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N° 56 July 1987

Causes of the development of the private ECU and the behaviour of its interest rates: October 1982 - September 1985

Giuseppe Tullio
and
Francesco Contesso*

Internal Paper

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CAUSES OF THE DEVELOPMENT OF THE PRIVATE ECU AND THE BEHAVIOUR OF ITS INTEREST RATES: October 1982 - September 1985

INTRODUCTION

The private ECU deposit and bond markets have experienced a spectacular growth which nobody expected at the time of the creation of the ECU and of the EMS in March 1979. At the end of June 1986 the ECU bank deposit market had reached a volume of about 66 billion ECU (including the interbank market), while the international ECU bond issues had reached 8.9 billions in 1986. International ECU bond issues fell, however, as a percent of the total market from 5.3 per cent in 1985 to 3.9 per cent in 1986.[1]) The reduction in the market share of ECU bond issue in 1986 was due to the competition from the strong Deutsche Mark, the weakness of sterling which made the ECU less attractive for investors and to the large volume of issues of end 1985, which the market needed to digest.

This paper is divided into three parts. Section I deals briefly with the causes of the development of the private ECU, both in the bank deposit and bond markets. Particular attention is devoted to the role that capital controls in Italy and France have played in the development of the market. Section II analyses the causes of the fluctuations of the spread between the quoted ECU interest rate and the combined Eurocurrency interest rate (or theoretical rate). In Section III a number of very simple tests are presented comparing the behaviour of interest rates in the ECU deposit market with those in the Eurodollar, Euromark and Europound deposit market. The first test is a test of Meiselman's (1966) expectations theory about the term structure of interest rates. This test is admittedly rather crude and is valid only under very restrictive assumptions. Then a test suggested by Fama (1984) of the hypothesis that the observed forward interest rate contains information about the future spot rate, which allows a variable risk premium, is presented. Finally a simple market efficiency test is performed for all four Euro-currencies by regressing the future spot rate on the past forward rate, following Frenkel (1976).

(*) We would like to thank our colleagues Paul De Grauwe, Erik De Souza, Hermann-Josef Dudler, Helmut Lohan and Manfred Neumann for useful comments and Vittorio Basano for helpful programming assistance.

(1) The loss in market share was even more pronounced for syndicated bank credits: from 6.2 per cent in 1985 to 1.7 in 1986.

The data used for this analysis are monthly averages of daily figures obtained from Chase Econometrics which in turn collects them from the Financial Times. The data is available only starting at the beginning of October 1982. The last observation relates to end September 1985. All data are averages of bid and offer rates.

The set contains interest rates on deposits of 1, 3, 6 and 12 months maturity. With these maturities we are able to extract from the data only forward interest rates on deposit of 3 and 6 months maturites. All the tests mentioned above are performed with non overlapping quarterly data, obtained by taking every third observation of the monthly data set. The use of overlapping monthly data would have generated strong autocorrelation of the residuals. Because the sample period is relatively short the degrees of freedom are only nine.[2])

1. The causes of the development of the private Ecu market

Among the causes of the private ECU's success probably the most important is the low risk-high return characteristics of the private ECU. Being defined in terms of a basket of currencies its value is likely to be more stable than the value of any individual component currency both for an investor whose consumption basket is in third currencies (US dollar, yens) or in component currencies. For the same reason its interest rate is likely to be less volatile than the interest rate of any individual currency.[3])

The low risk - high return characteristics of the private Ecu has been a cause of its development, thanks to the existence of transaction costs. With zero transaction costs investors and borrowers could diversify their risk by forming their own preferred basket of currencies and the private Ecu would never have developed.[4])

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(2) If we had interest rates on deposits of two months maturity, we could calculate forward rates for the one month maturity and we could have performed the tests with monthly data, without overlapping the period.

(3) This does not exclude that for instance for a Dutch investor, the Deutsche Mark may be more stable than the ECU in terms of Dutch Florins, nor that the German interest rate may be more stable than the ECU interest rate.

(4) This important point was suggested by Hermann-Josef Dudler.

Another cause is the favourable attitude of the Commission of the European Communities and the European Investment Bank towards the private ECU and the active role they have played in the market in the initial stages of its development.

More controversial are the roles that the European Monetary System (EMS) and the Exchange Rate Mechanism (ERM) on the one hand and the existence of capital controls on the other have played in the development of the private Ecu. On the role of the EMS and the ERM there are two opposite views: one maintains that the risk diversification function of the Ecu is reduced as the system becomes more coordinated and the ERM moves towards a system of fixed exchange rates. As Vaubel put it: "any narrowing of the margins of fluctuations reduces the Ecu's competitive edge in terms of short run exchange rate stability" (Vaubel, 1987). The second view holds that the declared objective of EMS member currencies to coordinate their monetary policy reinforces the private Ecu. According to this view the success of the private ECU is also related to the existence the ERM linking most ECU component currencies which keeps the short run volatility of exchange rates of component currencies against each other at low levels. This is especially important for ECU investors and borrowers residing in EMS member countries. They constitute the bulk of ECU primary lenders and borrowers.

In the ERM the Ecu also plays the role of the pivot of the system and this increases the confidence in the private Ecu. The success of the private Ecu during the period of stability of exchange rates from April 1983 to end 1985 seems to support this second view. Viceversa the inclusion of the Drachma, a high inflation currency, into the definition of the Ecu in September 1984 has been perceived by market participants as a negative factor, although its weight is only about 1 per cent. If a currency with a large weight in the basket became unstable this may reduce the attractiveness of the Ecu as a portfolio investment, despite a low covariance of its exchange rate and interest rate with those of the more stable component currencies. The experience of 1986 is instructive in this respect. The private Ecu also lost market shares because of the weakness

and volatility of sterling, which is part of the definition of the Ecu but does not participate in the ERM. This occurred despite the fact that sterling interest rates were very high both in nominal and in real terms. It is safe to conclude therefore that the fact that the ECU was a pivot of the ERM and that countries participating in it closely coordinate their monetary policies has contributed to the development of the private Ecu despite its reduced attractiveness as an instrument of diversification. This does not exclude, however, that in the future the balance between the confidence creating role of the EMS and the ERM and the diversification function of the Ecu which is reduced by them, may change and that further convergence may make the Ecu less attractive.

