International and European Monetary Systems

Edited by

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Supposing international consistency in targets, much more effort, it seems to me, should be put in identifying and securing an equal number of instruments of policy. The basic reason for policy conflicts of a strategic nature is in one sense always a shortage of instruments relative to targets. Before engaging in trading off the losses due to this shortage as the cooperative solution requires, one would do well to try to eliminate or reduce the shortage. This can be done either by giving up targets (the current account may be a prime candidate) or by finding and/or freeing additional instruments. Fiscal policy is one example; schemes for the international coordination of fiscal policy will remain moot as long as domestic political considerations prevent national fiscal policies from actually being changed. This brings another point to mind: one reason why the perceived gains from policy coordination appear to be much larger than those suggested by simulated comparisons between Nash and cooperative equilibrium may well be that countries are actually well below their Nash utility levels because of an inability to adjust their policy instruments.

Even with target consistency and a sufficient number of instruments, problems remain of policy coordination that cannot be analyzed with strategic behavior models. These problems stem primarily from uncertainty—more specifically, from lack of information about behavior parameters, the dynamics of adjustment, and the nature and origin of disturbances. It is here that Mundell's assignment problem and principle of effective market classification come into their own. The essential idea is to design robust systems of policy response that lead to convergence to targets in the face of uncertainty and imperfect information. This involves the design of broadly defined contingent rules of the type, "Assign monetary policy to the balance of payments under fixed exchange rates." That tradition of policy design should be revived, lest ambitious policy coordination schemes be adopted that are essentially unstable. To give but one example, Hans Genberg and I have recently shown that under flexible exchange rates, fiscal policy should be assigned to current account targets (if any) to achieve a stable system of policy response in that regime. This would contradict part of the assignment of policies to targets advocated in the "extended target zones" proposal.[1]

Finally, coherence between national policy rules and the logic of the international monetary system as a whole needs to be ensured. The $n - 1$ problem is one instance of this issue. Here incentive compatibility and strategic behavior are again relevant, and we should be grateful to Paul de Grauwe for bringing some of the issues involved to the fore.

NOTE

1. See Genberg and Swoboda (1987).

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Causes of the Development of the Private ECU and the Behavior of its Interest Rates

Giuseppe Tullio and Francesco Contesso

The private ECU deposit and bond markets have experienced a spectacular growth that no one 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 billion in 1986. International ECU bond issues fell, however, as a percentage 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 Deutschmark, the weakness of sterling, which made the ECU less attractive for investors, and to the large volume of issues at the end of 1985, which the market needed to digest.

This chapter is divided into three parts. Section 1 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 2 analyzes 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 3 a number of very simple tests are presented, comparing the behavior of interest rates in the ECU deposit market with those in the Eurodollar, Euromark, and Europound deposit market. The first tests Meiselman's (1966) expectations theory about the term structure of interest rates. This test is admittedly rather crude

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and is valid only under very restrictive assumptions. The second is 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. Finally, a simple market efficiency test is performed for all four Eurocurrencies by regressing the future spot rate on the past forward rate, following Frenkel (1976).

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 are available only from the beginning of October 1982. The last observation relates to the end of 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' 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 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 its low risk–high return characteristics. Defined in terms of a basket of currencies, its value is likely to be more stable than the value of any individual component currency for an investor whose consumption basket is in third currencies (U.S. dollar, yens) or in component currencies. For the same reason, its interest rate is likely to be less volatile than that of any individual currency.[3]

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

Another cause is the favorable attitude of the Commission of the European Communities and the European Investment Bank toward 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 toward 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 of 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. On the other hand, 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 were to become unstable, this might reduce the attractiveness of the ECU as a protfolio 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, the possibility that in the future the balance between the confidence-creating roles of the EMS and the ERM and the diversification function of the ECU that 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 U.S. dollar on the European side of the Atlantic. Corporations engaged in international trade would reduce their transaction and interest costs by holding one currency that is accepted in every EMS member country rather than by holding several European currencies.[5] In turn this would foster its role as a financial asset. The role of the private ECU as a medium of exchange is today virtually nonexistent. 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 U.S. 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, an average of interest rates of component currencies, will possess a greater stability than interest rates on any individual currency and will probably be characterized by a lower risk premium as well.

