$ and $\pi_{t,T}$ in (2) and (3) must be equal to zero.

Using (4) to substitute in (1) we obtain

$$1 + RE_{t,t',T} = 1 + RD_{t,t',T} \quad (5)$$

for all t' and $T \geq$ January 1, 1999.

The forward interest rates on ECU- and DM-contracts with settlement time after January 1, 1999 are equalised if the market is confident that the EMU will start on January 1, 1999.

Note that the irrevocably fixed exchange rate, \bar{S} , does not appear in equation (5). Put differently, whatever choice is made about the conversion rate between Euro and DM on January 1, 1999, this does not alter equation (5) and the conclusion that if the EMU is expected to start on that date, the forward interest rates of the ECU and the DM must be equal. Conversely, if we observe a deviation between these forward interest rates today, this can only mean that the market has doubts that EMU (i.e. irrevocably fixing of exchange rates and elimination of fluctuation margins between the Euro and the DM) will start on January 1, 1999.

It is important to point out that the previous conclusion does not apply to the forward rates with settlement time before January 1, 1999. These incorporate the risk relating to the uncertainty about the conversion rate (even if the market has no doubts that EMU will start on January 1, 1999). We can write the forward rates for $t' < \text{January 1, 1999}$ as follows

$$F_{t,t'} = E_t(S_{t'}) (1 + \pi_{t,t'}) \quad (6)$$

which is the same expression as (2) and

$$F_{t,T} = E_t(\bar{S}) (1 + \pi_t) \quad (7)$$

where $E_t(\bar{S})$ is the expected conversion rate and π_t is the risk associated with making a wrong forecast about this conversion rate.

Substituting (6) and (7) into the interest parity condition (1) leads to the conclusion that the forward rates with settlement date before January 1, 1999 will generally not be equalised even if the market is certain that EMU will start on that date. The spreads then reflect the uncertainty concerning the conversion rate that will be chosen between the ECU and the DM.

From the previous discussion we conclude that in order to obtain the market's expectations of the occurrence of EMU on January 1, 1999, forward interest rates with settlement time after January 1, 1999 should be used. These reflect the pure EMU-probabilities as they are cleared from all uncertainties about the conversion rates that will be used at the start of EMU.

Before we look at the data it is important to analyse how a monetary union will look like. First (and obviously), it must involve at least two national currencies. Thus, if the market

expects a monetary union to start on January 1, 1999 we should find at least two forward interest rates (with settlement time after that date) to be equal. In fact we should find more than two. A monetary union with only two members would probably not get off the ground. Second, the EMU, as envisaged in the Maastricht Treaty (and as confirmed at the Madrid Summit meeting of December 1995), will involve the transformation of the present ECU into the Euro which will be irrevocably fixed in terms of the other EMU-currencies. Thus, if the market expects EMU to happen we should also find that the forward ECU-interest rates are equal to the forward rates of the currencies that are expected to be in the EMU.

It should be stressed that this holds irrespective of the exchange rate that will be chosen in January 1999 to convert the ECU into Euros. At the Madrid Summit it was decided that this conversion rate would be 1:1. But even if another conversion rate would be chosen, this would not affect the conclusion that the forward interest rates on ECU contracts (with settlement date after 1999) should equal the forward interest rates on other EMU-currencies. To see the intuition of this, suppose that the private ECU will be converted into the Euro at, say, the rate 0.95 in 1999. If an investor buys a forward contract today to lend one million ECU in 2001, this will translate into a contract to lend 0.95 million Euro in 2001. If EMU exists in 2001 the interest earned on this contract should be identical to the interest earned on contracts expressed in other EMU-currencies because the Euro will be irrevocably fixed relative to these currencies. The exchange rate which will have been chosen on January 1, 1999 to convert the ECU into the Euro will have become irrelevant in 2001, and in fact for all contracts with a settlement date after January 1, 1999. Any differential between the forward interest rates on such contracts creates the scope for risk-free arbitrage if the market believes that EMU will be in existence at that time. Conversely, if we observe a differential in the interest rates on forward contracts with a settlement date after January 1, 1999, this can only be interpreted to mean that the market is not certain that the EMU will be in existence after that date.

3. THE EMPIRICAL EVIDENCE

We have organised the data as spreads of forward interest rates with respect to the DM-forward interest rates. Table 1 shows the average daily spreads of these forward interest rates of the main EU-currencies during January 2 - March 1, 1996. These are forward interest rates on interbank loans with a settlement time of 5 years in the future and a maturity of 5 years. We also show the daily observations of these spreads since 1990 in figures A1 and A2 in appendix.

