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On the Credibility of the Irish Pound in the EMS*

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Abstract: This paper assesses the degree of credibility of the Irish Pound in the European Monetary System between 1983 and 1997. Different credibility indicators proposed in the literature are used to measure agents' perceptions of the credibility of the ERM commitment in an attempt to distinguish between events stemming from problems in the ERM itself and those that appear to have been exclusive to Ireland.

I INTRODUCTION

The concern about excessive exchange rate volatility during the 1970s, and its possible adverse effects on the process of European integration, prompted the establishment of the European Monetary System (EMS) in March 1979.

The decision to join the EMS from its inception has been identified as one of the two strategic choices made by Irish policymakers in the post-war period (McCormack, 1979).[1] Indeed, after being linked with the Pound sterling since 1826, the Irish authorities had to weigh up the pros and the cons of participating

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1. The other choice was the move from protection to free trade and EU membership in the 1970s.

in the Exchange Rate Mechanism (ERM) in the absence of the main trading partner.[2] The view that Ireland's firm commitment to the ERM would lead to significant economic benefits won through. But these benefits crucially depended upon the credibility of such commitment.

The aim of this paper is to assess the degree of credibility of the Irish Pound in the ERM of the EMS during the 1983-1997 period. To that end, we use different credibility indicators that have been proposed in the literature to measure the agents' perception towards the ERM commitments, trying to distinguish between those events that stem from problems in the ERM from those that seem to be exclusive to Ireland. This might help us to understand the evolution of the behaviour of the Irish Pound during that period.

The structure of the paper is as follows. Section II briefly discusses the EMS and presents the credibility indicators. Section III contains the empirical results. In Section IV we carry out a comparison of the credibility indicators used in this study. Finally, Section V offers some concluding remarks.

II THE EMS AND THE CREDIBILITY INDICATORS

As is well known, the main element of the EMS was the ERM, an adjustable peg system in which each currency had a central rate expressed in terms of the European Currency Unit (ECU). These central rates determined a grid of bilateral central rates *vis-à-vis* all other participating currencies, and defined a band around these central rates within which the exchange rates could fluctuate freely. In order to keep these bilateral rates within the margins, the participating countries were obliged to intervene in the foreign exchange market if a currency approached the limits of its band. For this purpose, special credit facilities were established. If the participants decided by mutual agreement that a particular parity could not be defended, realignments of the central rates were permitted.

The fluctuation bands were originally set at ±2.25 per cent, but a ±6 per cent band was set for Italy and the newcomers (Spain, the UK, and Portugal). After almost a year of unprecedented turmoil in the history of the EMS, the fluctuation bands of the ERM were broadened to ±15 per cent in August 1993 (except for the Dutch guilder and the Deutschmark, which remained within the narrow bands of ±2.25 per cent). On the other hand, there have been fifty-six realignments during the 1979-1997 period, implemented in seventeen discrete adjustments. Note also that thirty-eight of such realignments were made prior to the currency turmoil of 1992/93.

It is common to divide the experience of the ERM in three periods (see, e. g., Higgins (1993)). The first one extends from the inception of the ERM in March

2. See Walsh (1993a) for a summary of the arguments in this debate.

1979 to January 1987, and is characterised by frequent realignments to correct the divergence in economic fundamentals of the participating nations. The second period (the so-called "new" ERM) lasted from 1987 to the end of 1991 and coincided with increasing confidence in the ERM, with the removal of capital controls, and with greater convergence in the economic fundamentals. The third period covers the successive crises of September 1992 and August 1993, the German unification and the recession in Europe, widely accepted as the underlying causes of such crises (see, e.g., Commission of the European Communities (1993)). We can also consider a new period which began with the broadening of the fluctuation bands to ±15 per cent in August 1993 and was characterised by volatility levels comparable to those prevailing before the crisis (see, e.g., Sosvilla-Rivero *et al*. (1999)).

The ERM is the most prominent example of a target zone exchange-rate system. There exists an extensive literature that builds on the seminal paper by Krugman (1991) and studies the behaviour of exchange rates in target zones. The main results of the target zone model is that, with perfect credibility, the zone exerts a stabilising effect (the so-called "honeymoon" effect), reducing the exchange rate sensitivity to a given change in fundamentals. Nevertheless, in a target zone with credibility problems, expectations of future interventions tend to destabilise the exchange rate, making it less stable than the underlying fundamentals (Bertola and Caballero, 1992).

