

Betting on the EMS

KEES G. KOEDIJK
Rijksuniversiteit Limburg, Maastricht, The Netherlands

CLEMENS J.M. KOOL
Rijksuniversiteit Limburg, Maastricht, The Netherlands

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Abstract Two speculative strategies within the European Monetary System are empirically evaluated. The potential profitability of speculating on a currency's devaluation at a realignment crucially depends on being able to predict timing and magnitude of the parity change. Such opportunity has been eliminated from the system since 1983. For the reverse strategy of "borrowing low, investing high," the evidence since 1983 suggests significant profitable opportunities for the weaker EMS countries—Belgium, Denmark, France and Italy—unconditional on knowledge of the timing of realignments. We conclude that this is due to a "peso problem" type of premium.

In this paper we empirically investigate some important economic hypotheses concerning the efficiency of financial markets in the EMS and the possibility of speculative gains using Euro-interest and exchange rates on a weekly basis over the period 1979–1990.

We focus on two different speculative strategies, both of which are often discussed in financial markets. Little empirical evidence exists, however, on the profitability of such strategies.¹ We add some new evidence, evaluated from the point of view of a domestic (Dutch) investor.

The first strategy to be evaluated concentrates on realignment periods and consists of borrowing a certain amount of a fundamentally weak currency—say Italian lira—in the Euro-market, converting it to a fundamentally strong currency—say Dutch guilders—using the current spot rate, and investing the Dutch guilder amount in Euro-guilder deposits with the same one-week maturity of the Italian lira loan.² After one week, during which the realignment is expected to have occurred, the open positions are closed. Both the Euro-guilder deposit and the Euro-lira loan mature and the investor can use the proceeds of the one to repay the other.

Of course, without a realignment, this strategy results in a limited loss, but in case of a devaluation of the weak currency the potential gain is unlimited. In Section 2 we empirically analyze the potential for making speculative gains with this strategy.

The second strategy we investigate is the reverse of the first one and consists of borrowing in low interest currencies like the guilder and investing the borrowed amount in high interest currencies like the lira. Obviously, the best times to implement such strategy are when no realignments are expected for the near future. The return on the strategy, again, is the sum of the interest rate differential and the exchange rate gain. As opposed to the former strategy, though, the *a priori* known interest rate differential is now positive, yielding a positive return, while the return on the open position on foreign exchange is likely to be negative, because, on average, the lira, in which the investor is long, is expected to depreciate against the guilder, in which the investor is short. Now, the downward risk to the investor is essentially unlimited and the maximum positive return will equal the interest differential. The empirical investigation of the profitability of this strategy occurs in Section 3.

Before turning to Sections 2 and 3 for the evaluation of the two strategies, we first describe the data used in this study in Section 1. We define the return on an open position in foreign Euro-deposits and present summary statistics of the return data with a preliminary discussion. Section 4 contains a summary and conclusions.

1. Data

We use weekly quotations of exchange rates and 7-day Euro-interest rates³ from Datastream, starting on Wednesday, April 4, 1979 and ending on Wednesday, May 16, 1990. All quotations are middle rates, i.e. the average of bid and offer rates. Transaction costs are not taken into account. In our calculations we take the Netherlands as the benchmark country and express all exchange rates as the number of Dutch guilders per unit of foreign currency. Weekly exchange rate changes are computed as the logarithmic growth rate of the exchange rate in percentages per week. Correspondingly, interest rates are also expressed in percentages per week.

Countries included in the analysis are the Netherlands, Germany, Belgium⁴, France, Italy, Denmark and the United Kingdom, although the U.K. was not formally involved in the exchange rate mechanism of the EMS over the sample period. Seven-day Euro-rates are only available from January 1981 onward for Belgium and from August 1983 onward for Denmark. Consequently, for these countries the analysis is

confined to the shorter period for which data are available. Ireland is completely excluded from the analysis for lack of interest rate data.

In many studies of the EMS, two sub-periods are distinguished regarding the functioning of the system. The first sub-period is usually taken to start with the founding of the EMS in March 1979 and to end in March 1983, when the last of a series of realignments took place. This period is characterized by strong deflationary policies in all countries involved in the EMS, though with different timing and at different speed, and by frequent realignments (seven) of the central EMS exchange rates. After March 1983, realignments become less frequent and smaller in magnitude. Only five realignments have taken place between 1983 and the present. The system appears to have stabilized.

To assess whether there is indeed a difference in the behaviour of financial markets between these two sub-periods, we both analyze the total period and the second sub-period. For convenience, we take August 1983 as the breakpoint between the two sub-periods. This way, the assumed breakpoint coincides with the first available Danish interest rate data. Although our breakpoint is a few months off in timing compared with most of the literature, this is not crucial for the results.

We define the excess return on an open position in foreign Euro-currency deposits in percentages per week as:

$$r_t = [\log(1 + i_t^*) - \log(1 + i_t) + \log(e_{t+1}/e_t)] * 100, \quad (1)$$

where e_t is the current spot exchange rate in guilders per unit of foreign currency, i_t and i_t^* are nominal 7-day Euro-currency rates on the Dutch guilder and the foreign currency, respectively, in basis points per week and e_{t+1} refers to the exchange rate one week from today. Under the null hypothesis of perfect capital mobility and substitutability, investors are indifferent between guilder and foreign currency deposits and r_t is a white noise series with mean zero.

Our first approach will be to summarize the statistical behaviour of the return r_t over time for each of the countries involved and of its two components, the realized exchange rate return and the interest differential. Table 1 presents a few summary statistics of these variables. Moreover, the reported t -statistic tests whether the mean return significantly deviates from zero, the S -statistic measures the degree of skewness and the J -statistic is a test on normality.⁵ In Table 1A total returns are investigated both for the whole period, the whole period excluding realignment weeks and the second sub-period. A number of interesting results emerge.