The results of table 1 suggest the following. We can classify currencies into three categories. First, the FF and the guilder have practically zero spreads with the DM, suggesting that the market believes these three currencies will be in the EMU in the year 2001. A second category is the BF and the ECU which exhibit an average spread of approximately 50 basis points vis à vis the DM. What this means in terms of expectations of these currencies being in EMU will be analysed shortly. A third category of currencies are the pound sterling, the Danish kronor, the peseta, the lira and the Swedish kronor which exhibit spreads with the DM of 100 and more. We are on safer grounds when we conclude that the market does not expect these currencies to be in EMU by the year 2001 (although, as will be shown later underlying probabilities can still be surprising).

The real puzzle of table 1 is the ECU. We find a rather large spread of approximately 60 basis points with the DM. How can this be interpreted? It means that the market has doubts that the future Euro will be in the EMU (whereas it does not seem to have these doubts concerning the DM, the FF and the guilder). This is rather odd, because if the EMU starts in 1999 the Euro will be part of it. Does this mean that the market has inconsistent views about the future EMU?

A possible explanation of this puzzle is that the market believes that forward contracts made in ECU today will not be converted automatically into Euros from 1999 on. This, however, must also be interpreted to mean that the market has doubts that the EMU will start in 1999 in the way envisaged in the Maastricht Treaty (and in the Madrid Council resolution). In other words, the market does not seem to be very confident that from 1999 on, an Euro with an irrevocably fixed exchange rate will exist. Instead, it expects that the future ECU will be the same currency as today which can appreciate (or depreciate) against the other participating currencies, and which therefore carries a different interest rate.

We conclude that the market has ambivalent views about the future EMU. On the one hand, it seems to believe that a small number of currencies (the DM, the FF, the guilder) will be in the EMU. On the other hand, the spreads between the ECU and the DM forward interest rates suggest that the market doubts that the EMU, including the Euro, will start at all. (Note that the market has similar doubts about the membership of Belgium in EMU). We will come back to this apparent inconsistency and present an interpretation.

Table 1 : Spreads (versus DM) of five-year forward interest rates on five year loans
basis points (Daily average January 2 - March 1, 1996)

NLG	-7
FF	-6
BF	45
ECU	57
GBP	94
DKR	108
SEK	183
ESP	239
ITL	292

Source: JP Morgan

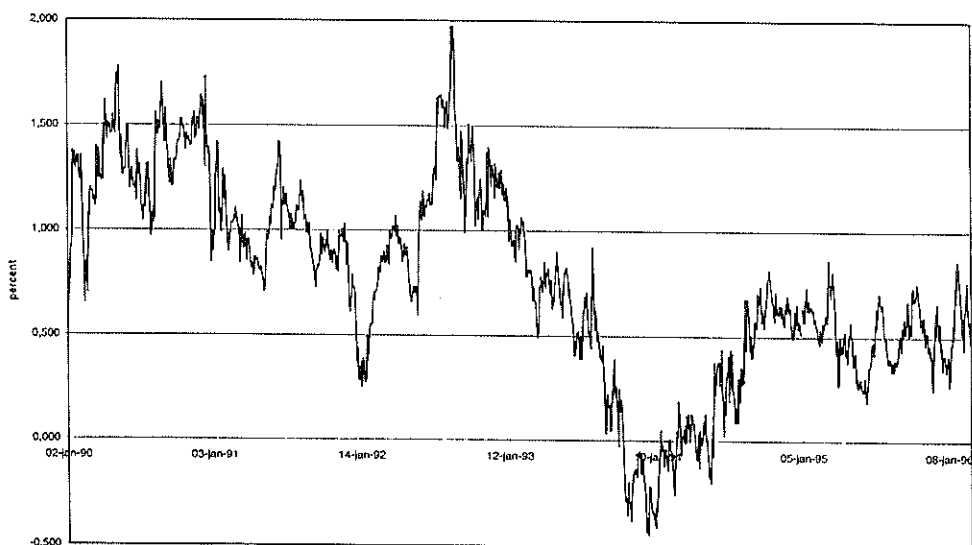
Note: The forward interest rates relate to interbank loans.

It is also instructive to analyse the evolution of the spreads during a larger period than the first two months of 1996. We concentrate our attention on the ECU-DM spread which has an important significance. For, as argued earlier, a failure of this spread for contracts with settlement time after January 1, 1999, to converge to zero is indicative of the market's distrust in the start of EMU on that date. In figure 1 we show the history of this spread since 1990. The most striking feature is the sharp decline of the spread during 1993. Prior to that date the spread was fluctuating (mostly) between 50 and 150 basis points. After the sharp decline of 1993 the spread first moved close to zero for a short while, and then increased again. Since the middle of 1994 it has moved around 50 basis points. How can this be explained? A first point to note is that since the spreads relate to five-year forward rates, all observations before January 1, 1994 relate to spreads on forward contracts with settlement date *before* the start of EMU on January 1, 1999. Thus, all these forward contracts carry the uncertainty about the conversion rate that will be used between the ECU

and the DM. This means that even if the market expected EMU to happen on January 1, 1999, the uncertainty about the conversion rate must be reflected in positive spreads. All observations after January 1, 1994 relate to spreads on forward contracts with settlement time *after* the start of EMU on January 1, 1999. Thus, as stressed earlier, the conversion risk in these contracts is completely eliminated, so that if EMU was expected to happen, these spreads should converge to zero.

