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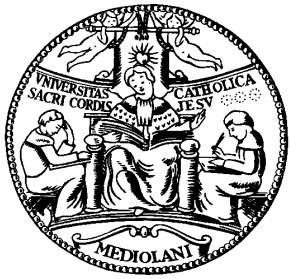

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A Puzzle Solved:
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Zeno Rotondi (*) Giacomo Vaciago (**)

(*) Capitalia, Funzione Studi, Roma, e-mail: zeno.rotondi@capitalia.it

(**) Direttore dell'Istituto di Economia e Finanza, Università Cattolica del Sacro Cuore, Via Necchi 5 – 20123 Milano, e-mail: gvaciago@mi.unicatt.it

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Istituto di Economia e Finanza
Università Cattolica del S. Cuore
Via Necchi, 5
20123 Milano
tel.: 02/7234.2976
fax: 02/7234.2781
e-mail: ecofin@mi.unicatt.it

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Abstract

A Puzzle Solved: the Euro is the D. Mark

Several alternative explanations have been put forward to explain what has been named the "mystery" of the weak Euro, after it started. We test a new hypothesis which is based on the historical process leading to the new European currency. It was necessary to convince the German public opinion that the Euro would have been as good as the DM.
Also the new European Central Bank - based in Frankfurt - should have been as capable as the Bundesbank in delivering monetary stability. This is therefore the hypothesis that we test and find positive results for. The weakness of the Euro mirrors what would have happened if the D. Mark were still alive. The quest for a more European currency continues.

JEL classification: E50, F30, F41, G15.

Keywords: euro, EMU, exchange rates, uncovered interest rate parity, ECB, interest rate rule.

1. Introduction*

From the start of EMU on 1/1/99 until September 2000 the value of the euro against the dollar declined significantly and persistently, with a depreciation of 25%. What surprised the analysts was that the 1999-2000 depreciation appears mostly unrelated to the underlying fundamentals, as predicted by the dominant theories.[1] The euro was expected to be a strong currency, but contrary to the widely-held expectation the euro has been falling. Several alternative explanations have been put forward in order to provide a rationale for the weakness of the euro after its launch: US-euro zone productivity growth differential (Alquist and Chinn, 2002); tight fiscal policies following the convergence mechanism (Cohen and Liosel, 2000); black market holdings of euro (Sinn and Westermann, 2001); mismatch between the demand and supply of euro-denominated assets and higher equity returns on New Economy assets in the US (Meredith, 2001); revisions of the expected growth rate of output differential between the US and euro-zone (Corsetti and Pesenti, 1999); weak ECB credibility due to an unsuccessful communication strategy (Vaciago, 2002, among others).

In conclusion, no one had predicted the fall in the euro and when it happened too many different explanations were given. This led to the issue being defined as a "puzzle" or "mystery".

Here we consider the issue under a different perspective. By using the uncovered interest rate parity (UIP) relationship we provide support for fundamentals in explaining the behaviour of the euro, but focusing only on German data and not on euro-zone ones.[2] Our findings suggest that private agents have regarded the euro as depending on the same fundamentals as the German mark, creating a sort of continuity between the two currencies. As shown in our empirical analysis, the reason for this

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[1] See for example Portes (2001) and De Grauwe (2000).

behavior lies mainly in the fact that the policy rule followed by the ECB is actually very close to the policy rule followed by the Bundesbank during the pre-EMU period based only on German data.

In particular, we show that the Bundesbank's policy reaction function estimated for the pre-EMU period fits reasonably well the actual euro zone interest rate. This finding holds either if we consider only German data, or if we consider euro area data. This implies that from the point of view of Germany the passage to the EMU did not lead to a substantial modification in the conduct of monetary policy, as the presence of the majority vote mechanism in the ECB might have suggested. This also confirms that Germany did not incur a cost for the change from DM to euro, as it was us who had to bring our old currencies to the level of monetary stability they had set.

Besides this surprising explanation of the 1999-2000 depreciation of the euro against the dollar, we provide another innovative contribution. We shed some light on the apparent failure of the UIP for the DM/$ during the '80s, by examining empirically the relationship between the exchange rate and the interest rate rules followed by the Fed and the Bundesbank. In particular we show that, even if the interest-rate differential was not on average equal to the ex post exchange rate change, UIP worked better that we used to believe.