Credibility can be defined in the degree of confidence that the economic agents assign to the announcements made by policymakers. In the context of an exchange rate target zone, like the EMS, credibility refers to the perception of economic agents with respect to the commitment to maintain the exchange rate around a central parity. Therefore, the possibility for the official authorities to change the central parity could be anticipated by the economic agents, triggering expectations of future changes in the exchange rate that can act as a destabilising element of the system.

In this section we present the four credibility measures that we have used in this paper and that have been widely used in the empirical literature.

2.1 *Svensson's Simple Test*

Svensson (1991) presented a simple test to study the credibility of a target zone exchange rate regime with fluctuation bands. There are two traditional versions of this test. In the first one, it is assumed that there is no arbitrage, while in the second version uncovered interest parity (UIP) is assumed to hold.

In order to compare this indicator with the one based on the drift-adjustment method (see subsection 2.2), a more recent variant of the former is usually estimated. Given that the log of the exchange rate s_t can be expressed as $s_t \equiv x_t + c_t$, where x_t is the deviation of the log exchange rate from the log central parity c_t,

the expected rate of currency depreciation within the band from time t to time t+τ is bounded by:

$$(\underline{x}_t - x_t)/\tau \leq E_t[\Delta x_{t+\tau}]/\tau \leq (\overline{x}_t - x_t)/\tau \quad (1)$$

Taking into account the UIP hypothesis:

$$i_t - i_t^* = E_t[\Delta s_{t+\tau}]/\tau \quad (2)$$

and by separating the two elements of the exchange rate, i.e., the central parity and the exchange rate within the band, Equation (2) can be rewritten as:

$$i_t - i_t^* = E_t[\Delta x_{t+\tau}]/\tau + E_t[\Delta c_{t+\tau}]/\tau \quad (3)$$

where i_t and i_t^* are the domestic and the foreign interest rate, respectively, and τ is the maturity (being 3/12 for a 3-month maturity).

Thus, the expected variation rate in the exchange rate can be separated in two components: the expected rate of depreciation within the band and the expected rate of realignment of the central parity.

By using Equations (1) and (3), the expected rate of realignment is bounded according to:

$$i_t - i_t^* - (\overline{x}_t - x_t)/\tau \leq E_t[\Delta c_{t+\tau}]/\tau \leq i_t - i_t^* - (\underline{x}_t - x_t)/\tau \quad (4)$$

In order to facilitate the comparison with the drift adjustment method, we calculate a 100 per cent confidence interval for the expected rate of realignment of the Irish pound/German mark exchange rate.

This recent version of Svensson's simple test has been criticised because it only takes into account the possibility of realignments in the limits of the band, thus placing an excesive weight on credibility. This is one of the reasons why the results obtained with this test must be considered with care.

2.2 *The Drift-adjustment Method*

This method, originally proposed by Bertola and Svensson (1993), computes an econometric estimate of the expectations of the economic agents regarding the realignment in the ERM. These realignment expectations constitute an inverse measure of credibility. The drift-adjustment method assumes UIP to hold,[3] using the modified expression (3).

3. Svensson (1992) and Ayuso and Restoy (1992) have estimated insignificant risk premia for the currencies in the ERM and, hence, the expected rate of depreciation is closely related to the interest rate differential.

Moreover, if p_t^τ denotes the probability at time t of a realignment during the period from time t to t+τ, it follows that:

$$E_t[\Delta x_{t+\tau}] = (1 - p_t^\tau)E_t[\Delta x_{t+\tau} / nr] + p_t^\tau E_t[\Delta x_{t+\tau} / r] \quad (5)$$

where the expectation terms on the right-hand side are conditional either to the absence of realignment (nr) or to the presence of realignment (r).

If g_t^τ denotes the expected rate of devaluation, then:

$$g_t^\tau = E_t[\Delta c_{t+\tau}] / \tau + \frac{p_t^\tau}{\tau}\{E_t[x_{t+\tau} / r] - E_t[x_{t+\tau} / nr]\} \quad (6)$$

where the first term on the right-hand side is the expected rate of realignment, whereas the second term is the expected rate of depreciation within the band when a realignment takes place.

Combining (3) and (5), and using (6), we obtain:

$$g_t^\tau = i_t - i_t^* - E_t[\Delta x_{t+\tau} / nr] / \tau \quad (7)$$

The procedure implies first estimating the expected rate of depreciation within the band (the last term on the right-hand side in (7)), and then computing the expected rate of devaluation g_t^τ. Once g_t^τ is estimated, the corresponding 90 or 95 per cent confidence intervals can be calculated. These intervals can be compared with those of the more recent version of Svensson's simple test.