We can now interpret the large decline of the spread during 1993. As we moved closer to the important date of January 1, 1994, five-year contracts increasingly incorporated the possibility of EMU actually happening in 1999. In addition, the conversion risk disappeared from these contracts after January 1, 1994. Thus the forward spread declined sharply. At the end of 1993 the spread had completely vanished. It remained around zero for several months during 1994, leading to the view that the market expected EMU to occur. Things changed during 1994, when the spread increased again. Thus, during 1994 the market became increasingly suspicious about the future of EMU. Note again that this increase had nothing to do with possible increases in the uncertainty about the conversion rate to be applied in 1999 between the ECU and the DM.

Figure 1: Spread between forward interest rate ECU -DM



4. FROM INTEREST RATE SPREADS TO PROBABILITIES

It is possible to obtain more precise information about the probabilities the market attaches to the start of EMU on January 1, 1999 using the forward interest rate spreads.

Let us write the observed spread of the ECU forward interest rate with the DM forward interest rate as follows:

$$s_E = p_E \cdot 0 + (1 - p_E) s'_E \quad (8)$$

where s_E is the observed spread between the ECU and the DM forward interest rate, p_E is the probability that EMU will start on January 1, 1999, and s'_E is the spread in the absence of a monetary union after January 1, 1999.

Equation (8) should be interpreted as follows. The observed spread expresses the probability, p_E , that EMU is realised (i.e. that EMU starts with the Euro irrevocably fixed in terms of the DM). In that case the spread is 0. The second term in equation (8) is the probability $(1 - p_E)$ that EMU is not realised. In that case the spread is expected to be s'_E . A given spread is therefore compatible with many different probabilities of EMU being realised. For example, a given spread is consistent with a high probability that EMU comes about and a low-probability of non-EMU combined with a large expected increase in the spread. Alternatively, the same spread can mean that the market attaches a relatively large probability of non-EMU together with a spread which is not expected to increase much.

We can write a similar equation as (8) for the spread of currency i with respect to the DM as follows:

$$s_i = p_i \cdot 0 + (1 - p_i) s'_i \quad (9)$$

where p_i is the probability that currency i will be in the EMU after January 1, 1999, s_i is the observed spread between the forward rate of currency i and the DM, and s'_i is the expected spread if currency i is not admitted in EMU.

We will use equation (8) and (9) to extract information about the probabilities p_E and p_i in the next sections.

5. THE PROBABILITY OF EMU

In this section we use equation (8) to estimate the probability the market attaches to the start of EMU on January 1, 1999. As argued, earlier the ECU-DM spread should be used as the basis for our computation. For, according to the Maastricht Treaty (as reaffirmed during the Madrid Council Resolution) on January 1, 1999 the ECU will be transformed into a true European currency (the Euro) and will be irrevocably fixed with the participating currencies. We also take the view that the DM will be in the EMU or there will be no EMU.

From equation (8) we can write the probability of EMU

$$p_E = 1 - s_E / s'_E \quad (10)$$

Note that whereas s_E is an observed spread, s'_E is not. It is the spread the market expects if EMU does not start in 1999. We will estimate s'_E as follows. We assume that if EMU does not come about in 1999, the ECU will continue to be the same basket currency as defined today (instead of becoming a currency in its own right with an irrevocably fixed exchange rate). This allows us to define s'_E as the spread of the ECU with the DM if the ECU maintains its basket definition after 1999. We can therefore calculate s'_E by using the observed DM-spreads of all the currencies in the basket, i.e.:

$$s'_E = \sum_i a_i s_i \quad (11)$$

where a_i is the weight of currency i in the ECU-basket, and s_i is the observed spread of currency i with the DM¹. Note that $\sum a_i = 1$ and that when $i = \text{DM}$, $s_i = 0$.