The paper is organized in the following way. Section 2 examines for the DM/$ exchange rate the relationship between the UIP and the interest rate rules followed by the Bundesbank and the Federal Reserve. Section 3 looks at the 1999-2000 depreciation of the euro and tries to explain it in terms of fundamentals; in this section we also make a comparison between the Bundesbank's reaction function and the ECB's monetary policy. Section 4 discusses our empirical results on the basis of the theoretical literature on the feasibility of the Monetary Union. Section 5 offers some concluding thoughts.

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[2] See also Vaciago (2002) for a first attempt at relating the weakness of the euro to the problems of the German economy.

2. UIP and interest rate targeting

Before examining the issue of the 1999-2000 depreciation of the euro against the dollar it is useful to consider first what we really know about the DM/$ exchange rate. Here we will focus on the uncovered interest parity. This relationship represents an empirical failure. Most disappointingly, as it constitutes a building block of theoretical models, the fact that this relationship does not hold in practice would suggest that current models are misspecified to a significant extent. The empirical evidence on UIP indicates that exchange rates fail to move in line with the interest rate differentials, but rather deviate significantly from this relationship moving on average in the opposite direction.[3]

A recent exception in the empirical literature is represented by the work of Flood and Rose (2001) which examines the UIP using only data available during the 1990s. They find that on a monthly basis UIP holds to a greater extent than, we used to think, with a coefficient of proportion of .19 and a Newey-West standard error of .01. This estimated parameter refers to the pooled UIP tests. In the pairwise country test for Germany against US they find a parameter of .13 with a Newey-West standard error of 1.11.

We consider a sample from 1985:07 to 1999:12 (which after adjusting endpoints becomes 1985:07 – 1998:11) and examine the DM/$ dollar rate as a function of the differential between the interest rate rules followed by the Bundesbank and by the Fed respectively during this period. The source of the data is DATASTREAM, apart from German inflation and output (taken from OECD statistics), euro-zone inflation and output (taken from ECB statistics), and the DM/$ exchange rate (taken from the FRED database of the Federal Bank of St. Louis).

[3] Surveys are provided by Hodrick (1987), Froot and Thaler (1990) and Lewis(1995).

The specification of the rule for the 1-month interest rate of the central banks is the same and is given by[4]

$$r_t = \theta r_{t-1} + (1-\theta)[\bar{r} + \sigma(E_t \pi_{t+12} - \bar{\pi}) + \psi E_t y_t]. \qquad (1)$$

The forward-looking reaction function considered reflects the standard specification used in the empirical literature. $E_t \pi_{t+12}$ is the inflation rate expected for 12 months ahead; $E_t y_t$ is the current expected output gap, $\bar{r}$ is the trend nominal interest rate, and $\bar{\pi}$ is the target rate of inflation.[5] We assume that (on average) the parameters $\theta, \sigma, \psi, \bar{\pi}$ and $\bar{r}$ are the same for both countries.[6] In the following notation we use the sign (*) for US.
The UIP is given by

$$E_t e_{t+1} - e_t = r_t - r_t^*, \qquad (2)$$

with e_t being the log of the DM/$ exchange rate. Inserting expression (1) in (2) we obtain

$$E_t e_{t+1} - e_t = \theta(r_{t-1} - r_{t-1}^*) + (1-\theta)[\sigma(E_t \pi_{t+12} - E_t \pi_{t+12}^*) + \psi(y_t - y_t^*)] + u_t. \qquad (3)$$

where u_t is a stochastic term that reflects disturbances in the central banks' reaction functions.
Using again the UIP in (3) we get

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[4] It is assumed that the 1-month interest rate is determined by monetary policy. The reason for choosing the 1-month interest rate is that we want to examine the UIP in combination with the interest rate rules followed by the two central banks.
[5] See for example Clarida, Gali and Gertler (2000) and (1998).
[6] Examination of the case when the parameter θ is set identical for both countries, while σ and ψ are allowed to differ, confirms the validity of this assumption for the coefficient of the inflation differential and to a lesser extent also for the coefficient of

$$E_t e_{t+1} - e_t = \theta(E_{t-1} e_t - e_{t-1}) + (1-\theta)[\sigma(E_t \pi_{t+12} - E_t \pi^*_{t+12}) + \psi(E_t y_t - E_t y^*_t)] + u_t. \quad (4)$$