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 favored particularly in German official circles holds that capital controls have been beneficial for the development of the private ECU market. The European Commission holds 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 ECUs 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 increasing 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 ECUs rather than in Deutschmarks 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 ECUs in Germany and to borrow in ECUs has certainly been a negative factor for the development of the market.[6]

The Italian government has issued debt expressed in ECUs, 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 ECUs, 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 ECUs. Credit controls accompanied by exchange restrictions my have therefore at times influenced the amount of borrowing and lending in ECUs.

Exchange controls have had a serious impact on the geographical distribution of borrowing and lending in ECUs. 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 or 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 not likely to be 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 by German borrowers and by 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 its effectiveness was reduced by the willingness of countries participating in the ERM to align their real interest rates to German rates.

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 counterparts. Table 8.1 contains the monthly interest spreads between the Euromarkets and domestic markets for three-month 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 nine months of 1985. For the lira the average was 1.54 in 1984 and 0.76 in the first nine months of 1985.

For the Deutschmark the average spread has been negative but negligible (in

Table 8.1
Spread between European and Domestic Three-Month Interest Rates (Monthly Averages)*

		ECU	DM	FF	LIT
1982	October	1.1878	-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	0.111	-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	2.0482
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.

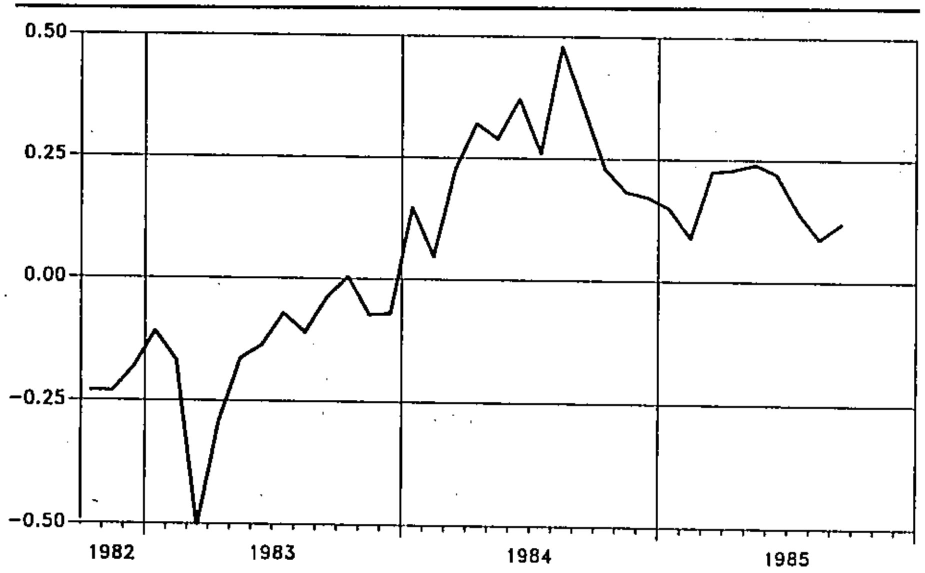
the order of 10 to 20 basis points), with the domestic rate systematically exceeding the Euromark rate, probably because of reserve requirements on bank deposits held in Germany by nonresidents. Also, for the DM the absolute value of the spread has tended to fall over time, but the changes are probably 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 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 nine months of 1985.

Figure 8.1 shows the spreads reported in Table 8.1. 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.