Substituting (11) into (10) yields

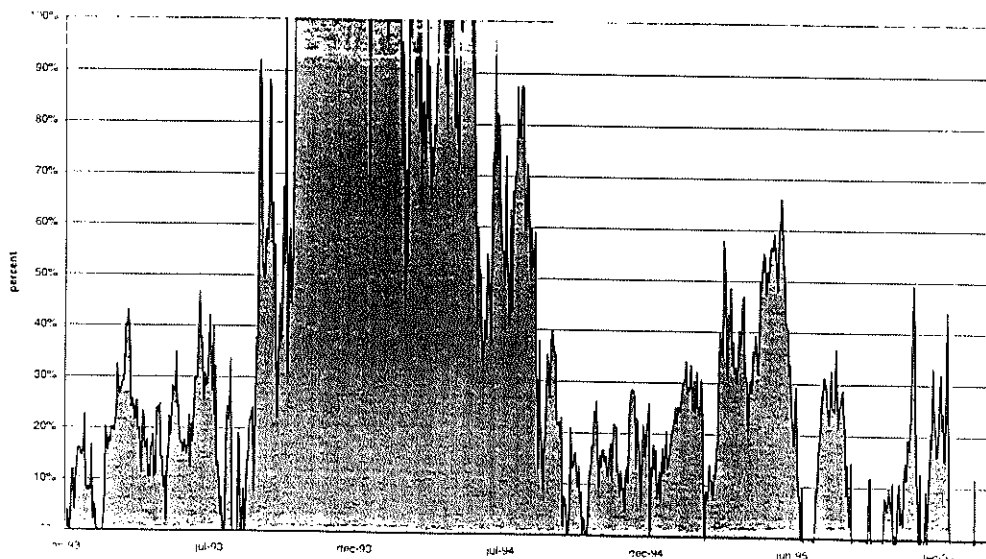
$$p_E = 1 - s_E / \sum a_i s_i \quad (12)$$

¹ It should be pointed out that the yield on the ECU is a non-linear relation of the yields of the underlying currencies. The non-linear component, however, is small, so that equation (11) is a rather good approximation.

Thus, when the market spread between the ECU and the DM (s_E) is zero, the probability of EMU is 1. Conversely, when the market spread is equal to the theoretical basket spread ($\sum a_i s_i$) the probability is zero. Note that there are some periods during which the market spread s_E is negative, i.e. the ECU forward rate is below the DM forward rate (see figure 1). We then set $p_E = 1$.

We computed these probabilities for the years 1993 - 1996 (March)². The results are given in fig. 2. The results are quite striking. At the end of 1993 up to the middle of 1994, the market was optimistic about the prospects of EMU in 1999. The probabilities are close to one. During the middle of 1994 there is a dramatic drop in these probabilities. Since the start of 1996 these probabilities have been zero or close to zero all the time. In other words, since the beginning of 1996 the market seems to have completely lost its confidence that EMU will start on January 1, 1999.

Figure 2: Probability of EMU



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As is well-known the weights a_i vary with the exchange rates. We used the exchange rates observed on March 15, 1996. We do not have observations of the forward interest rates of the drachme, the Irish punt and the Escudo. These currencies were therefore not included in the computation of the theoretical spreads of the ECU. Since these three currencies together have a weight in the ECU-basket of only 2.2 % the error introduced by ignoring these currencies is small.

6. THE "INS" AND THE "OUTS"

Equation (9) allows us to estimate the probability that currency i will be in the EMU. Rewrite (9) as follows:

$$p_i = 1 - \frac{s_i}{s'_i} \quad (13)$$

The difficulty here is to estimate s'_i , which as will be remembered is the expected spread between currency i and the DM if currency i is not allowed into EMU. Contrary to the case of the ECU, where the basket definition allowed us to obtain precise information about the market's expectation concerning this spread, we do not have such information on the bilateral spreads. We will use a rather ad-hoc procedure to estimate s'_i .

The spreads observed during the year 1990 were realised at a time when EMU was only a remote possibility. (It will be remembered that the Maastricht Treaty was signed in December 1991). We will, therefore, assume that the spreads observed during 1990 are the kind of spreads one should expect if EMU does not come about. We will take the daily average of the observed spreads during 1990 as the spread to which an individual currency i , which is not allowed into EMU, is expected to return. This assumption (admittedly a rough one) then allows us to compute the probabilities of currency i to be accepted in the union, using equation (13). The results are shown in figures 3-10.

The results exhibit relatively few surprises (except for the pound sterling). The FF and the guilder exhibit probabilities that are close to 1 much of the time. Especially since the second half of 1995, the market seems to expect these two currencies to team up with the DM to form a monetary union with certainty. The probability that the BF will be in the EMU fluctuates around an average of 50 % since early 1994. Note that it has increased since then, so that this probability now tends to fluctuate around 60 %.

The real surprise is the pound sterling. The market seems to attach a rather high probability of entry into EMU by the pound sterling. Since early 1994 this probability has fluctuated around 70 %. This rather strange result may be due to the fact that 1990 was a very special year for the pound sterling. As will be remembered, in October of that year the pound sterling joined the ERM after months of turbulence. In addition, it was widely felt that the pound entered the ERM at an overvalued exchange rate. This may have contributed

to produce large forward spreads. It is unlikely therefore that 1990 is a good benchmark for the pound sterling, i.e. that it can be considered to produce forward spreads to which the pound sterling will tend to return if it does not join the EMU.