First, normality of returns is strongly rejected for each country over the whole sample. Skewness appears to play a limited role only, but all distributions have much fatter tails than a normal distribution. Least

Table 1A. Statistics for weekly returns (% per week)

I. Period April 1979–May 1990 (580 observations) ^a							
	mean	variance	skewness	kurtosis ^b	<i>t</i> -test ^c	<i>S</i> -test ^d	<i>J</i> -test ^e
FF	0.0254	0.2380	-4.769	54.53	1.25	2.07	66,366.74
IL	0.0671	0.3151	-1.824	18.91	2.88	1.66	6,453.52
DM	-0.0056	0.0634	0.253	8.12	-0.54	0.83	638.92
BP	0.0347	1.2752	-0.287	4.72	0.74	1.66	79.77
BF	0.0270	0.7088	0.169	9.45	0.71	0.54	847.93
II. Period April 1979–May 1990 (excluding 12 realignment weeks) (568 observations)							
	mean	variance	skewness	kurtosis	<i>t</i> -test	<i>S</i> -test	<i>J</i> -test
FF	0.0501	0.1241	0.116	9.75	3.39	0.67	1,078.24
IL	0.0913	0.2371	-0.419	10.53	4.47	1.17	1,359.04
DM	-0.0067	0.0606	0.262	8.45	-0.65	0.84	708.27
BP	0.0499	1.2636	-0.293	4.84	1.06	1.76	88.56
BF	0.0368	0.6170	0.468	8.97	1.02	0.18	726.51
III. Period August 1983–May 1990 (352 observations)							
	mean	variance	skewness	kurtosis	<i>t</i> -test	<i>S</i> -test	<i>J</i> -test
FF	0.0306	0.1123	-3.172	34.37	1.71	2.03	15,018.84
IL	0.0608	0.1824	-2.165	15.83	2.67	1.17	2,687.94
DM	-0.0124	0.0347	4.177	9.71	-1.24	0.85	661.33
BP	-0.0133	1.1027	-0.280	4.78	-0.24	1.71	51.09
BF	0.0437	0.2554	-0.174	7.20	1.62	0.53	260.69
DK	0.0564	0.0934	-0.286	3.61	3.46	0.32	10.34

^a For Belgium, interest data are available from January 1981 only, giving 488 observations. Interest data for Denmark start in August 1983, yielding 352 observations

^b The 95% confidence interval for kurtosis under the null hypothesis of normality is (2.55, 3.45)

^c $t(T) = \text{mean} / \sqrt{(\text{variance}/T)}$

^d $S = 2(\# \text{ observations below mean} - T/2) / \sqrt{T} \sim N(0, 1)$ if $T \rightarrow \infty$

^e $J = T(\text{skewness}^2/6 + (\text{kurtosis} - 3)^2/24) \sim \chi^2(2)$ if $T \rightarrow \infty$

^f In part II, 478 observations are used for Belgium, as only 10 realignments fall in the Belgian sample.

so, though, for the British pound—effectively floating against the Dutch guilder—and the Danish krone.

The *t*-test—which should be interpreted with care due to the observed non-normality⁶—shows a highly significant value for Italy, suggesting that borrowing in a low-interest country like the Netherlands and investing in a high-interest country like Italy yields, on average, a significantly positive return. In percentages per year—multiplying the means in the table by 52—the excess return on investing in Italy with money borrowed in the Netherlands would have been almost 3.5 percent between April 1979 and May 1990.

In part II of Table 1A, the same statistics are displayed but now with the realignment weeks excluded. As can be seen, the omission of about 2 percent of all observations leads to a large decline in the degree of non-normality for France and Italy: both kurtosis and skewness are reduced considerably. For these two countries, which have experienced large-scale devaluations, the return variance also decreases considerably, illustrating the large impact of a few outlier realignment returns on the overall variance.

Part II shows that borrowing in the Netherlands and investing in either France or Italy would have been a profitable strategy, provided one could have forecasted the weeks in which realignments took place. Withdrawing one's investment at the beginning of the realignment week and coming back afterwards would have yielded 2.61 percent (France) and 4.75 percent (Italy) on an annual basis, respectively.

Part III of Table 1A is concerned with the return distributions from August 1983 onward. Although non-normality is severe again, significantly positive returns could have been made—even without knowledge about the precise timing of realignments—in Italy and Denmark and, though with less confidence, in France and Belgium. The annual return on Danish investments, for example, equals almost 3 percent. In Tables 1B and 1C, total returns are split up in the exchange rate change and the nominal interest differential, respectively. Note that all high-interest EMS countries—Belgium, Denmark, France and Italy—have, on average, depreciated against the guilder both over the whole period and over the second sub-period, but not as much as the average interest differential with the Netherlands would have predicted. The variability of the interest rate differential is almost negligible when compared with the variance of exchange rate changes. This latter variance in fact determines the significance of the mean return.

Table 1A confirms this conclusion. The computed total return variances are approximately equal to the variance of exchange rate changes. Note, moreover, that the variability of returns has significantly decreased from the first to the second sub-period. For France, Italy and Germany, return variances from 1983 onward are approximately half of total period

Table 1B. Statistics for weekly exchange rate changes (% per week)^a

I. Period April 1979–May 1990 (580 observations)							
	mean	variance	skewness	kurtosis	<i>t</i> -test	<i>S</i> -test	<i>J</i> -test
FF	-0.0589	0.2623	-5.697	61.61	-2.77	3.32	86,151.61
IL	-0.0788	0.3133	-2.207	22.71	-3.39	3.57	9,855.76
DM	0.0074	0.0622	0.252	8.14	0.71	0.66	645.27
BP	-0.0522	1.2665	-0.303	4.71	-1.12	1.66	79.37
BF	-0.0444	0.6814	0.120	9.22	-1.19	1.36	787.68
II. Period August 1983–May 1990 (352 observations)							
	mean	variance	skewness	kurtosis	<i>t</i> -test	<i>S</i> -test	<i>J</i> -test
FF	-0.0316	0.1150	-3.624	40.10	-1.75	2.13	20,962.94
IL	-0.0592	0.1819	-2.193	15.66	-2.60	2.03	2,632.37
DM	0.0011	0.0342	6.130	9.77	0.11	0.85	672.02
BP	-0.1046	1.0997	-0.305	4.78	-1.87	1.92	52.06
BF	-0.0063	0.2508	-0.331	7.34	-0.24	0.64	283.11
DK	-0.0150	0.0912	-0.300	3.66	-0.93	0.53	11.73

^a For notation and symbols, see table 1A.

variance. The decrease in Belgian return variance is even greater. Only for Britain, little change is seen, as could be expected for a formally floating currency. The reduction in average interest differentials, on the other hand, has been far less (as shown in Table 1C), thus leading to significantly positive mean returns after 1983 in particular. We elaborate on this point in Section 3.