There are two reasons, however, to believe that the private Ecu will retain its attractiveness. First if the private Ecu succeeds in developing as a medium of exchange, it could become the European "vehicle currency" to use a term coined by Alexander Swoboda, substituting the US dollar this side of the Atlantic. Corporations engaged in international trade would reduce their transaction and interest costs by holding one currency which is accepted in every EMS member country rather than by holding several European currencies.[5]) In turn this will foster its role as a financial asset. The role of the private Ecu as a medium of exchange is today virtually inexistent. The increased use of the private Ecu as a financial asset, a medium of exchange and a currency of invoicing of European imports would also shield Europe from the instability of the US dollar. Second, as the ERM moves closer to a fixed exchange rate system the variability of short term interest rates in member currencies will have to increase, especially if capital controls are relaxed further. Already during the period 1983-86, when the stability of exchange rates within the system was high, one has observed that national interest rates have moved in opposite directions. The smooth working of the balance of payments adjustment mechanism under pegged exchange rates requires this subordination of short term interest rates to the external objective (Russo and Tullio, 1987). It follows that the interest rate on the ECU, being an average of interest rates of component currencies, will possess a greater stability than interest rates on any individual currency and will probably be characterised by a lower risk premium as well.

(5) Swoboda (1973).

It follows from the above discussion that the relationship between the development of the ERM and the development of the private Ecu may not be monotonic. The attractiveness of the private Ecu is likely to be very small in an incohesive system with member currencies fluctuating wildly. It may increase as the cohesion of the system increases; as monetary policy coordination becomes stronger the currency diversification function of the Ecu may, however, be reduced and discourage its development. As one moves closer to a fixed exchange rate system and the variability of national short term rates increases, the private Ecu may become more attractive again, especially at the short end of the market.

On the relationship between capital controls and their role in the development of the private Ecu there are also two opposing views. One view favoured particularly in German official circles holds that capital controls have been beneficial for the development of the private Ecu market. The European Commission holds instead the opposite view. Those who believe that capital controls have been beneficial for the private Ecu argue that Italian and French firms borrow heavily in Ecu and are stimulated to do so by exchange restrictions in their respective countries. But French and Italian firms are generally free to borrow in any currency (including their own) and would not choose Ecus if they didn't have an intrinsic appeal.

The existence of capital controls has probably contributed to making new established parities more credible after a realignment and to increase the expected duration of new parities. Since nominal interest rates in France and Italy were so far higher than in strong currency members, French and Italian firms had an incentive to borrow abroad after realignments to take advantage of lower interest rates without incurring a large exchange rate risk. Again if they borrowed in Ecu rather than in Deutsche Marks it was because the former had an intrinsic appeal. On the contrary the outright prohibition by the German government for German firms, banks and households to hold Ecu in Germany and to borrow in Ecu has certainly been a negative factor for the development of the market.[6])

(6) The ban was lifted in June 1987.

The Italian government has issued debt expressed in Ecu which Italian residents were allowed to subscribe. As only the Italian government and the European Investment Bank were allowed to tap the Italian domestic market for borrowing in Ecu, they made use of their monopoly power and borrowed at a reduced cost: the yield in Italy was generally lower than the yield prevailing abroad, as arbitrage was prevented from operating. Exchange controls coupled with the granting of a monopoly power to two issuers can hardly be considered a measure fostering the private Ecu. However, Italy and France have had at times credit controls on lending expressed in domestic currency and, when they were binding they have undoubtedly stimulated borrowing in foreign currencies by domestic firms and therefore indirectly, borrowing in Ecu. Credit controls accompanied by exchange restrictions may have therefore at times influenced the amount of borrowing and lending in Ecu.

Exchange controls have had a serious impact on the geographical distribution of borrowing and lending in Ecu. Borrowers typically are residents of high interest rate countries with capital controls, where they are free to borrow in any currency but not to invest in foreign currencies or Ecus, and lenders are mainly residents of the Benelux countries where the domestic interest rate was generally lower than the one on the Ecu and there are no prohibitions to hold foreign assets nor Ecus. Capital controls in high interest rate countries have, however, probably implied higher transaction costs for Benelux residents interested in diversifying risk by forming their own basket. Thus indirectly capital controls may have made the private Ecu more attractive than it would otherwise have been. This latter point is likely to be not very important, however.

Exchange controls have therefore had mainly negative effects on the development of the private Ecu both by limiting the access to it to German borrowers and to Italian and French investors and by unbalancing the market geographically. This latter view finds some support in the fact that the Ecu market developed considerably at a time when capital controls have been relaxed (since 1983) and their effectiveness reduced by the willingness of countries participating in the ERM to align their real interest rates to German ones.

The difference between any Eurocurrency interest rate and the domestic interest rate on assets of equal risk and maturity has traditionally been considered a proxy of the overall degree of restriction on capital flows applied by the monetary authorities of the country in question. In the absence of capital controls and transaction costs and assuming equal reserve requirements at home and in Euromarkets, the two rates would tend to coincide owing to the operation of arbitrageurs. Because of the restrictions on capital flows applied by the French and the Italian monetary authorities, the Eurofranc and the Eurolira interest rates have usually been significantly higher than their domestic counterpart. Table 1 contains the monthly interest spreads between the Euromarkets and dometic markets for 3 months deposits for the ECU, the DM, the French Franc and the Lira. The averages for each year are reported at the bottom of the table.[7]) In 1983 the average spread was 3.68 for the French Franc and 2.05 for the Lira. However, these figures are heavily influenced by expectations of the March 1983 realignment. From April to December 1983 the average was 1.54 for the French Franc and 1.14 for the Italian Lira. For the French Franc the spread fell to 0.81 in 1984 and 0.41 in the first 9 months of 1985. For the Lira the average was 1.54 in 1984 and 0.76 in the first 9 months of 1985.

For the Deutsche Mark the average spread has been negative but negligible being in the order of 10 to 20 basis points, with the domestic rate systematically exceeding the Euromark rate probably because of reserve requirements on bank deposits held in Germany by non-residents. Also for the DM the absolute value of the spread has tended to fall over time, but the changes are probably too small to attach great significance to them.

The spread between the combined Ecu interest rate calculated in the Euromarkets and the combined Ecu rate calculated in national markets gives a synthetic view of changes in capital market restrictions within the EMS

(7) These spreads have to be interpreted with some caution first because the interest rates are not exactly comparable in terms of risk characteristics and secondly because the Euro-interest rates are averages of daily figures while most national interest rates are averages of Wednesday quotations.