Finally, the probabilities obtained for the peseta, the lira and the Swedish kronor confirm what most observers tell us about these currencies. Most of the time the market attaches a low probability that these currencies will join EMU in 1999. Similarly, the probability of the Danish kronor to join the EMU is considered to be small by the market (although not zero)³.

7. CONCLUSION

Does the market expect EMU to happen in 1999? The results of our investigation of this question can be summarised as follows.

First, we find consistently that the market expects EMU to happen between the FF, the guilder and the DM. The market seems to have doubts that the BF will be in EMU, and surprisingly considers the entry of the pound sterling in EMU not unprobable. The probability that the other currencies (peseta, lira, Swedish and Danish kronor) will be in EMU is considered low by the market.

Second, we also find that the market attaches a very low probability that the ECU will be transformed into a Euro with an irrevocably fixed exchange rate with the other EMU-member currencies. Since this transformation is one of the cornerstones of the start of EMU in January 1, 1999, this evidence should be interpreted as a disbelief existing in the market that EMU will start on that date.

This leads to a puzzle. On the one hand, the market seems to be quite sure that the DM, the FF and the guilder will be in the EMU (and possibly the BF and the pound sterling). On the other hand, it does not believe (in 1996) that the Euro will be part of this monetary union. How can this apparent inconsistency be resolved? One interpretation is as follows.

³ Note that the probabilities obtained before 1994 do not reflect probabilities of joining the EMU, as the spreads for observations before January 1994 also incorporate uncertainty about exchange rate changes before the start of EMU.

The market attaches a very low probability that EMU (including the Euro) as envisaged in the Maastricht Treaty and in the Madrid Council resolution, will start in 1999. However, at the same time it believes that, in the absence of a monetary union, France and Germany (together with the Netherlands) will fix their exchange rates from 1999 on, and will be successful in keeping these exchange rates fixed. Such a successful fixing of the exchange rates also produces equality of interest rates, without having a real monetary union.

Another possible interpretation is that the market is confident that some sort of monetary union will exist between the DM, the FF and the guilder. However, a lot of uncertainty still exists concerning the status of the Euro. Will it really be a currency in its own right with an irrevocably fixed exchange rate? Will the transition from the ECU to the Euro be possible without creating legal problems of enforcing contracts originally made in ECU? Doubts about these issues may create the spreads we have observed. Even in this interpretation, however, the market seems to distrust the decisions that have been made in Maastricht and in Madrid about how exactly the future monetary union will look like.

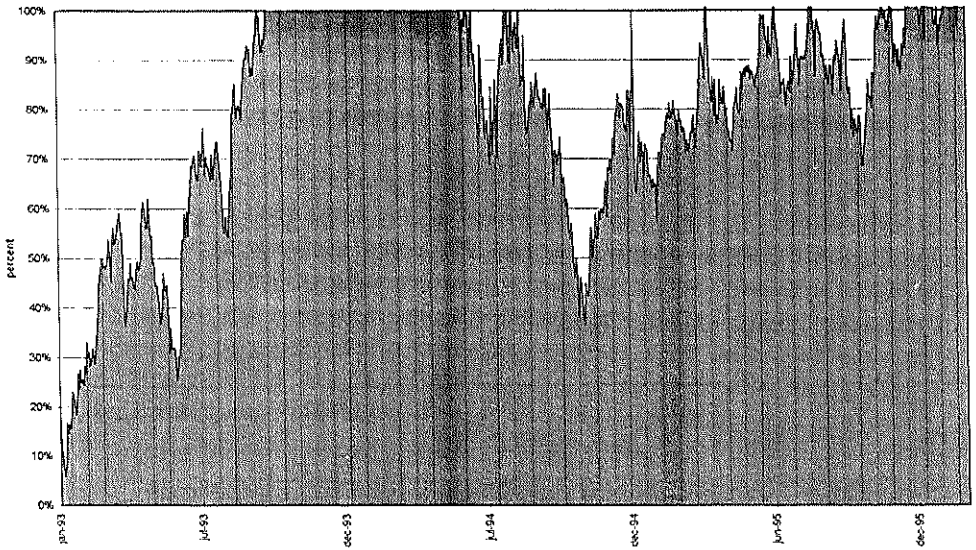
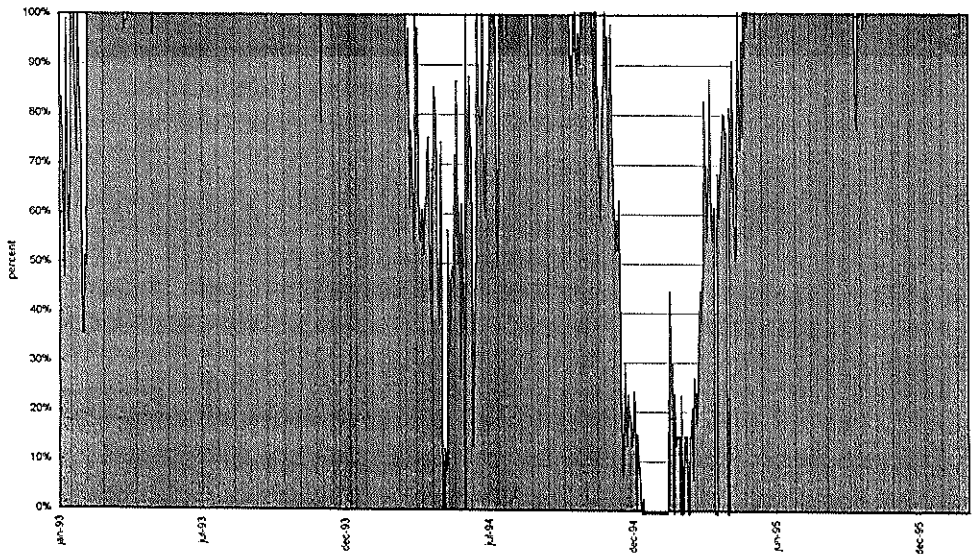
Figure 3: Probability of FF in EMU**Figure 4: Probability of guilder in EMU**