For the Dutch-German relation, the reverse is the case: the depreciation of the guilder as predicted by the interest differential has not been fully realized. No simple profitable strategy appears to exist between Dutch and German investments.

2. Speculative Strategies around Realignments

In this section, we investigate the potential for speculative gains by borrowing in weak currencies and investing in strong currencies over a week including an EMS realignment. Because of the one-sided devaluation possibility, the downward risk of this strategy appears limited

Table 1C. Statistics for weekly interest rate differentials (% per week)^a

I. Period April 1979–May 1990 (580 observations)							
	mean	variance	skewness	kurtosis	t-test	S-test	J-test
FF	0.0843	0.0233	11.723	175.78	13.29	9.14	734,701.51
IL	0.1458	0.0073	3.068	19.79	41.20	3.74	7,723.86
DM	-0.0130	0.0004	-0.717	13.55	16.07	2.08	2,741.48
BP	0.0868	0.0009	-0.931	4.74	69.96	1.08	157.11
BF	0.0714	0.0069	6.945	75.49	19.00	5.79	110,768.33
II. Period August 1983–May 1990 (352 observations)							
	mean	variance	skewness	kurtosis	t-test	S-test	J-test
FF	0.0622	0.0010	1.695	9.82	36.63	3.41	850.41
IL	0.1200	0.0021	0.995	4.70	49.68	3.52	100.55
DM	-0.0134	0.0001	0.359	4.35	-24.54	1.71	34.33
BP	0.0913	0.0005	-0.194	2.16	74.64	0.32	12.60
BF	0.0500	0.0011	3.293	28.21	28.65	5.44	9,954.96
DK	0.0714	0.0007	0.264	2.75	52.32	0.85	5.02

^a For notation and symbols, see table 1A.

to the interest differential between the weak currency and the strong one at the time the investment takes place, while the potential gain appears virtually unlimited and depends on whether the realignment indeed occurs and on the magnitude of the parity adjustment and the corresponding change in the market rate of exchange.

Theoretically, the uncovered interest differential should reflect the expected change in the exchange rate over the deposit maturity. Of course, a risk premium may also account for part of this differential. As both the expected exchange rate change and the risk premium are unobservable, however, the two cannot be empirically distinguished. One reason for such risk premia—as suggested by De Grauwe (1989) and Giavazzi and Giovannini (1989)—could be the illiquidity and corresponding excess variability of Euro-markets in the early eighties for some of the weaker EMS currencies due to domestic capital controls. Even if true, this source of risk should have been greatly reduced in recent years since markets have steadily become more liquid. Moreover, Giavazzi and Giovannini (1989) document the behaviour of the Euro-term structure around the 1983 and 1986 realignments and conclude that expectational effects probably dominate risk premia. Here, we abstract from a specification of risk premia and focus on the mean-variance characteristics of returns.

In Table 2 we list the sequence of EMS realignment dates, which all have taken place during a weekend⁷ in an attempt by the monetary authorities to prevent speculation in financial markets. The only exception to this pattern is the unilaterally announced devaluation of the Danish krone on Thursday night,⁸ November 29, 1979.

Official parity changes are expressed here as the percentage change of a currency against the Dutch guilder, although it may consist of a revaluation of the guilder against its parity and a devaluation of the other currency against its own parity. For comparison, the observed change in the market rate of exchange from the Wednesday preceding the realignment weekend to the Wednesday following this weekend and the 7-day interest differential over the same period are also displayed in Table 2. Their sum is shown as the total weekly return over an open position in foreign currency. The same information is provided for the week starting the Friday before the realignment, to informally assess whether this difference in timing significantly influences the results.

Table 2. Realignment periods (all returns in % per week)

A. France		Wednesday to Wednesday			Friday to Friday		
Date	Parity	\hat{c}	$i^{fr} - i^{n1}$	total	\hat{c}	$i^{fr} - i^{n1}$	total
	DG/FF			return			return
	Change						
24- 9-79	—	0.603	0.035	0.638	0.517	0.413	0.558
30-11-79	—	-0.597	0.009	-0.588	-0.503	-0.019	-0.522
23- 3-81	—	0.087	0.028	0.115	0.094	0.025	0.119
5-10-81	-8.5	-5.145	0.558	-4.588	-5.013	0.294	-4.719
22- 2-82	—	-0.200	0.065	-0.135	-0.247	0.071	-0.176
14- 6-82	-10.0	-6.239	0.456	-5.783	-5.126	0.228	-4.899
21- 3-83	-6.0	-3.336	2.650	-0.686	-2.721	2.772	0.051
20- 7-85	—	0.186	0.057	0.243	0.055	0.054	0.110
6- 4-86	-6.0	-3.529	0.287	-3.242	-0.700	0.125	-0.576
2- 8-86	—	-0.182	0.034	-0.148	0.139	0.027	0.166
12- 1-87	-3.0	-0.071	0.108	0.037	-0.511	0.074	-0.438
7- 1-90	—	0.348	0.044	0.392	0.224	0.038	0.262

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Table 2. (continued)