- TABLE 1 -

SPREAD BETWEEN EURO AND DOMESTIC 3-MONTH INTEREST RATES
(MONTHLY AVERAGES)

	ECU*	DM	FF	LIT
1982 OCTOBER	1.1678	-0.42	5.3936	3.83
NOVEMBER	1.4705	-0.1731	5.3889	6.1266
DECEMBER	2.4676	-0.2323	9.762	6.965
1983 JANUARY	2.1918	-0.2666	8.7687	5.4896
FEBRUARY	2.206	-0.1294	9.1341	4.4427
MARCH	2.8635	-0.3256	12.4149	4.3844
APRIL	0.1864	-0.1769	1.2035	-0.0262
MAY	0.0724	-0.2213	1.3418	-0.4808
JUNE	0.2708	-0.142	1.8204	1.0048
JULY	0.1111	-0.3483	1.4644	0.7176
AUGUST	0.4862	-0.1663	2.723	1.563
SEPTEMBER	0.5015	-0.1216	2.0012	1.7461
OCTOBER	0.3538	-0.2863	1.6355	2.8422
NOVEMBER	0.178	-0.1526	0.6436	1.4525
DECEMBER	0.2789	-0.1482	1.0041	1.4425
1984 JANUARY	0.244	-0.0875	0.8265	1.4675
FEBRUARY	0.7381	-0.0814	3.1065	2.34
MARCH	0.687	-0.1525	2.7181	3.2344
APRIL	0.1178	-0.1293	0.6967	1.4469
MAY	0.1474	-0.0935	0.4249	1.2715
JUNE	0.0846	-0.2362	0.5375	1.1219
JULY	0.144	-0.2578	0.2312	2.0687
AUGUST	-0.0241	-0.3653	0.0806	0.69
SEPTEMBER	0.1758	-0.2141	0.2094	1.1966
OCTOBER	0.2178	-0.1435	0.4181	1.81
NOVEMBER	0.1203	-0.1556	0.5125	1.1312
DECEMBER	0.0353	-0.133	-0.0359	0.7287
1985 JANUARY	0.2381	-0.0341	0.0606	1.45
FEBRUARY	0.4177	0.0714	0.3415	1.8312
MARCH	0.4487	-0.1722	0.1656	2.2469
APRIL	0.1716	-0.1189	0.1195	1.4737
MAY	-0.1072	-0.1386	-0.0231	-0.555
JUNE	0.0421	-0.1237	0.1062	0.3031
JULY	0.0789	-0.2045	0.5102	-0.14
AUGUST	0.3489	-0.1551	1.673	0.3437
SEPTEMBER	0.1651	-0.085	0.7458	-0.1167
1983 MEAN	0.8083	-0.2071	3.6796	2.0462
1984 MEAN	0.2240	-0.1708	0.8105	1.5423
1985 MEAN	0.2004	-0.1068	0.4111	0.7597

* DIFFERENCES BETWEEN COMBINED EUROCURRENCY AND COMBINED DOMESTIC THREE-MONTH INTEREST RATES

and/or their effectiveness during the sample period. It has fallen from 81 basis points in 1983 to 22 in 1984 and to 20 in the first 9 months of 1985.

Chart 1 shows the spreads reported in Table 1. Even disregarding the period before March 1983 which is disturbed by the general realignment, a downward trend in the spread for the ECU, the French Franc and the Lira is visible.

2. The spread between the quoted ECU interest rate and the combined Eurocurrency rate

Chart 2 shows the difference between the quoted ECU deposit rate at the three months maturity and the combined Eurocurrency interest rate.[8]) Table 2 contains the same difference for deposits of maturity of 1, 3, 6 and 12 months. The spread reached a minimum negative value of 50 basis points at the time of the March 1983 general realignment and a maximum positive value of 47 basis points in August 1984, the last full month prior to the mid-September change in the weights. The data reported in the table seem to suggest that the spread was more sensitive to expectations of realignments at the one month maturity while it was more sensitive to expectations of changes in the weights at the longer end of the market. Expectations of realignments and of changes in the weights must be clearly important factors to explain changes in the spread.

During the sample period, there was only one general realignment in March 1983,[9]) and only one change in the definition of the basket, in September 1984, when the quantity of the member currencies was changed and the Greek Drachma was introduced into the basket.

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(8) The method used to compute the combined Eurocurrency interest rate is Method A which is illustrated in Appendix 1.

(9) The realignment of July 1985 was minor since it involved only a change in the central rate of the lira and was largely unexpected.