As for the practical implementation of the drift-adjustment method, the empirical works that have computed this measure have used different econometric specifications for the expected rate of depreciation within the band. On one hand, Lindberg *et al.* (1993), Svensson (1993), and Rose and Svensson (1994) estimate a linear regression model where the exchange rate in t+τ depends on its value in moment t (and, in some cases, lagged exchange rates) and on the interest rate differential. On the other hand, Bertola and Svensson (1993) consider x_t as the only explanatory variable, assuming a mean-reverting model for the exchange rate within the band, as in Ayuso *et al*. (1993) and in Gómez and Montalvo (1997).

In this paper, the drift-adjustment method has been used to calculate the 90 per cent confidence intervals for the expected rate of devaluation. To that end, we have estimated the expected rate of depreciation within the band using a linear regression model where the exchange rate and the domestic and foreign interest rate are taken as explanatory variables.

The drift-adjustment method has also suffered several criticisms. In particular,

it has been pointed out that the selection of the explanatory variables is *ad hoc*, without an appropriate theoretical framework. Furthermore, the non-stationarity of the exchange rate may generate some problems in the estimation of its expected rate of variation. These problems depend on its position within the band. Thus, it is necessary to exert important care when we are interpretating the results obtained from this method.

2.3 *Models of Discrete Choice*

These kinds of model aim to estimate the probability of realignment by means of econometric techniques. To that end, we consider some explanatory variables of that probability, assuming normal or logistic distributions. Among the explanatory variables, the interest rate differential, the inflation differential, the current account balance, and the unemployment rate are usually considered, leading to estimations using monthly or quarterly data.

Edin and Vredin (1993) use a two-step procedure suggested by Heckman (1976) to calculate both the probability and the expected size of the devaluation. In the first step of the estimation procedure, the probability of devaluation occurring at time t+1 based on information available at time t is estimated. In the second step, the unconditional expectation of the rate of devaluation in period t is obtained.

2.4 *Marginal Credibility*

This credibility measure proposed by Weber (1991a) focuses on the ability of policy announcements to influence the public's expectations. It measures the impact of official announcements on exchange rate and may be thought of as the weight placed on the announcement when the public forms its expectations. This credibility measure is equal to one if the policymaker always makes fully credible announcements, and tends to zero as the announcements become non-credible. Marginal credibility (α) is defined as:

$$s_t - E_{t-1}[s_t] = \gamma + \alpha[c_t - E_{t-1}[s_t]] + u_t \tag{8}$$

where the expectation operator is conditional to the information available in t–1, and where u_t is a random disturbance.

A model of the public's expectations formation process is required in order to estimate α. By applying the Kalman filter, α can be estimated, obtaining a different value of α for each moment in the sample period, allowing the study of its evolution along time.