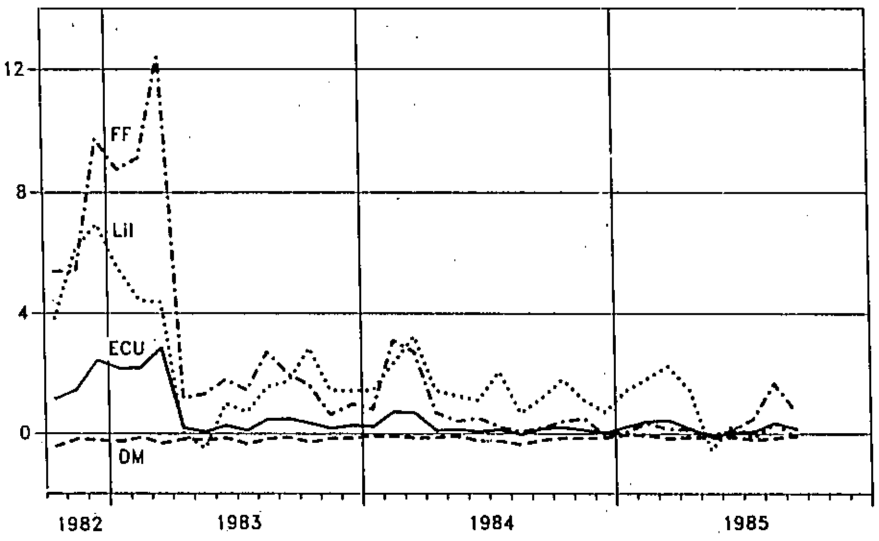
Figure 8.1
Spread between European and Domestic Interest Rates



2. THE SPREAD BETWEEN THE QUOTED ECU INTEREST RATE AND THE COMBINED EUROCURRENCY RATE

Figure 8.2 shows the difference between the quoted ECU deposit rate at the three-month maturity and the combined Eurocurrency interest rate.[8] Table 8.2 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.

Figure 8.2
Spread between Quoted ECU Three-Month Deposit Rate and Combined Eurocurrency Three-Month Interest Rate



During the same 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.

That expectations of realignments and of changes in the ECU weights should lead to changes in the spread is due to following. The influence of expectations of realignments on 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 ECUs and investing in Eurofrancs and in other component currencies of the ECU, without incurring an exchange risk. However, the possibility of making profits is limited by (a) the widening of the spread between bid and ask rates in the ECU deposit market, (b) the widening

Table 8.2
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	-0.1617
	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.

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) the widening of the spread in the Eurodeposit 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 was 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 into the definition of the basket. Table 8.3 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 five 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 prior to the September 17 change in the weights.

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 diversification function. If the ECU existed in such a world the combined and the quoted interest rate could not diverge. Second, especially in the early part of the sample period, the ECU market could be considered to be 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 as a result they could offer correspondingly low interest rates on deposits. A second scenario is that the banks, being new in the business, are demanding a very large spread between borrowing and lending rates, which depresses the borrowing rates substantially below the combined Eurocurrency rate and possibly raises lending rates above the combined Eurolending rates. This behavior 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 becomes less unbalanced, as a result of economies of scale setting in and as banks become more familiar with the new instrument, the spread between deposit and lending rates may fall, moving the quoted ECU deposit rate closer to the combined Eurocurrency deposit rate. Unfortunately, there is no direct way to test this hypothesis, since homogeneous time series on the spread between ECU deposit and lending rates are not

Table 8.3
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[a]	September 14 1984[b]	September 17 1984[c]
Deutschmark	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	0.0879	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 punt	0.00759	0.00871	1.1	1.0	1.2
Greek drachma		1.15			1.3

[1]Initial currency weights in the ECU, calculated with central parity rates on March 13, 1979.
[2]Pre-redefinition currency weights, calculated with market exchange rates on September 14, 1979.
[3]Post-redefinition currency weights, calculated with market exchange rates on September 17, 1979.

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

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 ECUs was substantially reduced.

3. THE TERM STRUCTURE OF ECU DEPOSIT RATES, TESTS OF MARKET EFFICIENCY AND COMPARISONS WITH OTHER EUROCURRENCIES

In the previous section the factors affecting the behavior of the spread between the quoted and the combined ECU deposit interest rate have been analyzed. In this section three separate tests will be presented for ECU, Eurodollar, Euromark, and 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 that 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 is 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 nine 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 three- and six-month 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 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 used: R = Actual rate of interest prevailing in the market, annualized. An interest rate of 10 percent 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 time until 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:

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

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 $R_{n,t}$ is the observed rate at time t with maturity n.