CHART 1: SPREAD BETWEEN EURO AND DOMESTIC INTEREST RATES

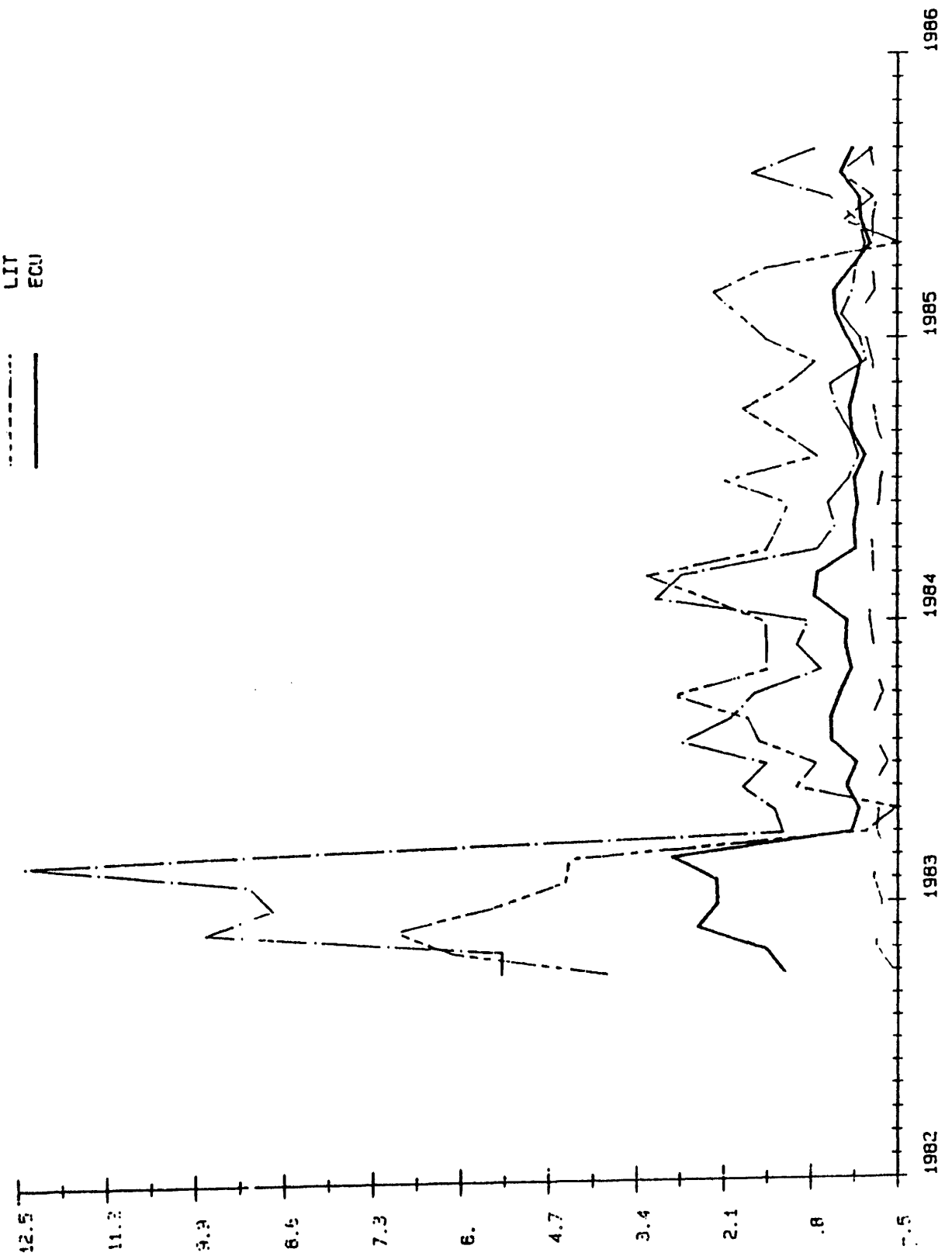
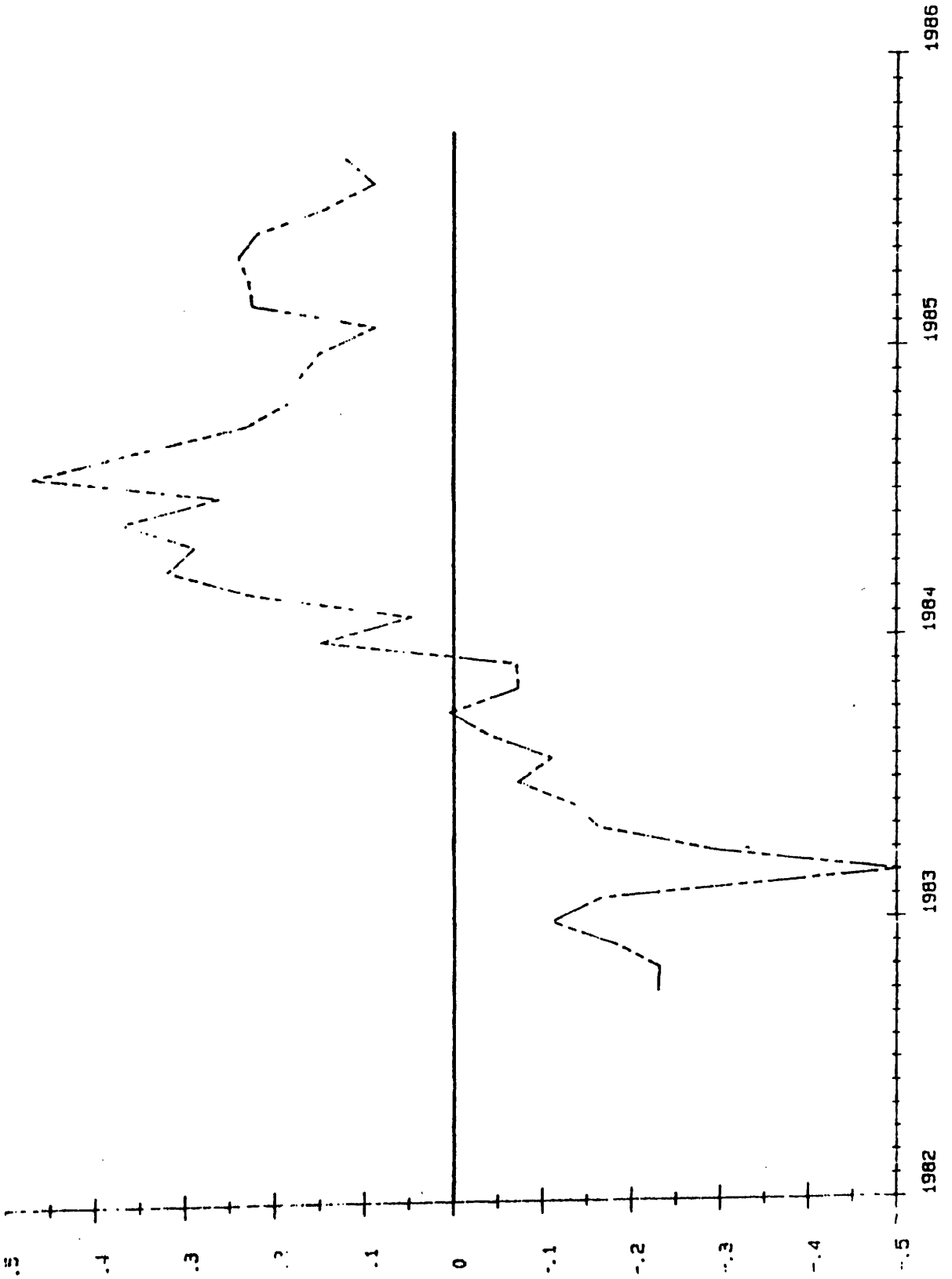


CHART 2: SPREAD BETWEEN QUOTED ECU 3-MONTH DEPOSIT RATE AND COMBINED EUROCURRENCY 3-MONTH INTEREST RATE



- TABLE 2 -

DIFFERENCE BETWEEN QUOTED ECU DEPOSIT RATE AND COMBINED EUROCURRENCY RATES (*)
(MONTHLY AVERAGES)