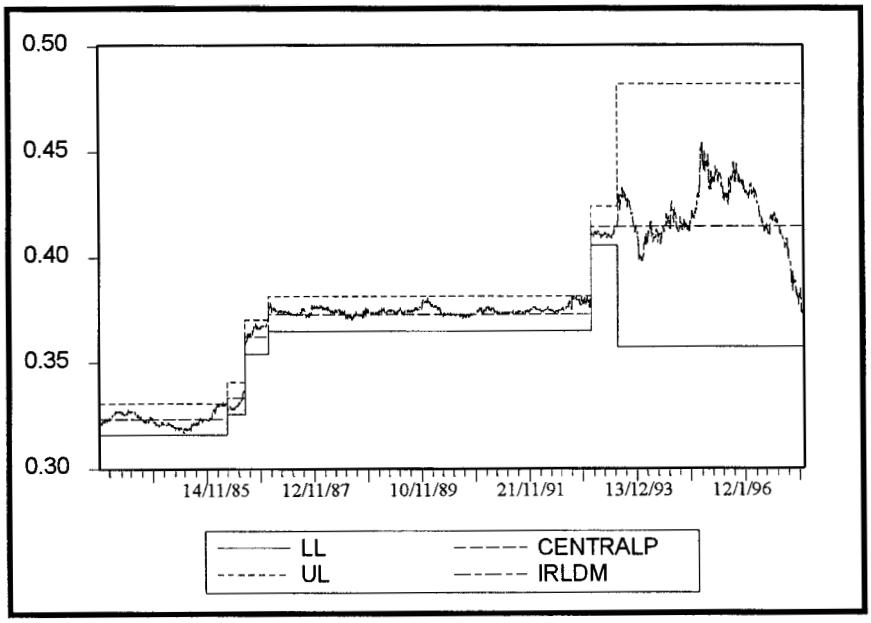
III EMPIRICAL RESULTS

The credibility indicators introduced in the previous Section have been applied to daily exchange-rate data of the Irish pound. Our exchange rates are expressed *vis-à-vis* the Deutschmark. The database used is composed of daily (mid-market) spot rates gathered by the Bank of Spain at 13:15 (GMT). The sample period runs from 21 November 1983 to 17 February 1997 (around 3,265 observations).

We will present the results following the same sequence we used in the last Section when introducing the credibility indicators.

Figure 1 presents the evolution of the Irish pound/Deutschmark exchange rate.[4] After the broadening of the fluctuation bands to ±15 per cent on 2 August

Figure 1: *Irish Pound-Deutschmark Exchange Rate (including ERM Intervention Limits)*



Notes: CENTRALP = central parity
LL = lower limit
UL = upper limit
IRLDM = Irish Pound-Deutschmark exchange rate

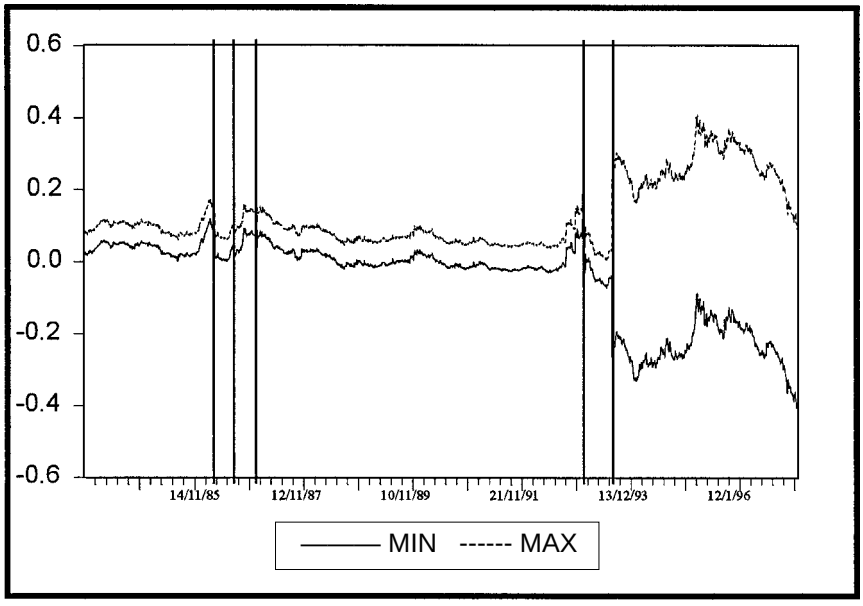
4. The fluctuation bands were built by following Honohan (1979). So we take into account the lack of symmetry between the two intervention limits due to the requirement that the upper intervention limit for currency X with respect to currency Y equals the lower intervention limit for currency Y with respect to currency X.

1993 (observation 2,413), we observe a depreciation episode until 6 March 1996 (observation 2,795), followed by an appreciation period.

3.1 *Svensson's Simple Test*

Using the three-month interbank rate, and as mentioned in Subsection 2.1, we calculated the more recent version of Svensson's simple test, obtaining the 100 per cent confidence bands for the expected rates of devaluation using expression (4). In this way, the maximum and the minimum expected realignment are constructed by subtracting from the interest rate differential the minimum and the maximum possible rates of depreciation within the band, respectively. The resulting expected rates of realignment are displayed in Figure 2. As can be seen, the difference between the maximum and minimum realignment increases after the broadening of the fluctuation bands to ±15 per cent on 2 August 1993 (observation 2,413).

Figure 2: *Maximum and Minimum Expected Rates of Realignment*



Notes: MIN = minimum expected rate of realignment in the Irish Pound-Deutschmark exchange rate, based on Svensson's simple test.
MAX = maximum expected rate of realignment in the Irish Pound-Deutschmark exchange rate, based on Svensson's simple test.
Vertical lines = actual ERM realignments and broadening of fluctuation bands.

This simple test does not seem to be very informative, since its sensitivity to the thickness of the fluctuation bands as can be seen from its behaviour since August 1993.