The Meiselman Model

Three-Month Forecasting Horizon

$${}_{t+3}r_{3,t} - {}_{t+3}r_{3,t-3} = F(\overbrace{{}_tR_3, {}_{t-t}r_{3,t-3}}^{\text{forecasting error}}) \qquad (8.1)$$

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

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

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

where ${}_{t+3}r_{3,t}$ is the forward interest rate on a three-month deposit expected at time t for time $t + 3$; ${}_{t+3}r_{3,t-3}$ is the forward interest rate on a three-month deposit expected at time $t - 3$ for time $t + 3$. Hence the difference ${}_{t+3}r_{3,t-t}$ +

${}_3r_{3,t-3}$ is the revision of the forward interest rate on a three-month deposit that the market makes at time t with respect to time $t - 3$. ${}_tr_{3,t-3}$ is the forward interest rate on a three-month deposit that the market had expected at time $t - 3$ for time t. Equation 8.1 states that at time t the market revises its opinion about the forward rate on a three-month deposit relating to time $t + 3$ on the basis of the forecasting error it makes at time $t - 3$.

Six-Month Forecasting Horizon

$$ {}_{t+6}r_{3,t} - {}_{t+6}r_{3,t-3} = F({}_tR_{3,t} - {}_tr_{3,t-3}) \quad (8.2)$$

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

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

where ${}_tr_{3,t-3}$ and ${}_tR_{3,t}$ are defined above.

Table 8.4 contains estimates of a linear version of Equations 8.1 and 8.2. For each currency the first line reports the estimates of a linear version of Equation 8.1 and the second line the estimate of the linear version of Equation 8.2.

Before we interpret the results presented in Table 8.4, 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 (Melino 1986). These are quite restrictive assumptions. Another reason for interpreting the results of Table 8.4 with caution is that the interest rate on deposits of nine months' maturity was obtained by geometric interpretation.

For the Eurodollar and the Euromark the estimates of the parameter b fall within the value of 1 ± 2 standard deviations. For these two Eurocurrencies the estimates of b for the six-month forecasting horizon are not significantly below the estimate of b for the three-month horizon. For both horizons these markets seem to make strong use of the information contained in the interest rate innovation. For Eurosterling and the quoted ECU one observes that the estimates of b are significantly below 1, 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 that changes through time. There is unfortunately not much agreement in the literature on how to measure the liquidity premium. Nevertheless, in Table 8.5 an attempt was made to measure the liquidity premium

Table 8.4

Meiselman's Model: Quarterly Non-overlapping Data with Quarterly Error Adjustment (Period: January 1983–September 1985)*

n	a	b	R^2	D.W.
EURODOLLAR				
3	0.003 (2.77)	1.06 (14.58)	0.95	1.49
6	0.002 (1.36)	1.08 (10.50)	0.92	1.69
EURODEUTSCHMARK				
3	0.003 (2.56)	1.13 (8.00)	0.88	2.38
6	0.002 (1.01)	1.06 (4.88)	0.73	2.21
EUROSTERLING				
3	-0.0009 (0.78)	0.80 (7.24)	0.85	1.84
6	-0.0008 (0.70)	0.78 (7.42)	0.86	2.06
E C U				
3	-0.0004 (0.21)	0.44 (2.23)	0.36	1.90
6	-0.003 (1.35)	0.18 (0.80)	0.07	2.43

*Numbers in parentheses are t-statistics.
Revision of Forward Rate = $a + b$. Forecasting Error + Epsilon.

Table 8.5
Liquidity Premium (monthly data; averages for period October 1982–August 1985)

PREMIUM FOR THREE MONTH HOLDING PERIOD

Currency	Asset maturity 6 months	9 months	12 months
USD	0.770 (1.219)	1.301 (2.553)	1.948 (3.956)
DM	0.526 (0.543)	0.878 (1.175)	1.298 (1.849)
STG	-0.166 (1.286)	-0.166 (2.215)	-0.186 (3.107)
ECU	0.717 (0.688)	1.009 (1.065)	1.422 (1.377)
ECU*	0.688 (0.676)	1.057 (1.068)	1.502 (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.
Standard deviations are in parentheses.

on the four Eurocurrencies 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 six months rather than for three months. The premium amounts to almost 200 basis points for 12-month

dollar deposits. For the DM the premium is about 50 basis points for six-month deposits and 130 for 12-month deposits. For the quoted ECU it is about 70 basis points for six-month maturity and about 140 for 12-month maturity.