	MATURITY			
	1 MONTH	3 MONTHS	6 MONTHS	12 MONTHS
1982 OCTOBER	-0.1704	-0.2299	-0.1918	-0.1943
NOVEMBER	-0.1866	-0.2316	-0.2057	-0.1968
DECEMBER	-0.1224	-0.1826	-0.1612	-0.1563
AVERAGE	-0.1598	-0.2147	-0.1862	-0.1825
1983 JANUARY	-0.1701	-0.1094	-0.1155	-0.1501
FEBRUARY	-0.2571	-0.1678	-0.1574	-0.0928
MARCH	-1.3971	-0.5048	-0.1998	-0.1515
APRIL	-0.2326	-0.2892	-0.1477	-0.162
MAY	-0.1909	-0.1633	-0.1705	-0.1617
JUNE	-0.1203	-0.1362	-0.1477	-0.256
JULY	-0.2501	-0.0723	-0.0644	-0.0556
AUGUST	-0.0647	-0.1106	-0.0576	-0.0729
SEPTEMBER	-0.0492	-0.0406	-0.0194	-0.0591
OCTOBER	-0.0232	4.114E-03	-0.0369	-0.0528
NOVEMBER	0.0166	-0.0735	-0.0525	-0.0602
DECEMBER	0.1047	-0.0705	-0.0473	-0.0796
AVERAGE	-0.2195	-0.1445	-0.1014	-0.1128
1984 JANUARY	1.07	0.1485	0.1396	0.1206
FEBRUARY	0.2864	0.0474	0.0403	0.0544
MARCH	0.3357	0.2262	0.1692	0.2999
APRIL	0.3786	0.32	0.3392	0.4604
MAY	0.3818	0.2894	0.2343	0.2262
JUNE	0.4223	0.3708	0.381	0.187
JULY	0.2703	0.261	0.2805	0.1337
AUGUST	0.4981	0.4697	0.6742	0.6504
SEPTEMBER	0.3649	0.354	0.5717	0.5533
OCTOBER	0.2414	0.2295	0.2185	0.2952
NOVEMBER	0.2488	0.1824	0.2629	0.4015
DECEMBER	0.1402	0.1726	0.1934	0.2621
AVERAGE	0.3865	0.2560	0.2921	0.3037
1985 JANUARY	0.2019	0.1505	0.1275	0.0831
FEBRUARY	0.3397	0.0891	0.0117	-0.1926
MARCH	0.2322	0.2251	0.1917	-0.0233
APRIL	0.2193	0.2293	0.2448	0.2851
MAY	0.176	0.2404	0.3005	0.2901
JUNE	0.1735	0.2197	0.2165	0.1159
JULY	0.1178	0.1435	0.1063	-0.0279
AUGUST	0.0799	0.0884	0.0838	0.0415
SEPTEMBER	-0.0974	0.1202	0.1347	0.054
AVERAGE	0.1603	0.1674	0.1575	0.0696
STANDARD DEV.	0.3710	0.2185	0.2178	0.2293

(*) QUOTED ECU RATE MINUS COMBINED RATE.

The reasons why changes in expectations of realignments and of changes in the Ecu weights should lead to changes in the spread are the following. As to expectations of realignments the reason why they influence the spread is related to the existence of transaction costs in arbitraging between the ECU market and Euromarkets and to the fact that these costs change as expectations of realignments change. The difference between bid and ask prices normally increases when a realignment approaches both in the foreign exchange market and in the Eurodeposit market. Arbitrage operations therefore become more costly and this should explain why the spread can reach the levels observed during and before March 1983. Consider the case of an imminent devaluation of the French Franc. The Eurofranc interest rate starts reflecting the expectations of the devaluation and goes up giving rise to the possibility of making profits by borrowing in Ecu and investing in Eurofrancs and in the other component currencies of the Ecu, without incurring an exchange risk. However the possibility of making profits is limited a) by the widening of the spread between bid and ask rates in the ECU-deposit market b) the widening of the spread between bid and ask rates in the foreign exchange market, where the borrowed Ecu has to be transformed into its component currencies and c) by the widening of the spread in the Euro deposit markets of the component currencies.

Expectations of changes in the weights have led to a large increase in the spread in the months preceding the September 1984 change because the weight of weak (high interest) currencies were expected to be increased and those of strong (low interest currencies) was expected to be reduced. In addition the Greek Drachma was expected to be introduced in the definition of the basket. Table 3 shows the weights of the member currencies before and after the change. As the ECU is defined in terms of a fixed number of each member currency, the weight of currencies that tend to depreciate falls in time. Member countries can, according to the EMS agreements, reassess the weights every 5 years or every time that the weight of one currency changes by more than 25 per cent. The quoted Ecu interest rate was already incorporating the expected increase in the combined interest rate already prior to the September 17 change in the weights.

(3)

TABLE 3:

WEIGHTS OF THE ECU BEFORE AND AFTER THE SEPTEMBER 1984 CHANGES IN THE WEIGHTS

CURRENCY	Amount of national currency in basket		Percentage weights of currencies in the basket		
	March 13 1979	September 17 1984	March 13 1979[1]	September 14 1984[2]	September 17 1984[3]
Deutsche Mark	0,828	0,719	33,0	36,9	32,0
French Franc	1,15	1,31	19,8	16,7	19,0
Pound Sterling	0,0885	0,0878	13,3	15,1	15,0
Italian Lira	109	140	9,5	7,9	10,2
Dutch Guilder	0,286	0,256	10,5	11,3	10,1
Belgian Franc	3,66	3,71	9,3	8,1	8,2
Luxembourg Franc	0,14	0,14	0,4	0,3	0,3
Danish Krone	0,217	0,219	3,1	2,7	2,7
Irish Pound	0,00759	0,00871	1,1	1,0	1,2
Greek Drachma	-	1,15	-	-	1,3

1 Currencies' initial weights in the ECU, calculated with central parity rates at 13.3.1979.
2 Pre-redefinition currencies' weights calculated with market exchange rates at 14.9.1984.
3 Post-redefinition currencies weights, calculated with market exchange rates at 17.9.1984.

Source: EC Commission and ECU Newsletter based on EC Commission data.

There are other factors influencing the spread as well. First, in equilibrium and in the presence of transaction costs, the ECU deposit rate would not necessarily be equal to the combined rate; it would be lower if ECU deposits diversify the risk and higher if the interest rates are positively correlated. This risk factor would not be constant through time; as interest rates and inflation rates of component currencies move closer together and they become closer substitutes, the risk diversification element would become smaller as discussed in the previous section. In a world without transaction costs private agents wanting to diversify the risk would form their own basket and the Ecu would lose its diversfication function. If the Ecu existed in such a world the combined and the quoted interest rate could not diverge. Secondly, especially in the early part of the sample period the ECU market could be considered as in its infancy. Two possible scenarios can be envisaged. One is that banks involved in ECU lending could have fixed interest rates at below competitive levels to attract customers and that as a result they had to offer correspondingly low interest rates on deposits. A second scenario is that the banks, being new in the business, were demanding a very large spread between borrowing and lending rates, which depressed the borrowing rates substantially below the combined Eurocurrency rate and possibly raised lending rates above the combined Eurolending rates. This behaviour would have also been justified by the initially higher transaction costs due to the large disequilibrium between primary ECU liabilities and assets of Eurobanks and the ensuing costs of "bundling" the ECU. As the market became less unbalanced, as a result of economies of scale setting in and as banks became more familiar with the new instrument, the spread between deposit and lending rates may have fallen, moving the quoted ECU deposit rate closer to the combined Eurocurrency deposit rate. Unfortunately there is no direct way to test this hypothesis, since homogenous time series on the spread between ECU deposit and lending rates are not available. However a very crude attempt was made to test for a significant effect of the ratio of bank ECU deposits to bank ECU assets, as a proxy for the disequilibrium in the market and the potential implications for transaction costs of banks, on the spread between the quoted and the combined ECU interest rate. No significant influence was detected. However the proxy used for disequilibrium in the market is available for only part of the

sample period and only on a quarterly basis; the series was interpolated linearly to obtain monthly figures.