B. Italy		Wednesday to Wednesday			Friday to Friday		
Date	Parity	\hat{e}	$i^{it} - i^{n1}$	total	\hat{e}	$i^{it} - i^{n1}$	total
	DG/IL			return			return
	Change						
24- 9-79	-	-1.055	0.058	-0.996	-0.287	0.075	-0.212
30-11-79	-	-0.456	0.019	-0.437	0.336	-0.008	0.327
23- 3-81	-6.0	-1.934	0.121	-1.813	-3.241	0.118	-3.123
5-10-81	-8.5	-5.429	0.545	-4.884	-3.765	0.264	-3.501
22- 2-82	-	-0.388	0.164	-0.224	-0.704	0.176	-0.528
14- 6-82	-7.0	-1.781	0.211	-1.570	-1.605	0.228	-1.377
21- 3-83	-6.0	0.733	0.876	1.610	2.233	0.410	2.643
20- 7-85	-8.0	-3.373	0.095	-3.278	4.019	0.082	4.101
6- 4-86	-3.0	-0.929	0.211	-0.718	1.737	0.159	1.896
2- 8-86	-	-0.047	0.091	0.044	-0.251	0.087	-0.164
12- 1-87	-3.0	-1.283	0.200	-1.082	-0.499	0.200	-0.298
7- 1-90	-3.7	0.304	0.063	0.367	0.685	0.063	0.748

C. Germany		Wednesday to Wednesday			Friday to Friday		
Date	Parity	\hat{e}	$i^{wg} - i^{n1}$	total	\hat{e}	$i^{wg} - i^{n1}$	total
	DG/DM			return			return
	Change						
24- 9-79	+2.0	0.797	-0.057	0.740	0.344	-0.051	0.292
30-11-79	-	-0.775	-0.056	-0.830	-0.525	-0.089	-0.614
23- 3-81	-	0.141	0.024	0.165	0.285	0.008	0.292
5-10-81	-	-0.541	-0.005	-0.546	-0.639	-0.016	-0.655
22- 2-82	-	0.210	-0.004	0.206	-0.024	-0.005	-0.029
14- 6-82	-	-0.162	0.002	-0.160	-0.273	0.000	-0.273
21- 3-83	+2.0	0.787	0.008	0.795	1.240	0.012	1.251
20- 7-85	-	-0.027	-0.026	-0.054	0.377	-0.026	0.351
6- 4-86	-	0.050	-0.016	0.034	-0.190	-0.018	-0.208
2- 8-86	-	0.038	-0.010	0.028	-0.124	-0.018	-0.142
12- 1-87	-	0.208	-0.024	0.184	-0.242	-0.024	-0.266
7- 1-90	-	-0.013	-0.001	-0.014	-0.135	-0.023	-0.158

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Table 2. (continued)

D. United Kingdom		Wednesday to Wednesday			Friday to Friday		
Date	Parity	\hat{e}	$i^{uk} - i^{n1}$	total	\hat{e}	$i^{uk} - i^{n1}$	total
	DG/BP			return			return
	Change						
24- 9-79	-	0.410	0.076	0.486	0.767	0.076	0.843
30-11-79	-	-0.709	0.073	-0.636	0.000	0.045	0.045
23- 3-81	-	0.672	0.043	0.715	0.817	0.040	0.857
5-10-81	-	-1.619	0.057	-1.562	-0.759	0.059	-0.700
22- 2-82	-	-1.461	0.072	-1.389	-0.940	0.075	-0.864
14- 6-82	-	-0.688	0.069	-0.619	0.372	0.068	0.440
21- 3-83	-	-0.755	0.112	-0.643	0.253	0.121	0.374
20- 7-85	-	0.719	0.107	0.826	0.055	0.104	0.159
6- 4-86	-	-2.119	0.112	-2.007	-1.939	0.110	-1.830
2- 8-86	-	-2.209	0.082	-2.127	-1.588	0.077	-1.512
12- 1-87	-	-2.292	0.092	-2.200	-1.575	0.091	-1.484
7- 1-90	-	0.796	0.111	0.907	1.754	0.106	1.861
E. Belgium		Wednesday to Wednesday			Friday to Friday		
Date	Parity	\hat{e}	$i^{be} - i^{n1}$	total	\hat{e}	$i^{be} - i^{n1}$	total
	DG/BF			return			return
	Change						
24- 9-79	-	0.719	n.a.	n.a.	0.378	n.a.	n.a.
30-11-79	-	-0.788	n.a.	n.a.	1.274	n.a.	n.a.
23- 3-81	-	-0.591	0.041	-0.550	-0.385	0.038	-0.348
5-10-81	-5.5	-3.271	0.237	-3.034	-3.259	0.257	-3.002
22- 2-82	-8.5	-4.423	0.099	-4.324	-4.124	0.150	-3.974
14- 6-82	-4.2	-2.426	0.105	-2.321	-3.151	0.111	-3.041
21- 3-83	-2.0	2.613	1.165	3.778	2.163	0.478	2.641
20- 7-85	-	-0.152	0.038	-0.114	-1.300	0.042	-1.258
6- 4-86	-2.0	1.185	0.372	1.557	1.875	0.108	1.982
2- 8-86	-	0.025	0.032	0.057	0.048	0.027	0.075
12- 1-87	-1.0	0.499	0.091	0.590	0.188	0.134	0.321
7- 1-90	-	-0.061	0.027	-0.034	0.813	0.023	0.836

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Table 2. (continued)

F. Denmark		Wednesday to Wednesday			Friday to Friday		
Date	Parity	\hat{e}	$i^{dk} - i^{nl}$	total	\hat{e}	$i^{dk} - i^{nl}$	total
	DG/DK			return			return
	Change						
24- 9-79	-2.9	-1.040	n.a.	n.a.	-0.795	n.a.	n.a.
30-11-79	-4.8	-4.809	n.a.	n.a.	-4.227	n.a.	n.a.
23- 3-81	-	0.165	n.a.	n.a.	0.071	n.a.	n.a.
5-10-81	-5.5	-2.751	n.a.	n.a.	-3.019	n.a.	n.a.
22- 2-82	-3.0	-2.014	n.a.	n.a.	-2.047	n.a.	n.a.
14- 6-82	-4.2	-1.761	n.a.	n.a.	-0.894	n.a.	n.a.
21- 3-83	-1.0	-1.958	n.a.	n.a.	2.776	n.a.	n.a.
20- 7-85	-	0.234	0.060	0.294	-0.652	0.059	-0.594
6- 4-86	-2.0	0.295	0.063	0.357	0.470	0.073	0.543
2- 8-86	-	0.481	0.072	0.552	0.917	0.067	0.984
12- 1-87	-3.0	-0.578	0.108	-0.470	-0.211	0.176	-0.036
7- 1-90	-	-0.060	0.062	0.002	0.410	0.058	0.468

Note that the returns (r) as quoted here are for an open position in foreign exchange from the point of view of a Dutch investor, that is, for a long foreign position and a short domestic one. Large negative returns thus offer support for the hypothesized profitability of this strategy. As concerns the Dutch-German relation, large positive returns suggest that the proposed strategy is profitable, the Dutch guilder being the weak currency in this case.