Figure 5: Probability of BF in EMU

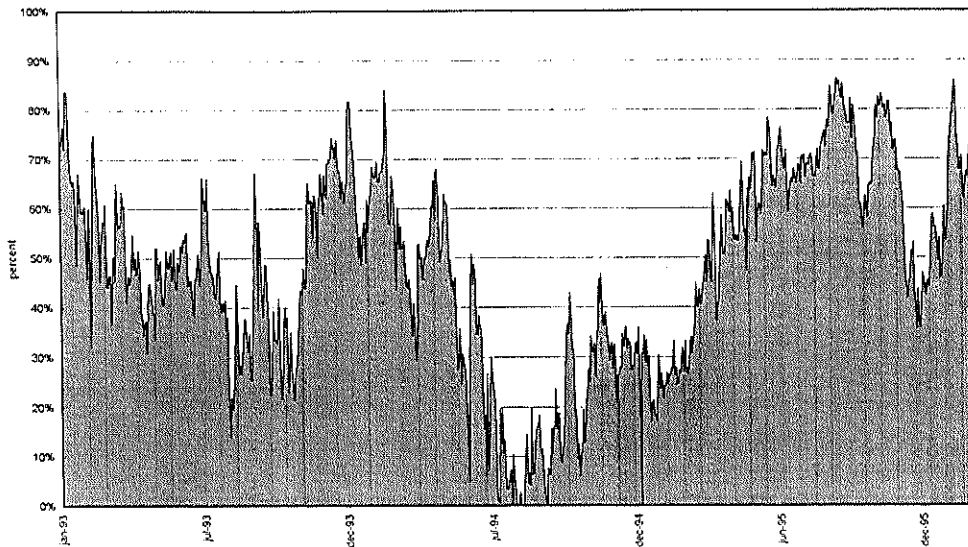


Figure 6: Probability of pound sterling in EMU

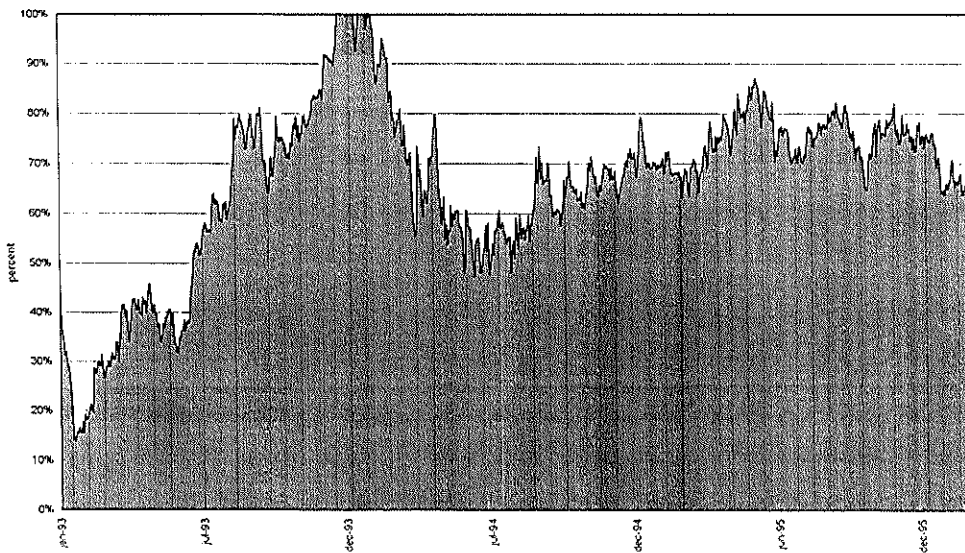


Figure 7: Probability of peseta in EMU