For completeness it should be observed that the spread was again negative at the time of writing[10]) and that in 1986 the disequilibrium between primary bank borrowing and lending in ECU was substantially reduced.

3. The term structure of Ecu deposit rates, tests of market efficiency and comparisons with other Euro-currencies

In the previous section the factors affecting the behaviour of the spread between the quoted and the combined ECU deposit interest rate have been analysed. In this section three separate tests will be presented for the ECU, the Eurodollar, the Euromark and the Europound interest rates. The tests are first a test of Meiselman's expectations theory about the term structure of interest rates, a test of the hypothesis that the observed forward interest rate contains information about the future spot rate suggested by Fama (1984) and finally a simple market efficiency test which consists of regressing the future spot interest rate on the past forward interest rate (Frenkel 1976).

The sample period is October 1982 to September 1985. The data set used are monthly averages of daily figures purchased from Chase Econometrics which in turn collects them from the Financial Times. All the data are averages of bid and ask rates.

The data set contains interest rates on deposits of 1, 3, 6 and 12 months maturity. The interest rate on deposits of 9 months maturity was obtained by geometric interpolation. With these maturities we are able to extract from the data only forward interest rates on deposits of 3 and 6 months maturities. All the tests mentioned above are performed with non overlapping quarterly data obtained by taking every third observation of the monthly data set. The use of overlapping monthly data would have sharply increased the numbers of degrees of freedom but would have led to

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strong autocorrelation of the residuals. Because the sample period is relatively short the degrees of freedom are only nine. Thus all the results have to be interpreted with some caution.

A test of Meiselman's expectations theory about the term structure of interest rates will be presented first. This test shows to what extent innovations in interest rates are significantly correlated with changes in the forward rate. The innovation is defined as the difference between the spot rate and the past forward rate. This difference is the forecasting error made by using the forward rate as the predictor of the future spot rate. The test suggests to what extent the information contained in the current spot rate is incorporated into the revision of the forward interest rates implicit in the term structure.

To explain the tests made, the following symbols are defined:

R = Actual rate of interest prevailing in the market, annualized. An interest rate of 10% is expressed as 0.10

r = Forward rate of interest.

The subscript on the left refers to the month or week in which the rate becomes applicable (e.g. t+n stands for n weeks or months from week or month t). The first subscript on the right refers to the length to maturity of the deposit, generally expressed in months. The second subscript on the right, refers to the month or week during which the expectation of the future interest rate is held by the market.

DEFINITIONS RELEVANT FOR MEISELMAN'S MODEL

Pure expectations theory:

$$(1+R_{n,t})^n = (1+R_{1,t})(1+{}_{t+1}r_{1,t})\cdots\cdots(1+{}_{t+n-1}r_{1,t})$$

Hicksian formulation of the forward rate:

$$ {}_{t+n}r_{1,t} = \frac{(1 + R_{n+1,t})^{n+1}}{(1 + R_{n,t})^n} $$

Where:

$R_{n,t}$ = The observed rate at time t with maturity n.

THE MEISELMAN MODEL

A. THREE MONTHS FORECASTING HORIZON

$$(1) \qquad {}_{t+3}r_{3,t} - {}_{t+3}r_{3,t-3} = F(\overbrace{{}_{t}R_{3,t} - {}_{t}r_{3,t-3}}^{\text{forecasting error}})$$

$$ {}_{t+3}r_{3,t} = \frac{(1 + R_{6,t})^2}{(1 + R_{3,t})} - 1$$

$$ {}_{t+3}r_{3,t-3} = \frac{(1 + R_{9,t-3})^3}{(1 + R_{6,t-3})^2} - 1$$

$$ {}_{t}r_{3,t-3} = \frac{(1 + R_{6,t-3})^2}{(1 + R_{3,t-3})} - 1$$

where:

${}_{t+3}r_{3,t}$ = is the forward interest rate on a 3 month deposit expected at time t for time t+3

${}_{t+3}r_{3,t-3}$ = is the forward interest rate on a 3 months deposit expected at time t-3 for time t+3. Hence the difference ${}_{t+3}r_{3,t} - {}_{t+3}r_{3,t-3}$ is the revision of the forward interest rate on a 3 months deposit which the market makes at time t with respect to time t-3.

${}_{t}r_{3,t-3}$ = is the forward interest rate on a 3 months deposit which the market had expected at time t-3 for time t.

Equation (1) states that at time t the market revises its opinion about the forward rate on a 3 months deposit relating to time t+3 on the basis of the forcasting error it makes at time t-3.

B. SIX MONTHS FORECASTING HORIZON

(2) $$_{t+6}r_{3,t} - {}_{t+6}r_{3,t-3} = F({}_{t}R_{3,t} - {}_{t}r_{3,t-3})$$

$$_{t+6}r_{3,t} - 3 = \frac{(1+R_{9,t})^3}{(1+R_{6,t})^2} - 1$$

$$_{t+6}r_{3,t-3} = \frac{(1+R_{12,t-3})^4}{(1+R_{9,t-3})^3} - 1$$

where $_{t}r_{3,t-3}$ and $_{t}R_{3,t}$ are defined above.

Table 4 contains estimates of a linear version of equations (1) and (2). For each currency the first line reports the estimates of a linear version of equation (1) and the second line the estimate of the linear version of equation (2).

Before interpreting the results presented in Table 4 a word of caution is in order. From the test presented one can infer that the market revises the forward rate on the basis of the forecasting error only under certain restrictive assumptions. If the risk (liquidity, time) premium is zero or time invariant and if the interest rate follows a univariate stationary process whose innovations are orthogonal to the history of publicly available information, then the optimal forecasts of future interest rates will be updated exactly as Meiselman's model predicts (Molino, 1986). These are quite restrictive assumptions. Another reason for interpreting the results of Table 4 with caution is that the interest rate on deposits of 9 months maturity was obtained by geometric interpretation.

TABLE 4: MEISELMAN'S MODEL

QUARTERLY NON-OVERLAPPING DATA WITH QUARTERLY ERROR ADJUSTMENT
(Period: January 1983 - September 1985)

Revision of Forward Rate = a + b . Forecasting Error + Epsilon

EURO - DOLLAR				
n	a	b	R^2	D.W.
3	0.003	1.06	0.95	1.49
	(2.77)	(14.58)		
6	0.002	1.08	0.92	1.69
	(1.36)	(10.50)		

EURO DEUTSCHE MARK				
n	a	b	R^2	D.W.
3	0.003	1.13	0.88	2.38
	(2.56)	(8.00)		
6	0.002	1.06	0.73	2.21
	(1.01)	(4.88)		

EURO STERLING				
n	a	b	R^2	D.W.
3	-0.0009	0.80	0.85	1.84
	(0.78)	(7.24)		
6	-0.0008	0.78	0.86	2.06
	(0.70)	(7.42)		

E C U				
n	a	b	R^2	D.W.
3	0.0004	0.44	0.36	1.90
	(0.21)	(2.23)		
6	-0.003	0.18	0.07	2.43
	(1.35)	(0.80)		

* Numbers in parentheses are t-statistics.