The results in Table 2 contain a number of interesting characteristics. In our discussion, we first consider the Wednesday to Wednesday results. Then, a comparison is made between starting a speculative strategy the Wednesday or Friday prior to the realignment.

First, total returns on open positions in realignment weeks are completely dominated by the realized exchange rate changes. Interest differentials appear to be small and fairly stable and, therefore, play only a minor role in the total return. The realignment of March 21, 1983 forms an exception in this respect, as France purposely drove interest rates up to prevent speculation.

Second, the magnitude of the observed exchange rate change over the realignment week and, consequently, the magnitude of the total return is determined by two factors: whether the country is itself involved in the realignment and whether the parity adjustment greatly exceeds the fluctuation margin of the country's currency.

France presents a good example of the influence of these two factors. The parity rate of the French franc versus the guilder has been adjusted only five times during the EMS period. For the seven realignment weeks in which the French franc/guilder parity was not adjusted, the return on an open position in French francs always is small and ranges from -0.588 to $+0.638$ percent per week, with an average of 0.074 . Comparing these seven individual returns with the corresponding distribution of returns outside realignment weeks in part II of Table 1A, it is easily seen that they all fall into the 95 percent confidence interval around the mean and do not significantly deviate from the mean return of the distribution. The evidence for the other countries is similar and we conclude that returns in realignment weeks in which the relevant currency is not involved generally are indistinguishable from returns with respect to that currency in non-realignment weeks.

When a currency is involved in a realignment, two possibilities exist. Normally, a weak EMS currency that is expected to be devalued during realignment talks is already moving close to its lower bound in the EMS. That is, it is using most of its allowed margin fluctuations. In case the announced magnitude of the realignment is of the same order of magnitude as its maximum fluctuation margin, no sizeable exchange rate change is necessary to have the new exchange rate move in the midst or even in the upper part of its new range. Then, the realignment is just a formal confirmation of a situation that already exists and the effect of the parity adjustment on the observable exchange rate may be almost zero. The total return on an open position in that currency will also be quite small in such circumstances. The 3 percent devaluation of the French franc against the guilder on January 12, 1987 is illustrative in this respect: despite this devaluation, the exchange rate drops by only 0.071 percent.

The alternative is a devaluation significantly exceeding the maximum fluctuation margin of a currency, as is the case for the remaining four devaluations of the French franc against the guilder of 8.5, 10, 6 and 6 percent respectively, in chronological order. The concurrent exchange rate changes in these four weeks range from -3.336 percent to -5.145 percent. Note, however, that even then the change in the market rate of exchange is considerably less than the parity change.

As significantly negative returns on an open position in French francs are observed in these weeks, our chosen strategy here, to take an open position in guilders using borrowed French francs, would have been quite profitable. Obviously, the interest differential in favour of France most of the time has been insufficient to prevent such speculation. Although France has been used as an example throughout, the same holds for the realignments of the guilder versus the other currencies.

The Friday to Friday results, in general, are comparable to the Wednesday to Wednesday ones. Total returns are similarly dominated by exchange rate changes, with interest rate differentials being small and relatively stable. Interest differentials do not consistently rise from the Wednesday to the Friday prior to realignment, and, thus, do not reflect increasing realignment fears towards the weekend. Changes in market rates of exchange in most instances only marginally depend on whether the investment strategy is implemented on Wednesday or Friday.

Noteworthy is the fact that in a few exceptional cases, speculating on devaluations of weak currencies turns against investors using a Friday to Friday investment period. Examples are the realignment of July 20, 1985 for Italy and of April 6, 1986 for France. In both cases, the so-called weaker currency strongly appreciates versus the guilder in the realignment week despite a large downward parity adjustment. This yields a considerable loss on the investment. The explanation of this phenomenon may be found in an occasionally strong depreciation of weaker currencies within the EMS band on the eve of a realignment. Apparently, realignment fears are reflected more in exchange rate changes than in interest differentials. Investors initiating their investment on Friday are then too late. Most of the weak currency's depreciation has already taken place.

The above results imply that for speculating on devaluations of weak currencies through realignments to be *ex ante* profitable, an investor not only would need to be able to forecast the timing of the realignment, but also which currencies would be involved and of what magnitude the parity adjustment would be. Shifting from Wednesday to Friday in implementing such strategy doesn't change that conclusion. It suggests that little additional relevant information has become available to the market between the Wednesday and Friday before a realignment, on average.

To assess whether the market as a whole had such forecasting power, we searched the *Financial Times* around each realignment date for additional independent evidence. Table 3 presents⁹ evidence on the earliest date when realignment rumors are mentioned and on the *ex post* accuracy of the reported realignment expectations. Overall, the information suggests that much uncertainty exists about the timing and magnitude of realignments. In many cases strong realignment rumors—as published in the financial press—, only emerge on Friday or Saturday, with the actual realignment occurring over the weekend. Consequently, 7-day interest rates observed on Wednesday, or even on Friday, as is the case in our study, may poorly reflect realignment fears.