From (4) we get the following specification of the UIP

$$e_{t+1} - e_t = C(2)(e_t - e_{t-1}) + (1-C(2))[C(1) + C(3)(\pi_{t+12} - \pi^*_{t+12}) + C(4)(y_t - y^*_t)] + \varepsilon_t. \quad (5)$$

with ε_t given by

$$\varepsilon_t = u_t - (1-C(2))C(3)(\pi_{t+12} - E_t \pi_{t+12}) + (1-C(2))C(3)(\pi^*_{t+12} - E_t \pi^*_{t+12}) - (1-C(2))C(4)(y_t - E_t y_t) + (1-C(2))C(4)(y^*_t - E_t y^*_t) + (e_{t+1} - E_t e_{t+1}) - C(2)(e_t - E_{t-1} e_t). \quad (6)$$

In (6) it is assumed that $E_{t-1} e_t \approx E_t e_t$.[7]

The General Method of Moments (GMM) estimates of the coefficient in (5) for the sample period considered are reported in table 1.

Table 1 – GMM estimation of equation (5)

	Coefficient	St.error	t-Statistic
C(1)	0.1970	0.1437	1.3707
C(2)	0.3012	0.0325	9.2590
C(3)	0.4182	0.0698	5.9897
C(4)	0.3529	0.0494	7.1390

the output-gap differential.

[7] This assumption is needed in order to ensure that $E[\varepsilon_t | I_t] = 0$, where I_t is the information set at time *t*.

R-Squared	0.0753	S.D. dependent var.	0.0270
J-Statistic	0.1911	S.E. of regression	0.0262

We have corrected for heteroscedasticity and autocorrelation of unknown form with a Newey-West fixed bandwidth, and have chosen Bartlett weights to ensure positive definiteness of the estimated variance-covariance matrix.[8] The output gap is measured for both countries by the percent deviation of log industrial production from a trend.[9] We have taken as instruments the first 12 lags of the Federal Funds rate, the DM/$ exchange rate, the German and US inflation rates, the German and US output gaps.

The relevant parameters reported in table 1 are all significant and positive, suggesting that the interest-rate differential should be an explanatory variable for exchange-rate changes. In order to confirm this we estimate, using the same econometric methodology and instruments as above, the following standard expression for the UIP:

$$e_{t+1} - e_t = C(1) + C(2)(r_t - r_t^*) + v_t, \qquad (7)$$

with

$$v_t = e_{t+1} - E_t e_{t+1}. \qquad (8)$$

The General Method of Moments (GMM) estimates of the coefficients of (7) are reported in table 2.

[8] As starting values for the coefficients we took Two-Stage Least Squares estimates.

[9] We used the deviation of output from its long-run level as measured by the Hodrick-Prescott filter.

Table 2 – GMM estimation of equation (7)

	Coefficient	St.error	t-Statistic
C(1)	0.0061	0.0009	7.0850
C(2)	0.1509	0.0263	5.7491

R-Squared	-1.1172	S.D. dependent var.	0.0270
J-Statistic	0.1945	S.E. of regression	0.0286

It is possible to observe that the estimates reported in table 2 confirm our findings derived from table 1. The coefficient on the interest rate differential is of the same magnitude as that found by Flood and Rose, but contrary to them the sample period starts in the middle of the 80s. The Newey-West standard error implies that the coefficient is significantly different from zero.

3. Analysis of 1999-2000 depreciation of the euro

Here we examine the period after the start of the euro. The UIP predicts that countries with relatively high interest rates should, on average, have depreciating currencies. According to the specification, this implies that countries with high output gaps and expected future inflation should have depreciating currencies as well. Now, by making use of specification (5), it is possible to show that during the 1999-2000 period the behavior of the euro was explained relatively more by German fundamentals than by euro-zone fundamentals. In figures 1,2,3 and 4 we have plotted the log of 1-month ahead euro/$ against the output gap and

the 12-month ahead inflation differentials corresponding to euro zone and German data. In table 3 we report the correlations between the exchange