For the Eurodollar and the Euromark the estimates of the parameter b fall within the value of one plus or minus two standard deviations. For these two Euro-currencies the estimates of b for the 6 months forecasting horizon are not significantly below the estimate of b for the 3 months horizon. For both horizons these markets seem to make strong use of the information contained in the interest rate innovation. For the Eurosterling and the quoted ECU one observes that the estimates of b are significantly below one suggesting a less than complete incorporation of the new information into the forecast of the future interest rate. For the quoted ECU the estimates of b are the lowest.

It has already been mentioned that a problem of Meiselman's tests is the existence of a risk premium which changes through time. There is unfortunately not much agreement in the literature on how to measure the liquidity premium. Nevertheless in Table 5 an attempt was made to measure the liquidity premium on the four Euro-currencies for deposits of up to 12 months, following Santomero (1975).[11])

The liquidity premia are quite high for all currencies except the Pound Sterling. According to the calculations investors seem to require a premium of about 80 basis points on an annual basis to hold dollar deposits for 6 months rather than for three months. The premium amounts to almost 200 basis points for 12 months dollar deposits. For the DM the premium is about 50 basis points for 6 months deposits and 130 for 12 months deposits. For the quoted ECU it is about 70 basis points for the 6 months maturity and about 140 for the 12 months maturity.

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(11) The premium is calculated as follows:
First one computes the asset return as:

$$A_{n,t} = \frac{(1+{}_tR_{n,t})^n}{(1+{}_{t+1}R_{n-1,t+1})^{n-1}} - 1$$

The premium is:

$$P_{n,t} = A_{n,t} - {}_tR_{1,t}$$

where the symbol ${}_tR_{n,t}$ stands for the market interest rate on an asset of maturity n observed at time t.

- Table 5 -

Liquidity Premium

monthly data; averages for period: october 1982-august 1985
(standard deviation in brackets)

PREMIUM FOR THREE MONTH HOLDING PERIOD

currency	Asset maturity 6 month	9 months	12 months
usd	0.770	1.301	1.948
	(1.219)	(2.553)	(3.956)
dm	0.526	0.878	1.298
	(0.543)	(1.175)	(1.849)
stg	-0.166	-0.166	-0.186
	(1.286)	(2.215)	(3.107)
ecu	0.717	1.009	1.422
	(0.688)	(1.065)	(1.377)
ecu*	0.688	1.057	1.502
	(0.676)	(1.068)	(1.487)

PREMIUM FOR SIX MONTH HOLDING PERIOD

currency	Asset maturity 12 months
usd	1.123
	(1.981)
dm	0.652
	(0.725)
stg	-0.064
	(1.146)
ecu	0.840
	(0.497)
ecu*	0.942
	(0.576)

* combined eurocurrency ecu interest rate

The liquidity premia for holding a deposit for 12 months rather than 6 have the same ranking by currency as those calculated for 3 months holding periods[12] the highest premium being recorded for the US dollar and the lowest for the DM and the pound. The variability of the liquidity premia, as measured by their standard deviations, was also quite high.[13] It is worth noting that for the ECU it is amongst the lowest of all maturities and for all holding periods.

In a recent article Fama (1984) presents a generalization of Meiselman's model which allows for time varying risk premia and which incorporates Meiselman's pure expectations theory as a special case. Fama considers the following regressions (where the error terms have been omitted for simplicity):

(3) $P_{3,t} = a_1 + b_1({}_{t+3}r_{3,t} - {}_tR_{3,t})$

(4) ${}_{t+3}R_{3,t+3} - {}_tR_{3,t} = a_2 + b_2({}_{t+3}r_{3,t} - {}_tR_3)$

He calls the term in brackets the current forward - spot differential. This differential is different from the forecasting error of equations (1) and (2). Equations (3) and (4) imply that changes in the current forward - spot differential influence both the risk premium $P_{3,t}$ and the future change in the spot rate ${}_{t+3}R_{3,t+3} - {}_tR_{3,t}$. Evidence that b_1 is reliably positive means that the current forward rate contains information about the premium. Evidence that b_2 is reliably positive means that the current forward rate has power as predictor of the spot rate to be observed at time t+3. Under Meiselman's pure expectations theory the coefficient b_1 is equal to zero (there is no premium or the premium is time invariant) and the coefficient b_2 is equal to 1.0. In this case it follows from (4) that:

(5) ${}_{t+3}R_{3,t+3} = a_2 + {}_{t+3}r_{3,t} +$ Error term

which says that the forward rate is an unbiased predictor of the future spot rate, if in addition a_2 is equal to zero.

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(12) See the bottom half of Table 5.
(13) They are reported between brackets in Table 5.

Table 6 contains tests of equation (4) with non-overlapping quarterly data. The most satisfactory results are obtained for the Deutsche Mark and the ECU for which the estimate of the coefficient b_2 is reliably positive and not significantly different from 1. For both of these currencies the D.W. statistics indicate the absence of significant autocorrelation of the residuals and the R^2 is satisfactory.[14])

To test whether the forward interest rate is an unbiased predictor of the future spot interest rate, the following regression has been estimated, following Frenkel (1976):

(6) $${}_tR_{3,t} = a + b\ {}_tr_{3,t-3} + \text{Error term}$$

where ${}_tR_{3,t}$ is the current 3-month rate and ${}_tr_{3,t-3}$ is the three-month forward rate observed at time t-3.

If the constant in this regression doesn't differ significantly from zero and the coefficient on the forward rate doesn't differ from unity, the latter is an unbiased predictor of the former.

Table 7 contains the estimates of equation (6) for the four Euro-currencies, performed with non overlapping quarterly data. While all the regressions have a relatively weak R^2, the D.W. statistics indicate the absence of autocorrelation for the Eurosterling and the ECU. In addition the estimates of the coefficient b for these two currencies are not significantly different from 1 and the estimates of the coefficient a are not significantly different from zero. For the private ECU and for the Euro-sterling the tests presented in Table 7 seem to indicate that the market is efficient.

On the basis of the tests presented in Table 6 and 7 one can conclude that the ECU deposit market compares quite well with the other Eurocurrency deposit markets considered here, both as far as the predictive power of

(14) No attempt was made to estimate equation (3) because of the difficulties in extracting reliable time series of the risk premium from the data.