3.2 *The Drift-adjustment Method*

As mentioned above, in order to compute the expected devaluation rate using Equation (7), we have to estimate the expected rate of depreciation within the band. To that end, following Svensson (1993), we consider the following linear regression:

$$\frac{x_{t+\tau} - x_t}{\tau} = \sum_j \alpha_j d_j + \beta_1 x_t + \beta_2 i_t^* + \beta_3 i_t + \varepsilon_{t+\tau} \qquad (9)$$

where $x_{t+\tau}$ and x_t are the exchange rate's (log) deviation from the central parity in period $t+\tau$ and t, respectively, and where i_t and i_t^* are the Irish and German three-month interest rates, respectively. The variables d_j denote the dummies for the subperiods between the realignments and the widening of the bands.[5]

Svensson (1993) eliminates from the sample the 65 observations corresponding to the three months before a realignment took place, given that he, like us, uses $\tau = 3$ months. But given the important reduction in the number of observations implied by this strategy, we estimate Equation (9) using the whole sample.[6] In this way, we are estimating the expected devaluation rate within the band that includes possible jumps in each realignment. Therefore, we obtain the expected rate of realignment, but not the expected devaluation rate g_t^τ (which, in addition, includes the expected jump in the exchange rate within the band in the realignments).

Table 1 shows the results of OLS estimation of (9), where the standard errors have been corrected for serial correlation and heteroscedasticity which necessarily results from the "overlapping observations" problem, with a Newey-West covariance estimator. As can be seen in Table 1, all the estimated coefficients are clearly significant. The coefficient for x_t is negative, indicating mean-reversion of the exchange rate within the band. In addition, the "t value" for the coefficient is –3.48, safely rejecting the null hypothesis of a unit root, as in Svensson (1993). The estimated signs are in accordance with those reported by Svensson (1993) and by Rose and Svensson (1994). Finally, all the dummy variables are significant, indicating the relevance of the different "regimes" in the history of the Irish pound in the ERM.

5. O'Donnell (1995) did not consider the widening of the bands, since her data went up to June 1993. In this paper we have also taken into account this event since it has produced a major change in the ERM, as can be observed in a greater fluctuation of the exchange rate before August 1993.

6. Gómez and Montalvo (1997) follow a similar approach.

Table 1: *Expected Exchange Rate Depreciation Within the Band*

D1	0.2442
	(0.0394)
D2	0.2719
	(0.0368)
D3	0.2688
	(0.0385)
D4	0.2080
	(0.0339)
D5	0.2389
	(0.0368)
D6	0.1435
	(0.0254)
X	–1.2278
	(0.3523)
i*	0.0679
	(0.0151)
i	–0.1444
	(–7.1866)

Notes: OLS estimation of Equation (9). Newey-West standard errors within parentheses. Di denote dummy variables for the six subperiods delimited by the realignments of the Irish Pound and the widening of the bands.

The estimated expected rate of realignment from Equation (7) and the 90 per cent confidence interval are both presented in Figure 3. As can be seen, for most of the sample the hypothesis that the expected rates of realignment are zero cannot be rejected.

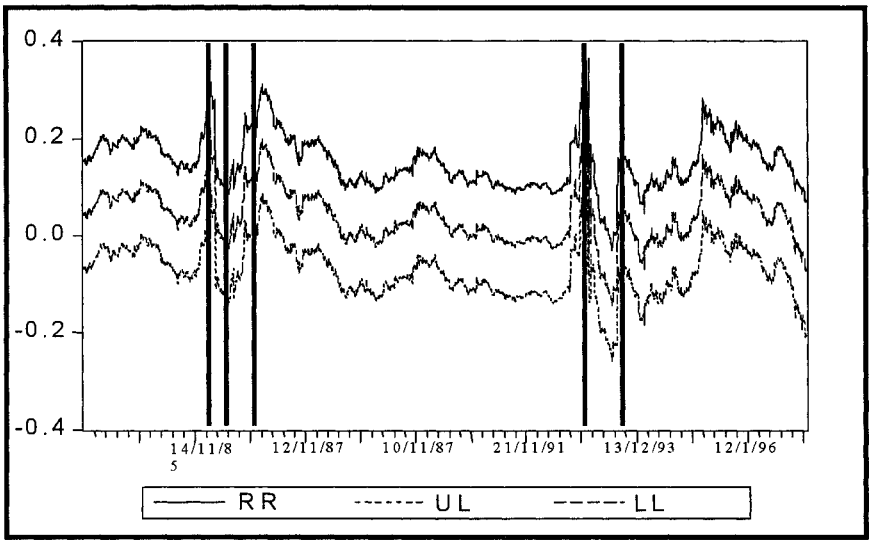
Nevertheless, we detect four episodes where the expected rate of devaluation is positive: (i) before the realignment of the Irish pound on 7 April 1986 (observation 596); (ii) the period from before the realignment of the Irish pound on 4 August 1986 (observation 679) to the realignment on 12 January 1987 (observation 788); (iii) around the realignment of the Irish pound on 1 February 1993 (observation 2,289),[7] and (iv) around the devaluation of the Spanish peseta and the Portuguese escudo on 6 March 1995 (observation 2,795). In addition, after the Italian lira rejoined the ERM on 25 November 1996 (observation 3,213), there seems to be an increase in the expected rate of appreciation.