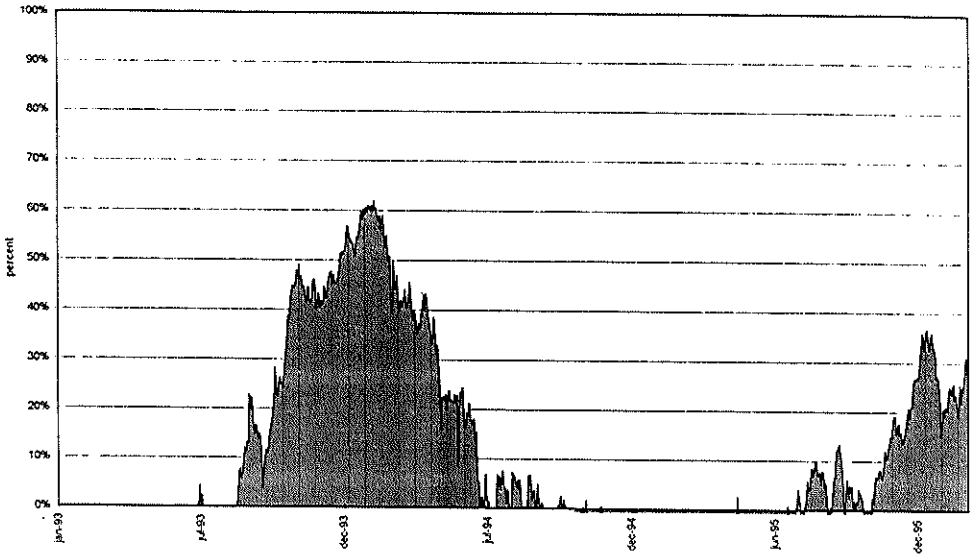


Figure 8: Probability of lira in EMU

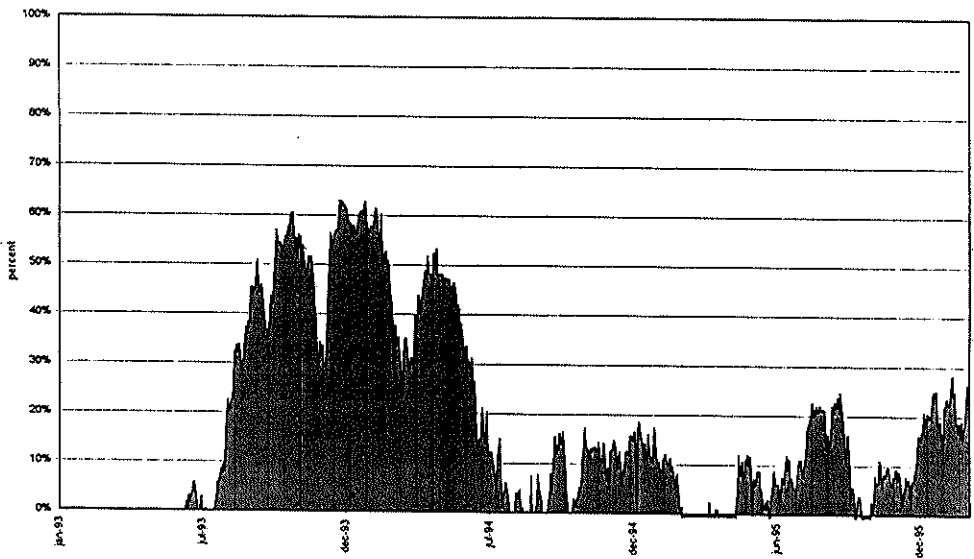


Figure 9: Probability of Swedish Kronor in EMU

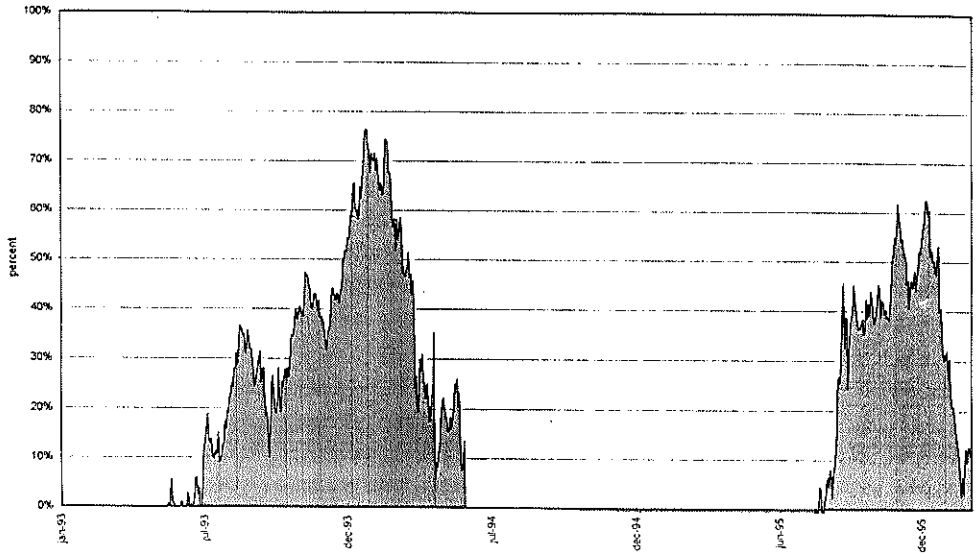