Figure 1 - Output-gap differential and 1-month ahead euro/$: euro zone data

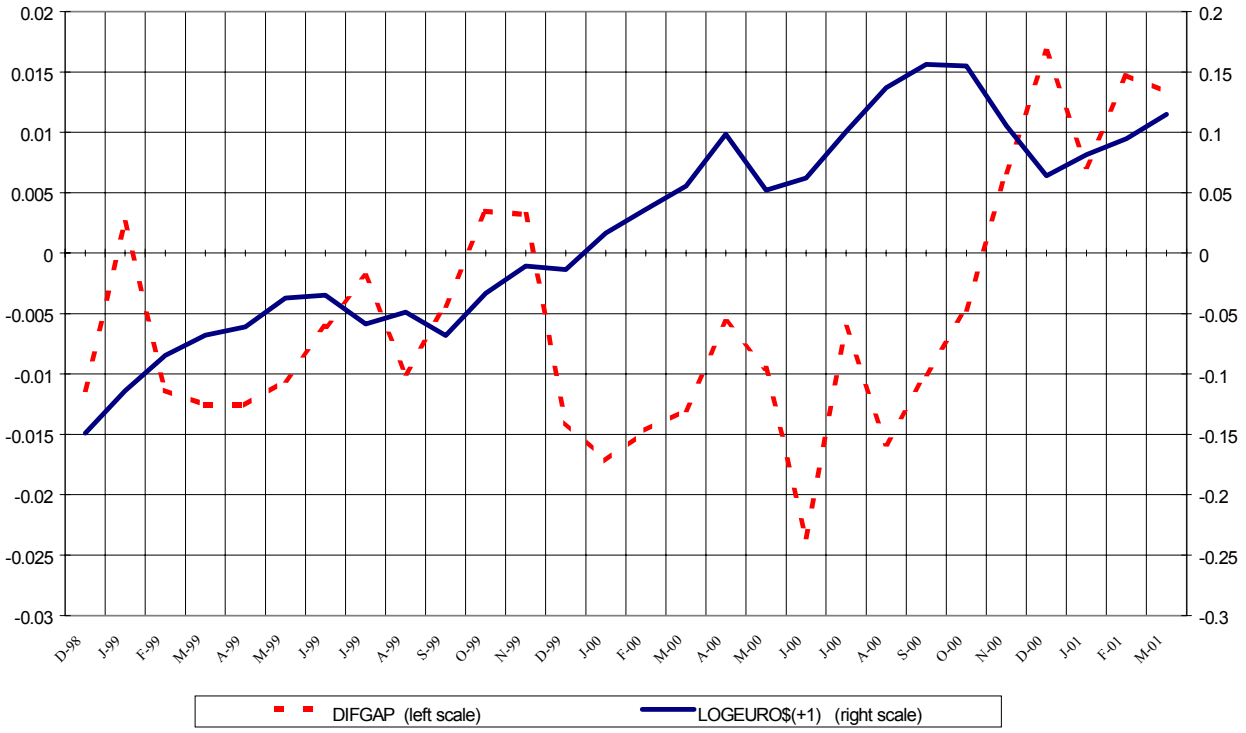


Figure 2 - Output-gap differential and 1-month ahead euro/$: german data