TABLE 6: Changes in the spot rate on the current forward spot differential. Estimates of Equation (4). Quarterly non-overlapping data. (Period: January 1983 - September 1985)

	a_2	b_2	R^2	D.W.
EURO-DOLLAR	0.86 (1.11)	-1.89 (1.54)	0.21	2.10
EURO-DEUTSCHE MARK	-0.58 (2.27)	1.18 (2.01)	0.31	1.74
EURO STERLING	0.20 (0.56)	0.44 (0.56)	0.03	2.53
ECU	-0.87 (2.73)	1.26 (2.90)	0.48	2.22

* Numbers in parenthesis are t-statistics

TABLE 7: Tests of market efficiency. Quarterly non-overlapping data. (Period: January 1983 - September 1985)

	a	b	R^2	D.W.
EURO-DOLLAR	5.21 (1.65)	0.43 (1.43)	0.19	1.13
EURO-DEUTSCHE MARK	4.21 (3.13)	0.23 (1.04)	0.11	1.23
EURO STERLING	3.91 (0.86)	0.65 (1.49)	0.20	1.76
ECU	2.78 (0.73)	0.66 (1.79)	0.26	2.25

* Numbers in parenthesis are t-statistics

the 3-months forward rate is concerned (Table 6) and as far as the efficiency of the market is concerned (Table 7). On the other hand the ECU fares badly as far as the pure expectations theory of the term structure of interest rates is concerned (Table 4). This may be due to the fact that expectations of realignments and of changes in the ECU weights have significantly altered the term structure of interest rates in the ECU deposit market. For the tests of Table 4 interest rates on deposits of up to 12 months maturity were used, while for the tests of Tables 6 and 7 interest rates on deposits of only up to 6 months maturity were used.

Appendix 1 - Methods to calculate the combined ECU interest rate

The theoretical ECU interest rate can be calculated in four manners.

The first two methods lead under certain conditions to identical results; the same holds for the other two.

The difference between these two groups of computing formulas lies in the kind of exchange rate used to compute the weight of the interest rate of each component currency: spot in the first two methods, forward in the last two.

METHOD A.

In this paper the following formula to compute the theoretical ECU interest rate has been used:

$$\text{Combined ECU interest rate} = \sum_{i=1}^{n} \frac{CU_i}{EX_i} \cdot I_i$$

Where:

- n = number of component currencies in the ECU
- CU_i = units of currency i in the ECU basket definition
- EX_i = spot exchange rate of currency i against ECU defined as a number of units of currency i per ECU
- I_i = currency i interest rate

METHOD B

This method relies on the interest rates of member currencies obtained from the interest rate of one of the member currencies or of a third currency by using the assumption of interest rate arbitrage. The spot exchange rate is used to compute the component currency weight in the ECU, as in Method A.

This method can be viewed as the same as the first one, only if the interest parity condition holds perfectly.

$$\text{Theoretical ECU interest rate} = \sum_{i=1}^{n} \frac{CU_i}{EX_i} \cdot (I_x + FP_i)$$

Where :

I = interest rate on base currency x.

FP = forward premium or discount for component currency i against the base currency x, expressed in annual percentage terms.

METHOD C

This formula is a variant of Method A obtained by replacing the spot exchange rate by the forward exchange rate.

$$\text{Theoretical ECU interest rate} = \sum_{i=1}^{n} \frac{CU_i}{FX_i} \cdot I_i$$

Where:

FX_i = forward exchange rate of currency i against the ECU defined as units of component currency i per ECU.

METHOD D

This method, called commercial bank method, uses an outright forward exchange rate against the ECU.

We know that the forward exchange rate of currency i against the ECU, under covered interest rate parity is given by:

$$FX_i = EX_i + EX_i \cdot \left[\frac{\left(1 + \frac{I_i}{100}\right)}{\left(1 + \frac{I_{ECU}}{100}\right)} - 1 \right]$$

The theoretical rate is computed by solving the above equation for I_{ECU}:

$$\text{ECU interest rate} = \left[\frac{\left(1 + \frac{I_i}{100}\right) \cdot EX_i}{FX_i} - 1 \right] \cdot 100$$

The resulting ECU interest rate is lower than the rate generated using spot exchange rates. This is due to the fact that high interest rate currencies are at a discount under covered interest parity and consequently these currencies have a lower percentage weight in the basket than when spot exchange rates are applied to the fixed currency units, as in Methods A and B.

Appendix 2: Description and Sources of the data used

A. EURORATES

The Euro-market interest rates (supplied by Chase Econometrics Interactive Data Corporation) are weekly averages of daily market closing rates (Source: Financial Times).

The data used are middle rates between bid and ask quotations.

The maturities are 1 month, 3 months, 6 months, 12 months.

The 9-month rate has been obtained by calculating the geometric mean between 6 and 12 month rates.

The period covered is from the 40th week of 1982 until the 39th week of 1985.

The data are available for the following Euro-currencies: US Dollar, Deutsche Mark, Dutch Guilder, Belgian Franc, Danish Krona, Franch Franc, Italian Lira, ECU.

For the Irish Punt and the Greek Drachma, the corresponding domestic interest rates have been used to calculate the combined Euro-currency ECU interest rates.

For the Irish Punt the 1, 3 and 6 months maturities are available.
The 6 month rate has been used as a proxy for the 12 month rate.

For the Greek Drachma, only the interest rate at the 3-month maturity is available; this has been used as a proxy for all the other maturities.

B. DOMESTIC INTEREST RATES

The domestic interest rates used are:

For the Deutsche Mark, the 3 month interbank bid rate, weekly (Wednesday quotation).

For the Irish Punt, the 3 month deposit middle rate, weekly average.

For the Pound Sterling, the 3 month commercial paper ask rate, weekly (Wednesday quotation).

For the Italian Lira, the 79-days Treasury Bill middle rate, weekly (Wednesday quotation).

For the French Franc the 3 months interbank paper rate was used, ask rate (Wednesday quotations)

For the Dutch Guilder, the 3 month large bank deposit middle rate, weekly (Wednesday quotation).

For the Belgian Franc, the 120-days Treasury Bill middle rate, weekly (Wednesday quotation).

For the Danish Krone, the short-term bill rate, monthly.

For the Greek Drachma, the 3 month money market offered rate for convertible Drachma, weekly average.

The Source for the Drachma is The Bank of Greece; for all the other currencies, the Source is Chase Econometrics Interactive Data Corporation.

C. EXCHANGE RATES

The exchange rate data are national currencies against the ECU. They are weekly averages of middle rates. The source is the Financial Times (data collected by Chase Econometrics), except for the Greek Drachma exchange rate where the source is the Commission of the European Communities.

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