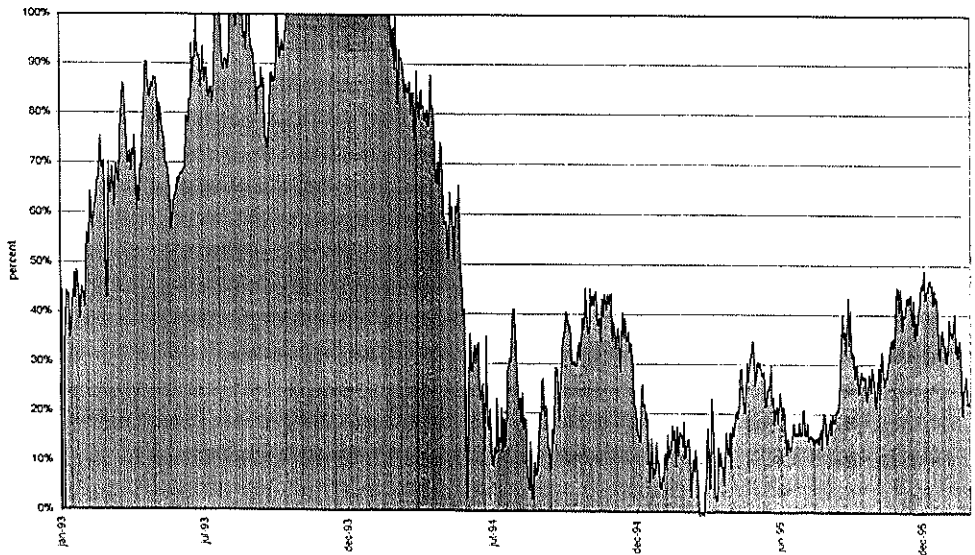


Figure 10: Probability of Danish Kronor in EMU



APPENDIX

Figure A1: Spread of BF, FF, NLG with DM

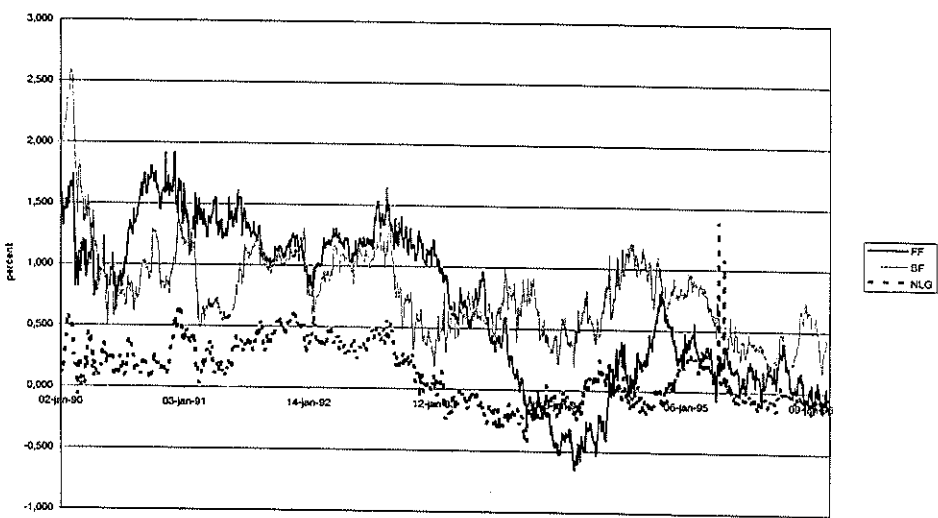


Figure A2: Spread of lira, pound, and DKR with DM