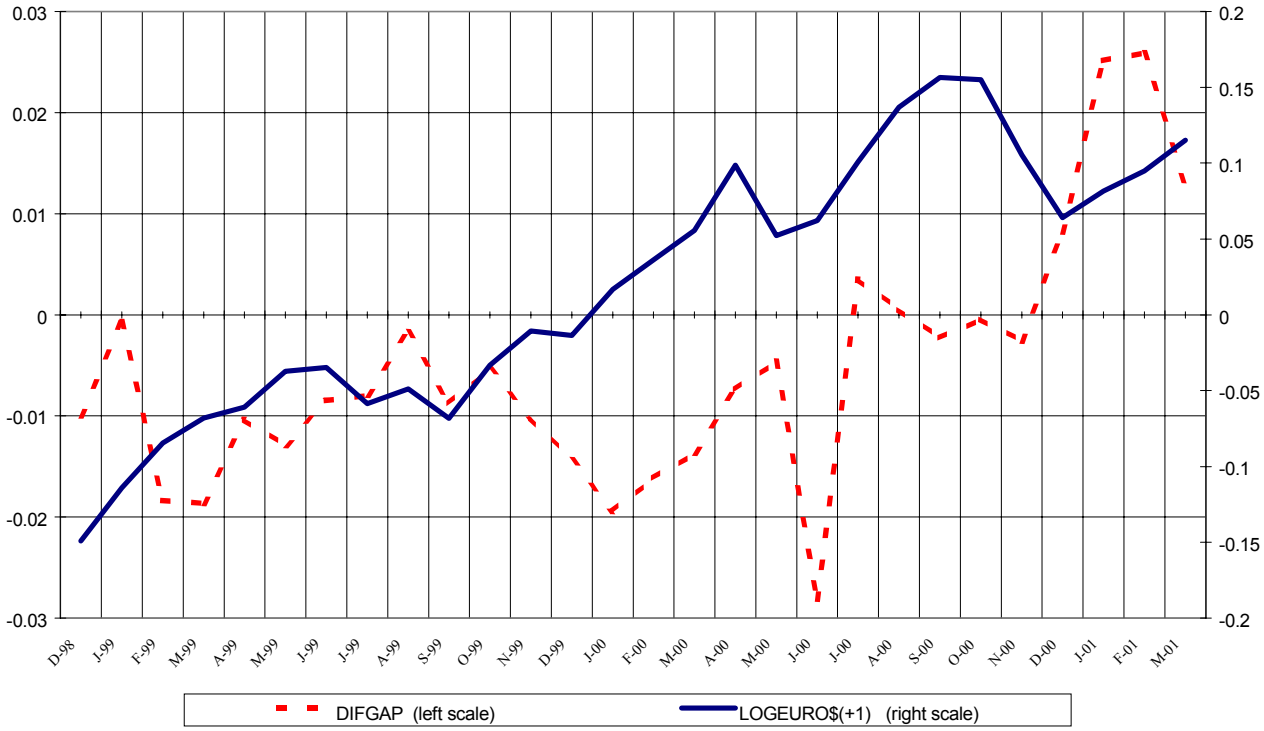


Figure 3 - 12-month ahead inflation differential and 1-month ahead euro/$: euro zone data

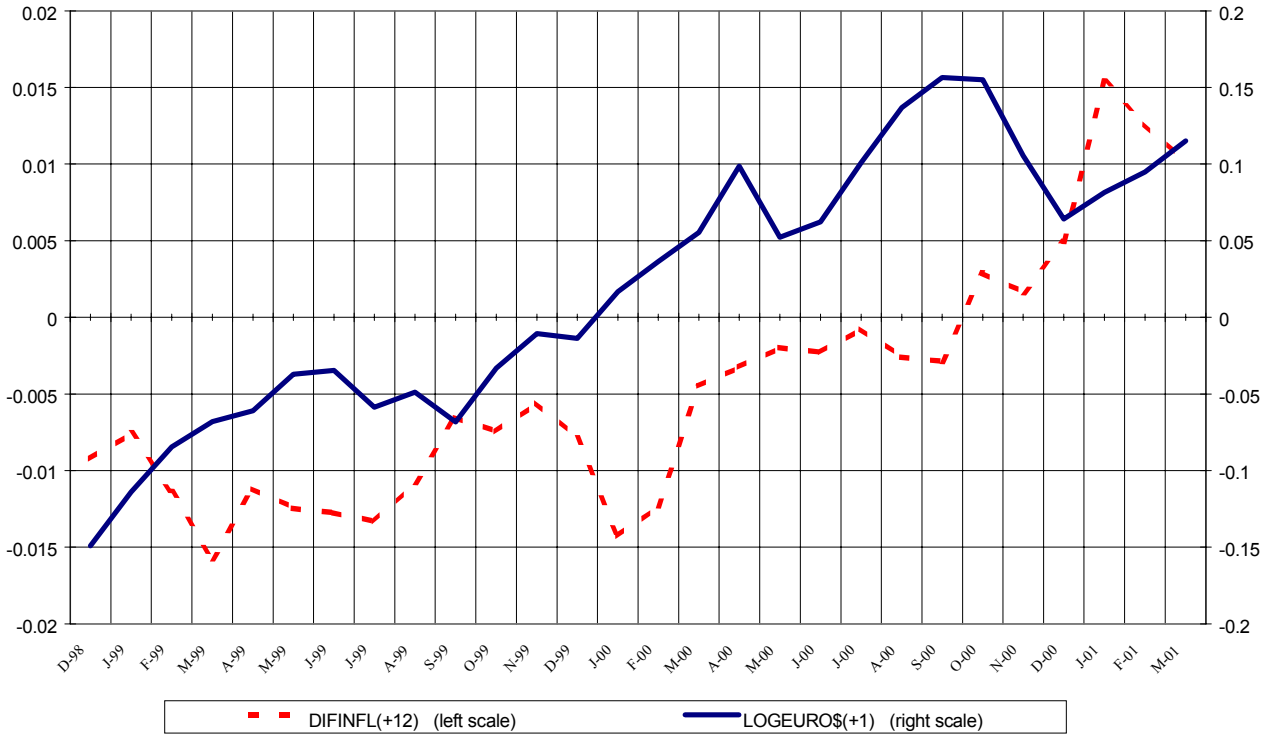
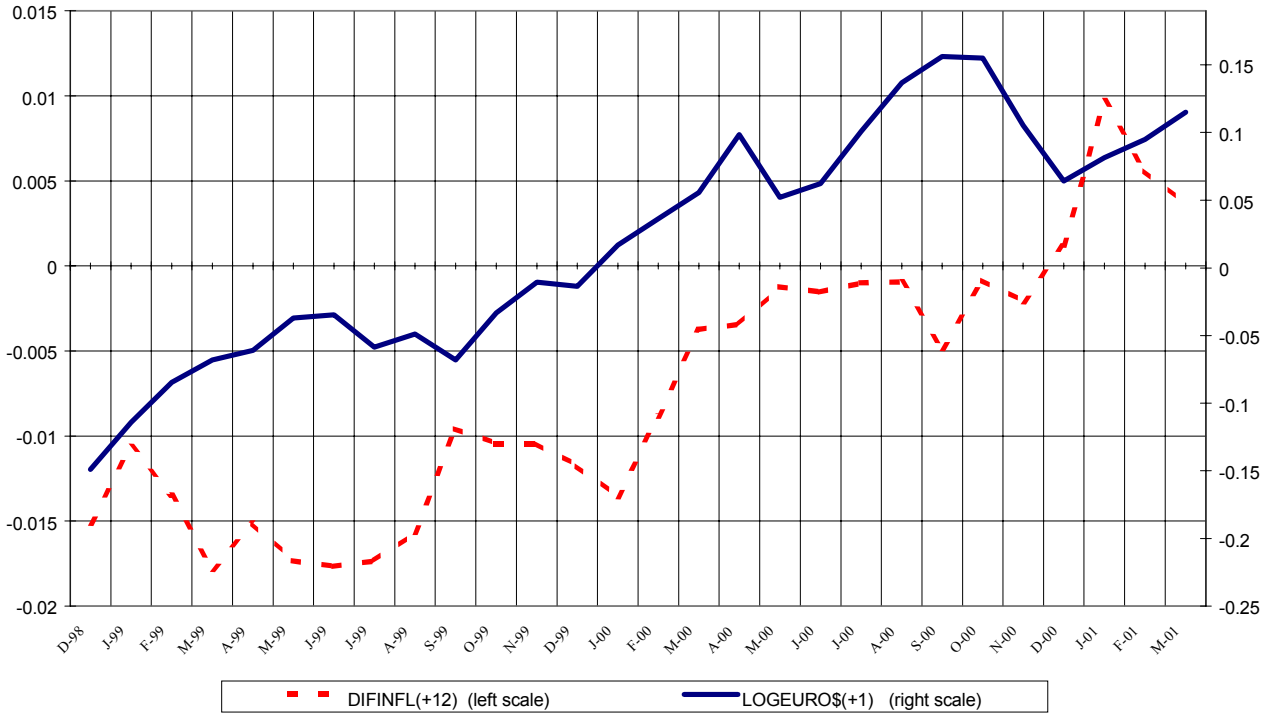