Table 3. Information on realignments from the *Financial Times*

Date of Realignment	Earliest date in FT	Stated Expectations	Realized Parity Changes
24- 9-79	17- 9-79	speculative selling of BF+DK	DM revalued 2% DK devalued 2.9%
30-11-79	26-11-79	—	DK devalued 4.8%
23- 3-81	—	—	IL devalued 6%
5-10-81	3-10-81	reevaluation DM devaluation FF	DM+DG revalued 5.5% FF+IL devalued 3%
22- 2-82	—	—	BF devalued 8.5% DK devalued 3%
14- 6-82	9- 6-82	devaluation FF against DM by 10%	DM+DG revalued 4.25% FF devalued 5.75% IL devalued 2.75%
21- 3-83	17- 3-83	speculation against FF and later BF+DK+IP	DM revalued 5.5% DG revalued 3.5% DK revalued 2.5% BF revalued 1.5% FF+IL devalued 2.5% IP devalued 3.5%
20- 7-85	—	—	IL devalued 6% other currencies revalued 2%
6- 4-86	5- 4-86	broad realignment devaluation of FF against DM by 6-8%	DM+DG revalued 3% BF+DK revalued 1% FF devalued 3%
2- 8-86	—	—	IP devalued 8%
12- 1-87	7- 1-87	first speculation on FF/DM rate (3-5%); later also pressure on BF, DK, IP, IL	DM+DG revalued 3% BF revalued 2%
7- 1-90	6- 1-90		IL devalued 3.7%

Given this general uncertainty about the timing of realignments, the precise currencies that will be involved and the magnitude of the parity adjustments—even when markets appear to be aware of the unsustainability of the existing parities—the large observed returns on speculative (short) positions in weak EMS currencies over realignment weeks provide insufficient evidence about the *ex ante* profitability of speculating on devaluations of the weak currencies through realignments.

Moreover, any profitable strategies that may have existed over these weekly realignment periods in the early years of the EMS most likely have been eliminated in more recent years, for various reasons. First, Table 2 shows that the magnitude of parity changes has decreased after 1983, with correspondingly smaller returns on open positions. Second, the frequency of realignments has declined, which has further decreased the attractiveness of the proposed strategy.

3. Borrowing Low, Investing High

An alternative strategy to consider is to borrow in low-interest currencies and to invest the borrowed money in high-interest currencies.¹⁰ In fact, this is exactly the reverse strategy of the first one. Obviously, this strategy will be more successful in periods without significant realignments than in realignment periods.

One advantage of this strategy—if at all profitable—is that it can be applied much more often. With the current scarcity of realignments within the EMS, speculating on a large downward parity adjustment of the weak EMS currencies will make sense on rare occasions only. Speculating that no large changes in market rates of exchange will happen, on the other hand, may be interesting for longer and more frequent periods.

Table 1 contains the empirical evidence that “borrowing low, investing high” has been a profitable strategy for some countries. Disregarding complications caused by the non-normality of the distribution of returns, the conclusion is that the mean return over the whole EMS period is significantly positive for Italy and equal to 3.5 percent annually. Considering the period from August 1983 to May 1990, significantly positive mean returns are observed for Italy (3.2 percent), Denmark (2.9 percent) and (marginally) France (1.6 percent) and Belgium (2.3 percent). By excluding the realignment weeks from the calculations, a mean positive return (2.6 percent) is also present for France over the complete 1979–1990 period. The Italian mean excess return then increases from 3.5 percent to 4.75 percent.

3.1 *The Information in Interest Rate Differentials*

Now we extend the analysis and investigate whether the incorporation of the current interest differential as an explanatory variable is of any help in developing a profitable investment strategy.¹¹ The interest rate differential is known before the investment strategy is implemented and, thus, may be viewed as an indicator of future developments.

For each country, we regress the total weekly return on an intercept, the interest rate differential and the lagged endogenous variable. This last term is added to correct for serial correlation, which otherwise would be present in a number of regressions. Note that in an efficient market and in the absence of risk premia, uncovered interest rate parity should hold on average. Then, the interest rate differential should have no significant forecasting power for the total return.

Table 4 shows the regression results both for the whole period 1979–1990 and the second sub-period 1983–1990. To circumvent the noted non-normality problem, t -ratios are calculated on the basis of heteroskedastic-consistent estimates of the standard deviation of the estimated coefficients.¹² Because of the inclusion of the lagged endogenous variable, the standard Durbin-Watson statistic is unreliable. Moreover, the computation of Durbin's h -statistic breaks down in every single case because it requires the square root of a negative number. As an alternative, we regressed the regression's residual on the original explanatory variables and the lagged residual. A standard t -test on the coefficient of this lagged residual is asymptotically equivalent to Durbin's h .¹³ This t -value is given in the last column of Table 4. For the whole period, the bilateral interest differential has explanatory power for the German mark, British pound and Belgian franc. For only the German mark, the lagged return is significant. After August 1983, both the interest differential and the lagged return are significant for the German mark, Belgian franc and Danish krone. The regression explaining the Dutch-German return has an unexpectedly high explanatory power of over 20 percent. Note that the test on serial correlation of the residuals still signals two cases in which autocorrelation is present.

Table 5 contains results for the same set of regressions with all realignment weeks and the weeks immediately following a realignment week excluded. This way, the impact of outlier events due to realignments is removed.

The explanatory power of both interest differentials and lagged returns considerably increases. The interest rate differential is insignificant for the British pound regression in the second sub-period only, while the lagged return is insignificant for the British pound and Italian lira in the second sub-period. In all other cases, at least 10 percent significance is observed. Again, significant autocorrelation of the residuals remains in a number of instances, probably due to the non-normality of the data.