The liquidity premia for holding a deposit for 12 rather than six months have the same ranking by currency as those calculated for three-month holding periods.[12] The highest premium was recorded for the U.S. 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 among the lowest of all maturities and for all holding periods.

In a recent article Fama (1984) presents a generalization of Meiselman's model that 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):

$$P_{3,t} = a_1 + b_1({}_{t+3}r_{3,t} - {}_tR_{3,t}) \quad (8.3)$$

$$ {}_{t+3}R_{3,t+3} - {}_tR_{3,t} = a_2 + b_2({}_{t+3}r_{3,t} - {}_tR_3) \quad (8.4)$$

He calls the term in parentheses the current forward–spot differential. This differential is different from the forecasting error of Equations 8.1 and 8.2. Equations 8.3 and 8.4 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 for the spot rate 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 Equation 8.4 that

$$ {}_{t+3}R_{3,t+3} = a_2 + {}_{t+3}r_{3,t} + \text{Error term} \quad (8.5)$$

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

Table 8.6 contains tests of Equation 8.4 with non-overlapping quarterly data. The most satisfactory results are obtained for the Deutschmark 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):

$$ {}_tR_{3,t} = a + b\, {}_tr_{3,t-3} + \text{Error term} \quad (8.6)$$

Table 8.6
Changes in the Spot Rate on the Current Forward Spot Differential (Period: January 1983–September 1985)*

	a_2	b_2	R^2	D.W.
Eurodollar	0.86 (1.11)	-1.89 (1.54)	0.21	2.10
Eurodeutschmark	-0.58 (2.27)	1.18 (2.01)	0.31	1.74
Eurosterling	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

Estimates of Equation 8.4. Quarterly non-overlapping data.
*Numbers in parentheses are t-statistics.

where ${}_tR_{3,t}$ is the current three-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 8.7 contains the estimates of Equation 8.6 for the four Eurocurrencies, 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 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 Eurosterling the tests presented in Table 8.7 seem to indicate that the market is efficient.

On the basis of the tests presented in Table 8.6 and 8.7 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 the 3-months forward rate is concerned (Table 8.6) and as far as the efficiency of the market is concerned (Table 8.7). 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 8.4). 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 8.4 interest rates on deposits of up to 12 months maturity were used, while for the tests of Tables 8.6 and 8.7 interest rates on deposits of only up to 6 months maturity were used.

Table 8.7
Tests of Market Efficiency (Period: January 1983–September 1985)*

	a	b	R^2	D.W.
Eurodollar	5.21 (1.65)	0.43 (1.43)	0.19	1.13
Eurodeutschmark	4.21 (3.13)	0.23 (1.04)	0.11	1.23
Eurosterling	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

Quarterly non-overlapping data.
*Numbers in parentheses are t-statistics.

APPENDIX 1: METHODS TO CALCULATE THE COMBINED ECU INTEREST RATE

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

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 chapter 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 is the number of component currencies in the ECU; CU_i is the units of currency i in the ECU basket definition; EX_i is the spot exchange rate of currency i against ECU, defined as a number of units of currency i per ECU; and I_i is the currency interest rate i.

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, but 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 is the interest rate on base currency x; and FP is the 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 is the forward exchange rate of a currency i against the ECU, defined as units of component currency i per ECU.

Method D

This method, called the 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

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

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

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

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

Eurorates

The Euromarket 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, and 12 months.

The nine-month rate has been obtained by calculating the geometric mean between six- and twelve-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 Eurocurrencies: U.S. dollar, Deutschmark, Dutch guilder, Belgian franc, Danish krone, French franc, Italian lira, ECU.

For the Irish punt and the Greek drachma, the corresponding domestic interest rates have been used to calculate the combined Eurocurrency ECU interest rates.

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

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

Domestic Interest Rates

The domestic interest rates used are:

For the Deutschmark, the three-month interbank bid rate, weekly (Wednesday quotation).

For the Irish punt, the three-month deposit middle rate, weekly average.

For the pound sterling, the three-month commercial paper ask rate, weekly (Wednesday quotation).

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

For the French franc the three-month interbank paper rate was used, ask rate (Wednesday quotations).

For the Dutch guilder, the three-month large bank deposit middle rate, weekly (Wednesday quotation).

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

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

For the Greek drachma, the three-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.