Figure 4 - 12-month ahead inflation differential and 1-month ahead euro/$: german data



rate and the above variables. While for the inflation differential we do not observe significant differences, the output gap differential based on euro-zone data is uncorrelated with future values of the exchange rate during the 1999-2000 period. In the 2000-2001 period there is an improvement in the correlation between the exchange rate and euro-zone fundamentals, but in general German fundamentals present higher correlation with exchange rate movements than euro-zone data.

Table 3 – Correlations

		Euro zone		Germany	
		DIFGAP(t)	DIFINFL(t+12)	DIFGAP(t)	DIFINFL(t+12)
EURO/$(t+1)	Jan-99/ Jan-01	0.02	0.67	0.36	0.78
	Jan-00/ Jan-02	0.32		0.40	

In order to understand better this surprising finding we relate the monetary policy of the ECB to the reaction function of the Bundesbank estimated for the pre-EMU period. We estimate for the period 1986:01 – 1998:12 by means of GMM the following interest rate rule for the Bundesbank[10]

$$r_t = C(2)r_{t-1} + (1-C(2))[C(1) + C(3)(\pi_{t+12} - 2) + C(4)y_t] + \omega_t, \quad (9)$$

[10] Our analysis assumes again that the 1-month interest rate is policy-determined. See Favero (2001) for a similar assumption.

with

$$\omega_t = (1 - C(2))[C(3)(E_t\pi_{t+12} - \pi_{t+12}) + C(4)(E_t y_t - y_t)] + \xi_t. \tag{10}$$

The General Method of Moments (GMM) estimates obtained from (9) are reported in table 4.