Table 4. The information in interest differentials^a

I. April 1979–May 1990 (579 observations)						
Currency	intercept	interest differential	lagged return	\bar{R}^2	see	t^b
FF	0.03 (1.10)	-0.0001 (0.0004)	-0.05 (0.90)	-0.001	0.488	-1.47
IL	-0.03 (0.42)	0.71 (1.27)	-0.09 (1.31)	0.015	0.557	-2.04
DM	0.03 (2.07)	2.84 (3.62)	-0.21 (3.18)	0.067	0.243	-0.08
BP	-0.39 (2.78)	4.87 (2.97)	0.09 (1.81)	0.025	1.114	0.04
BF	-0.15 (3.76)	2.56 (4.40)	-0.10 (1.32)	0.066	0.815	-0.21
II. August 1983–May 1990 (351 observations)						
Currency	intercept	interest differential	lagged return	\bar{R}^2	see	t^b
FF	0.08 (0.65)	-0.66 (0.32)	-0.13 (1.36)	0.016	0.427	0.18
IL	-0.02 (0.26)	0.62 (1.28)	0.06 (0.71)	0.003	0.165	-0.35
DM	0.03 (2.02)	3.88 (3.41)	-0.44 (5.46)	0.215	0.165	-1.35
BP	-0.30 (1.49)	3.17 (1.34)	0.05 (0.73)	0.002	1.050	0.36
BF	-0.10 (1.89)	3.10 (2.80)	-0.33 (3.63)	0.131	0.472	-1.73
DK	-0.12 (2.80)	2.62 (4.52)	-0.17 (2.60)	0.058	0.297	-2.50

^a t -values in parentheses^b t is a test-statistic on first-order autocorrelation of the residuals

Overall, the results in Tables 4 and 5 suggest that interest rate differentials have some forecasting power. Table 5 indicates that, once realignment weeks are excluded, returns respond proportionally or even more than proportionally to interest rate differentials. Again, the issue is how to predict realignments.

Table 5. The information in interest differentials (excluding realignment weeks)^a

I. April 1979–May 1990 (555 observations)						
Currency	intercept	interest differential	lagged return	\bar{R}^2	see	t^b
FF	-0.02 (0.87)	1.06 (4.74)	-0.23 (3.54)	0.136	0.324	-1.41
IL	-0.04 (1.02)	1.05 (4.53)	-0.21 (2.83)	0.065	0.471	-2.40
DM	0.02 (1.64)	2.30 (3.30)	-0.25 (3.73)	0.072	0.233	-1.39
BP	-0.37 (2.52)	4.82 (2.84)	0.10 (1.90)	0.026	1.113	-0.03
BF	-0.10 (2.41)	2.13 (2.98)	-0.15 (1.89)	0.044	0.763	-0.25
II. August 1983–May 1990 (341 observations)						
Currency	intercept	interest differential	lagged return	\bar{R}^2	see	t^b
FF	0.06 (2.01)	1.84 (4.22)	-0.23 (1.82)	0.069	0.277	-0.67
IL	-0.02 (0.41)	0.90 (2.06)	-0.09 (1.15)	0.010	0.383	-0.09
DM	0.04 (2.01)	3.72 (3.22)	-0.45 (5.24)	0.210	0.166	-2.09
BP	-0.30 (1.49)	3.39 (1.42)	0.05 (0.76)	0.003	1.038	0.31
BF	-0.06 (0.99)	2.45 (1.73)	-0.33 (3.46)	0.112	0.474	-2.08
DK	-0.13 (3.06)	2.76 (4.82)	-0.19 (2.87)	0.064	0.295	-2.20

^a t -values in parentheses

^b t is a test-statistic on first-order autocorrelation of the residuals

The evidence in Table 4 suggests that the German mark-Dutch guilder return has offered exploitable profit opportunities using the information

contained in the interest rate differentials and lagged returns. No knowledge of the realignment timing appears required in this case.

4. Summary and Conclusions

In this paper we have empirically investigated two speculative strategies using 7-day Euro-currency deposits in EMS currencies. The analysis is based on weekly data from April 1979 to May 1990. First, we discuss the potential of speculating on a currency's devaluation at a realignment date by borrowing in a weak EMS currency, investing the money in a strong EMS currency and reversing the investment after the realignment.

Summarizing the evidence on the speculative returns in realignment weeks, we conclude that occasionally large returns on the proposed strategy are realized. In general, however, great uncertainty has existed both about the timing and the magnitude of relative parity adjustments. Often, strong rumors of realignment only surface just prior to the realignment weekend, though EMS tensions may have prevailed long before. Wednesday—and even Friday—notations of 7-day Euro-interest rates, therefore, may contain only limited information about next weekend's realignments.

Interest rate movements as measured here certainly have not been excessive. If anything, interest rates have moved too little to compensate for exchange rate changes induced by announced parity adjustments. Especially in the first years of the EMS, therefore, speculative gains could have been made by borrowing in the weak currencies and investing in the strong ones, provided a parity adjustment of the weak currency considerably exceeding the fluctuation margin was expected. The evidence on the uncertainty surrounding realignments, however, throws doubt on the market's ability to effectively forecast realignments and exploit this strategy.

Moreover, this speculation possibility has been virtually eliminated from the system since 1983. Most of the subsequent realignments have been of a relatively small magnitude, insufficient to generate large returns. The frequency of realignments has also declined, reducing the scope for this strategy.

The second strategy we have investigated is "borrowing low, investing high." For each of the weaker EMS countries—Belgium, Denmark, France and Italy—the mean return on open positions in foreign currency has been (marginally) significantly positive after August 1983, even including realignment weeks. The same result is also obtained for Italy over the whole period 1979–1990. This provides suggestive evidence that "borrowing low, investing high" has been a profitable strategy for

at least some EMS countries. For West Germany and the U.K., on the other hand, average returns are insignificant.

Obviously, realignment periods in which the foreign currency is devalued reduce the profitability of this strategy. Excluding realignment weeks leads to significantly positive returns over the whole EMS period for France, too. For Italy, the results improve considerably. Again, no positive returns are found for Germany and the U.K.

The interest differential on 7-day Euro-deposits which is known before the strategy is implemented, also appears to have some explanatory power for most countries. For France and Italy this is true only when realignment weeks are excluded, both over the whole period and after 1983. For Belgium, Denmark, Germany and the U.K., significant interest rate coefficients are found whether or not realignment weeks are included. The relation may be unstable for the U.K. as the significance vanishes in the second sub-period.

In addition, lagged returns contain significant information. This is true for almost all countries both over the whole period and the second sub-period when realignment weeks are excluded. Italy and the U.K. in the second period are the exceptions. With realignment weeks included, the lagged return effect is significant for Germany and, in the second period, for Belgium and Denmark. The negative coefficient on the lagged return implies an oscillatory movement of the return. Only for the U.K. is this coefficient positive.