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, the source for which is the Commission of the European Communities.

NOTES

1. The loss in market share was even more pronounced for syndicated bank credits: from 6.2 percent in 1985 to 1.7 percent in 1986.
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 the fact that, for instance, for a Dutch investor, the Deutschmark 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.
5. Swoboda (1968).
6. The ban was lifted in June 1987.
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 second because the Euro interest rates are averages of daily figures, while most national interest rates are averages of Wednesday quotations.
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.
10. May 1987.
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 ${}_tR_{n,t}$ stands for the market interest rate on an asset of maturity n observed at time t.

12. See the bottom half of Table 8.5.
13. They are reported between parentheses in Table 8.5.
14. No attempt was made to estimate Equation 8.3 because of the difficulties in extracting reliable time series of the risk premium from the data.

COMMENT BY

Manfred J. M. Neumann

The private use of ECUs has made considerable headway during recent years. Though still rather small by comparison, the ECU deposit and loan markets may have passed the state of infancy sufficiently to warrant academic attention. The primary purpose of the chapter by Tullio and Contesso is to discuss why private interest in the ECU has grown during recent years and to compare the behavior of the interest rate in the ECU deposit market with those of other Euro deposit markets.

WHY PRIVATE ECUs?

The private ECU is a currency cocktail that permits the investor to diversify his or her portfolio in a standardized fashion in order to improve the return/risk distribution. Although it seems that even for European investors the ECU is below the efficiency frontier (von Moltke 1986), it is a fact that the ECU deposit and loan markets have grown remarkably during recent years.[1]

Tullio and Contesso provide a useful discussion on why these markets may have taken off. In their view the private ECU has profited from the fact that the official ECU serves as a pivot of the European exchange rate mechanism. Indeed, this is an important aspect that may explain why of all private currency cocktails only the ECU has made headway. The private SDR, for comparison, is a complete failure.

In my view, additional important factors in favor of the ECU have been (1) the massive support of these markets by the EC authorities, who have a vested interest in developing this unit, and (2) the credit and capital controls instituted by weak currency countries like Italy and France. The geographical imbalance in ECU borrowing and lending is quite telling in this respect. Whether it will change because German residents are free now to borrow in ECUs remains to be seen.

It is by no means clear, however, that the private ECU will become an important instrument should the member countries of the EMS improve on policy coordination and abolish the still substantial restrictions on the free flow of capital within the EMS area. After all, the productivity of the private ECU, and hence its attractiveness, will decrease the closer the national rates of interest and inflation move together (Neumann 1983). Of course, matters would be different if the ECU were to become a medium of exchange, as Tullio and Contesso speculate. But that would require a European union with joint monetary policy—the end of the tunnel to some, a nightmare to others.

ON THE SPREAD BETWEEN THE QUOTED ECU DEPOSIT RATE AND THE COMBINED EUROCURRENCY RATE

In section 2 of their chapter Tullio and Contesso present computed spreads between ECU deposit rates quoted by banks for various maturities and corresponding combined Eurocurrency rates (see their Table 8.2). They observe that these spreads were negative until the end of 1983 and positive threrafter. This is a peculiar observation that requires explanation. Consequently, the authors advance several suggestions with special emphasis on the role of expectations of realignments and of official redefinitions of the ECU basket. However, very likely their observation is just a statistical artifact. To substantiate this surmise I will first offer a theoretical and then an empirical argument.

Consider a bank that arbitrages between ECU deposits and Euromarkets. The bank will invest funds in the Euromarkets at the combined rate i_E and cover them by supplying ECU deposits at the quoted rate i_Q, provided the interest differential matches the bank's transaction cost c_B.

$$i_Q - i_E \leqq -c_B \qquad (8.7)$$

It follows that the spread $i_Q - i_E$ cannot be nonnegative, though it may fall numerically with increasing competition, diminishing capital controls, and improvements in banking technologies. Also, the negative interest rate spread will rise numerically during periods of increasing uncertainty in response to rising bid/ask spreads in Eurocurrency markets, which raise c_B temporarily.[2]

The theory of arbitraging implies that the spreads considered by Tullio and Contesso must be negative. Observations to the contrary indicate a serious data problem. I suggest that the combined Eurocurrency rates computed by the authors[3] are not comparable to the deposit rates quoted by banks. In the computation of the combined rates the authors apply weights based on the official currency composition of the ECU. This amounts to assuming a closed basket. Most banks, in contrast, treat ECU deposits as open ECU baskets in order to facilitate trading (Lomax 1983). As a result, the deposit rates quoted by banks will take expected changes in the currency composition into account, as the authors realize themselves. It follows that the inconsistent construction of the interest spreads precludes any insight into the interdependence of ECU deposit and Eurocurrency markets.