Table 4 – GMM estimation of equation (9)

	Coefficient	St.error	t-Statistic
C(1)	4.6884	0.2822	16.6113
C(2)	0.9194	0.0268	34.3424
C(3)	1.6381	0.1734	9.4490
C(4)	0.5086	0.1979	2.5699

R-Squared	0.9872	S.D. dependent var.	2.2313
J-Statistic	0.0693	S.E. of regression	0.2549

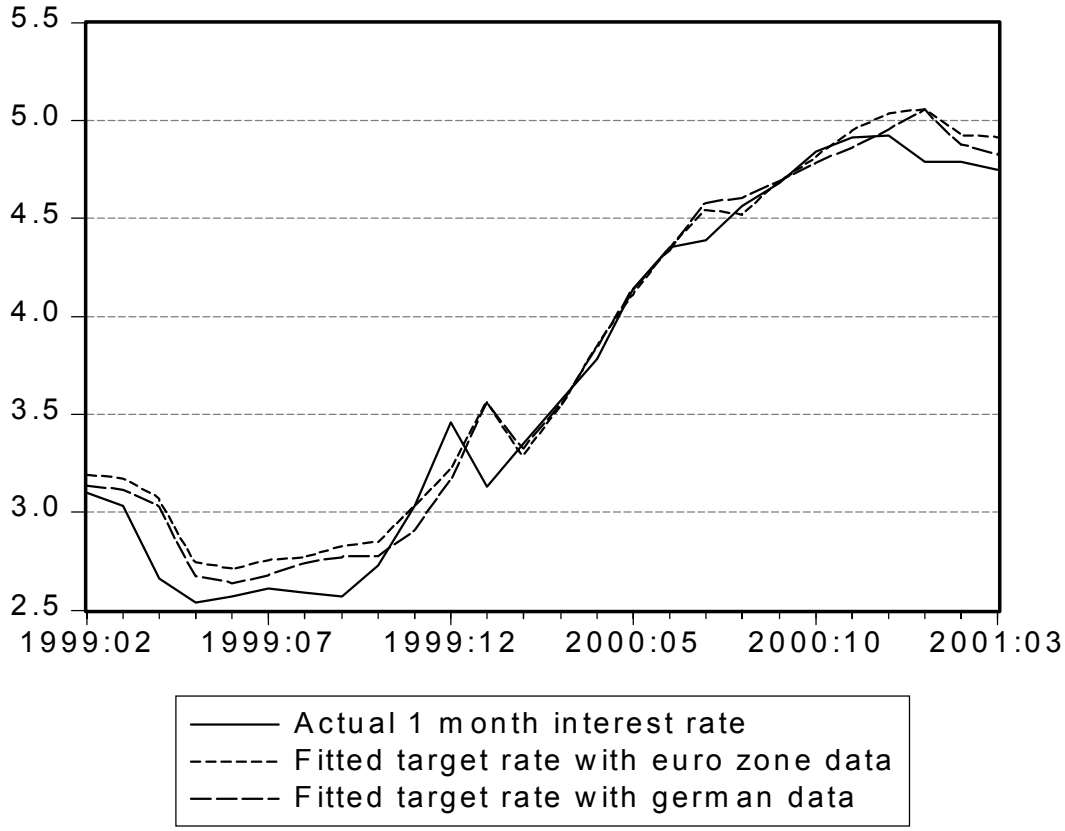
Again we have corrected for heteroscedasticity and autocorrelation of unknown form with a Newey-West fixed bandwidth and chosen Bartlett. However, in this case we have taken as instruments the first 6 lags of the German inflation rate, output gap and 1month interest rate.

In figure 5 we compare the euro-zone 1-month interest rate with the target rates derived from the estimated Bundesbank's reaction function, based alternatively on German and on euro-zone data. First, we focus on euro-zone data. In this case, we do not find the large discrepancies between actual and target rates found for the first year of EMU by Faust, Rogers and Wright (2001), with euro-zone interest rates generally lower

than the target rates.[11] However, we confirm the finding of Begg, et al. 2002 that the ECB was initially slow in responding to euro-zone news, while starting from 2000 the ECB rate and the rate set by the Bundesbank rule substantially coincide.[12]

The new insight deriving from our analysis appears when we consider the estimated Bundesbank's reaction function and compare the case when the central bank reacts to German news with the case when it reacts to euro zone news. As shown in figure 5, the target rates based on German data are very close to those based on euro-zone data.