Summarizing, our results suggest that consistently implementing a "borrowing low, investing high" strategy would have resulted in significantly positive returns in some cases even without information about the timing of realignments. Being able to forecast realignments would have improved the results. The information in interest differentials can also contribute to better forecasts of future returns for some currencies.

In a sense, our results may underestimate the profitability of the strategy. Assuming it is easier to determine *a priori* that over a relatively short future period no realignment is likely than to precisely predict when a new realignment will occur, the strategy may be implemented over relatively quiet periods in the EMS. Moreover, an investor engaging in this strategy may leave the end point of his strategy undetermined. Rolling over his investment every week enables him to stop as soon as he thinks the odds are becoming less favourable, resulting in higher returns than implied by our blunt approach.

In future research, we intend to investigate whether information available in past interest and exchange rates may be exploited to optimally determine when to take open foreign positions and when to close them. This appears to be a promising avenue as judged by our evidence on the significant explanatory power of interest rates.

One may wonder, of course, where the documented significantly

positive returns come from and whether they will persist.¹⁴ Take, for example, the case of the Italian lira which provides the strongest evidence of positive returns. A positive mean return on Italian lira has existed on average over the whole period, thereby violating open interest rate parity. One would expect interest rate differentials and realized exchange rate movements to approximately match if expectations are rational.

A few escape routes are open. First, Baldwin (1990) argues that even the presence of small transactions costs may lead to a relatively large inactivity band within which no arbitrage takes place. Baldwin implements his theoretical model by making additional assumptions with respect to plausible values of the model's parameters to arrive at the conclusion that, in a (semi-)fixed exchange rate system, interest differentials between 1 and 4 percent on an annual basis may persist without inducing arbitrage flows. To our knowledge, no empirical work has been done yet on the practical relevance of Baldwin's approach. We do not explore this issue here. Note, though, that Table 1C documents mean interest rate differentials around or in excess of 4 percent for the weak EMS currencies both for the whole period and the period after 1983.

Second, imperfect capital mobility through capital controls may hamper arbitrage across markets. Although such controls have been in effect in all weak EMS countries considered here during part of the period, capital controls do not apply to Euro-currency markets and, therefore, have no bearing on our results. Other inefficiencies such as illiquidity are also hard to accept, especially for the later period.

Third, the existence of risk premia may be used to justify the persistent positive returns on the weak EMS currencies. However, all types of empirical tests so far have failed to provide evidence on the existence of persistent risk premia in foreign exchange markets.¹⁵

The most likely explanation in our view, also expressed by Dornbusch (1991), is that the market perceives the EMS to be an unstable institution without sufficient credibility, despite the proclaimed progress towards EMU and the commitment of monetary authorities in all EMS countries to maintain fixed exchange rates. Our evidence that exchange rate fluctuations within the EMS have significantly declined over the years without a corresponding decline in interest differentials—resulting in significant positive returns on open positions in weak currencies—is consistent with this hypothesis.

In that case, the (too) high interest rates in the weaker EMS currencies contain a "peso problem" risk premium (Krasker 1980), reflecting the perception that exchange rates will not remain fixed indefinitely. A prolonged gradual convergence process to EMU in the absence of further realignments may exacerbate this problem. Now that the EC member countries have agreed on a specific deadline for the transition

to EMU (January 1, 1999), speculation may increase over time that the fundamentally weak EMS countries will not succeed in reaching sufficient convergence prior to that date, thereby weakening the credibility of the EMS system as a whole. The likely result will be either higher interest rate differentials or more frequent realignments forced on the monetary authorities by the market, or both.¹⁶

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Notes

1. Bilson and Hsieh (1987) present related empirical evidence using a portfolio approach for the period 1980–1984. More recent work by Giavazzi and Giovannini (1989), Giovannini (1990, 1991) and Dornbusch (1991) also investigates this issue in an informal way.
2. Alternatively, this strategy may be thought of as engaging in a one week forward exchange contract, going long (buying) forward Dutch guilders and going short (selling) forward Italian lira.
3. We prefer Euro-currency interest rates to domestic ones as they are not subject to capital restrictions, are more homogeneous and are available for shorter maturities.
4. During most of the sample period, a dual-exchange market was in operation in Belgium: the “official” market (for current account transactions) and the “financial” market. The exchange rate determined on the latter is the relevant one for our purpose and is used in the computations.
5. The *S*-statistic is a non-parametric Sign test, to be used to test the null hypothesis that a population median is zero. It has a binomial distribution and in the limit approaches normality (Newbold 1988). The *J*-statistic is known as the Bowman-Shelton test for normality and may be found in Jarque and Bera (1980).
6. We nevertheless feel that the reported *t*-ratios may be quite reliable, as aggregating weekly returns to bi-weekly or even monthly returns considerably reduces non-normality, while at the same time increasing the magnitude of the *t*-ratios. With respect to monthly returns for Denmark over the period 1983–1990, for instance, normality cannot be rejected and the *t*-ratio equals 3.94.
7. In a number of cases, negotiations lingered on until Monday morning before a consensus was reached.
8. To account for this, “Thursday to Thursday” interest and exchange rates are used in Table 2 under the heading “Friday to Friday” for the realignment of November

- 29, 1979.
9. A more detailed appendix including abstracts from the Financial Times is available from the authors on request.
 10. This point is sometimes referred to as the Walters critique of the EMS (see Walters 1990, ch. 5).
 11. Alternative explanatory variables include the slope of term structure and conditional second moments. These are left for future research.
 12. All regressions are computed using standard TSP routines, which make use of the method suggested by White (1980) to correct for heteroskedasticity.
 13. See Johnston (1972).
 14. Informal evidence on the profitability of "borrowing low, investing high" is provided by Giovannini (1990, 1991) for both monthly and yearly returns of the Italian lira and French franc versus the German mark.
 15. For a discussion of this point, we refer to Giavazzi and Giovannini (1989) and Giovannini (1990).
 16. See also Froot and Rogoff (1991) for a similar analysis.

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