ON THE TERM STRUCTURE AND MARKET EFFICIENCY

In the final section of their chapter Tullio and Contesso present regression work. To judge from the last paragraph of that section the implicit idea is to demonstrate "that the ECU deposit market compares quite well with the other Eurocurrency deposit markets" in terms of the predictive power of the three-month forward rate and of market efficiency. If the estimates presented and the data used are reliable, however, one might equally well conclude that all these markets are defective because none of them passes a simple efficiency test.

The authors estimate first Meiselman's error learning model of the term structure. According to that model expectations about future interest rates are systematically adjusted (by a constant factor) to the most recent forecast error:

$$_{t+3}r_{3,t} - {}_{t+3}r_{3,t-3} = a + b({}_tR_{3,t} - {}_tr_{3,t-3}) + \epsilon_t \qquad (8.8)$$

where $a = 0$ and $1 > b > 0$, $_{t+3}r_{3,t}$ denotes the three-month rate expected at t for $t + 3$, and $_tR_{3,t}$ is the actual rate at t. Of the authors' estimates only the one for the three-month ECU rate is in line with Meiselman's model, exhibiting a zero intercept and a positive slope coefficient that is significantly below unity (see the authors' Table 8.4).

The authors, in contrast, give more prominent attention to their estimates for the Eurodollar and the Euromark, which produce slope coefficients of unity. The latter property is unwarranted, however, because it implies market inefficiency. If $b = 1$, Equation 8.8 can be written as

$$_{t+3}r_{3,t} = {}_tR_{3,t} + a + ({}_{t+3}r_{3,t-3} - {}_tr_{3,t-3}) + \epsilon_t \qquad (8.9)$$

This says that the three-month rate expected today for $t + 3$ equals today's actual rate plus a constant plus the future change of this rate as it was expected at $t - 3$. Clearly, this is not a property of an informationally efficient market. Hence, if we accept the estimates of the authors' Table 8.4 we have to conclude that the Euromarkets for dollar, mark, and sterling are inefficient.

But note that Tullio and Contesso provide further estimates that cast doubt on the efficiency of the ECU deposit market, too. They estimate the following regression, taken from Fama (1984):

$$_{t+3}R_{3,t-3} - {}_tR_{3,t} = a_2 + b_2({}_{t+3}r_{3,t} - {}_tR_{3,t}) + v_t \qquad (8.10)$$

The actual change in the interest rate is regressed on its expectation. If expectations are rationally formed and the market is competitive, the intercept a_2 should be zero, the slope b_2 unity, and the error term white noise. None of the estimates, presented in the authors' Table 8.6, passes this test. The estimates for Eurodollar and Eurosterling do not reach the 5 percent level of significance, while the estimates for Euromark and ECU yield significant non-zero intercepts.

These damaging results are confirmed by a final test, where the authors regress spot interest rates on past forward rates (see the authors' Table 8.7). None of the estimates reaches the 5 percent level of significance.

In sum, the empirical results presented by Tullio and Contesso may lead us to conclude that none of the Euromarkets examined complies with the requirements of informational efficiency.[4] However, on the consideration that the authors' data base consists of no more than 11 observations, we must not be too concerned.

NOTES

1. But note that the ECU's market share is still small. At the end of 1986 no more than 2.1 percent of total foreign assets and 1.8 percent of total foreign liabilities of the BIS-reporting banks were ECU dominated.
2. But note that changes in bid/ask spreads cannot show up in the empirical measures presented by Tullio and Contesso because their data are averages of bid and offer rates.
3. The authors report four different methods of computing combined Eurocurrency rates but do not explain why the method actually used is to be preferred.
4. But note that the authors themselves do not draw this conclusion.