Figure 5 – Bundesbank's reaction function based on german data and euro zone data and comparison with euro zone 1 month interest rate



[11] Also Alesina et al. (2001) and Gali (2001) have found that in the first period of EMU the euro-zone interest rates are generally lower than a benchmark monetary rule would predict but the discrepancies are not very large.

[12] Contrary to Begg, et al. (2002) our approach to the definition of the benchmark monetary policy rule follows Faust, et al. (2001), who have kindly provided data and estimation information to us.

Moreover, as shown in table 5, the one-step ahead forecasts derived from the target rates based on German data have a predictive accuracy slightly superior to that of the target rates based on euro-zone data.

Table 5 – Forecast diagnostics of one-step ahead forecasts

	Fitted target rate versus actual 1-month interest rate	
	German data	Euro zone data
Root Mean Squared Error	0.16	0.19
Mean Absolute Error	0.12	0.14
Mean Absolute Percentage Error	3.65	4.40

4. EMU and the feasibility of the monetary union

Our results imply that from the point of view of Germany the passage to EMU did not imply a substantial modification in the conduct of monetary policy, as the presence of the majority vote mechanism in the ECB would have suggested.

During the 90s one of the main issues in the discussion of the benefits of EMU was the credibility gain for low inflation policies. Alesina and Grilli (1993) identify the conditions which make monetary union feasible by focusing on the issue of "how to keep Germany in". In fact the question they ask is, why should the country with the highest anti-inflationary reputation agree to help the other European countries to gain credibility? Alesina and Grilli argue that, as the country with the lowest inflation has relatively greater bargaining power, monetary union is

feasible only if the European Central Bank is entrusted to Germany. In their framework Germany is just indifferent between joining the union or not; so in order to keep "Germany in", concessions have to be made to this country.

The ECB was indeed shaped according to the institutional arrangement of the Bundesbank. The Maastricht Treaty famously requires the ECB to pursue the single goal of price stability with no trade-off permitted between that and other goals. The ECB is allowed to pursue real economic stability only insofar as this is consistent with the goal of price stability, where price stability is usually understood as zero or close to zero inflation. The main rationale for this explicit restriction, as with the adoption of monetary targeting, has been the attempt to ensure continuity with respect to the past, in order to help the ECB to inherit the anti-inflationary reputation earned by the Bundesbank. Indeed, the hierarchical formulation of goals is consistent with the well-known formulation of the Bundesbank's goals, where "safeguarding the currency" was interpreted as the primary goal and "support the general economic policy of the Federal Government, but only in so far as this is consistent with the aim of safeguarding the currency" was interpreted as the secondary goal.[13]

The results presented in table 5 on the predictive accuracy of the target rates based on euro-zone and German data show that the discrepancy with the actual interest rate is basically the same in both cases. So according to our analysis, Germany is indifferent if the ECB follows the same interest rate rule as the Bundebank and monetary policy is based on euro zone news, or if monetary policy is chosen by the Bundesbank and is based on German news only. Hence, we may conclude that the concession made to Germany in order to make EMU feasible, implicit in the Maastricht Treaty, was to require the ECB to follow the Bundesbank's reaction function. This concession represents an element

[13] See Driffill and Rotondi (2002).

of fragility in the union, as it may become difficult to bear for the other countries if and when they suffer severe shocks.

5. Conclusions

Notwithstanding all the propaganda of the '90s, the euro started its life as a weak currency, with a 25% depreciation against the US dollar. Previous research was not able to find a convincing reason for that weakness of the new currency. We have tried to solve the puzzle by remembering how the German people (and Government) were induced to accept the new currency: the euro would be as good as the D. Mark[14] and the ECB would follow the same policies as the Bundesbank. By modelling this hypothesis we find convincing evidence to solve the analytical and political puzzle: the euro is the D. Mark in disguise. If this is true for the period of time considered, when will the euro become the currency of the whole of Europe?

[14] This paper had already been produced by the time the English opposers to the euro started their campaign suggesting that the new currency had indeed being the legitimate heir to Hitler's currency (*The Economist*, July 6th 2002, pp. 30-31). Our analysis gives opposite results: Bundesbank's policies have always been in favour of monetary stability precisely to avoid those crisis that led to Hitler's success.

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