3.3 *Models of Discrete Choice*

Instead of estimating the probability of realignment proposed by Edin and Vredin (1993), we have estimated the value of that probability using the same daily data used in all the other credibility indicators analysed in this paper.

7. Bartolini (1993) also found the importance of this realignment of the Irish pound. Even he argues that it was an excesive devaluation in comparison to the investors expectations.

Figure 3: *Expected Rate of Realignment (Including 90 Per Cent Confidence Intervals)*



Notes: RR = expected realignment rate in the Irish Pound-Deutschmark exchange rate, based on estimation results in Table 2.
UL = 90 per cent confidence interval's upper limit.
LL = 90 per cent confidence interval's lower limit.
Vertical lines = actual ERM realignments and broadening of fluctuation bands.

We have estimated a logit based on the following expression:

$$P_t = P(y_t = 1) = \Phi(z_t^{\copyright}\delta) = \frac{e^{z_t^{\copyright}\delta}}{1+e^{z_t^{\copyright}\delta}}; \quad z_t^{\copyright}\delta = \delta_1\delta_2 z_{1t} \tag{10}$$

where $\Phi(\cdot)$ is the logistic distribution function (so that $\Phi(\lambda)$ is the probability that normally distributed random variable with zero mean and unit variance does not exceed λ), z_{1t} denotes an explanatory variable, and $P(y_t=0)=1-P_t$. The parameters in (10) are estimated maximising the logarithm of the likelihood function with respect to individual observations:

$$\text{LogL} = \sum_{t=1}^{T} y_t \log \Phi(z_t^{\copyright}\delta) + \sum_{t=1}^{T}(1-y_t)\log[1-\Phi(z_t^{\copyright}\delta)] \tag{11}$$

Note that the estimated parameters should be interpreted in relative terms.

In Section 2.2 it was explained that the drift-adjustment method estimates the 90 per cent confidence interval, which was later on calculated in Section

3.2. If both limits of the interval were simultaneously greater or lesser than zero, the agents would expect realignments with 90 per cent of confidence. Thus, assuming that when y_t=0 there is no credibility and that when y_t=1 there is credibility, we use the drift-adjustment method to design the logit model. In other words, when y_t=0 the limits of the confidence interval for the expected rate of realignment are simultaneously greater or lesser than zero. When y_t=1 that does not occur.[8] This strategy allows us to obtain the probability that agents assign to the credibility of the exchange rate regime in each moment of time.

We have used different approaches to estimate the probability that Irish commitments towards the ERM were credible, defining as the explanatory variable z_t: either the Irish pound/German mark exchange rate, or the distance to the upper fluctuation band, or the distance to the central parity, or the interest rate differential. Moreover, we have also considered the Irish pound/British pound exchange rate and interest rate differential with respect to the United Kingdom.[9] The latter tries to capture the effects of the competitiveness between Ireland and United Kingdom and its influence in the credibility level (Thom, 1995). Table 2 shows the estimation results using each one of these six options, while in Table 3 we present the associated summary statistics of their estimated probability.

Table 2: *Logit Estimation Results*

Parameters	*Irish Pound / Deutschmark Exchange Rate*	*Distance to Upper Band*	*Distance to Central Parity*	*Interest Rate Differential with Germany*	*Irish Pound / Pound Sterling Exchange Rate*	*Interest Rate Differential with UK*
δ_1	4.82	1.89	2.77	5.20	12.64	2.73
	(0.69)	(0.07)	(0.08)	(0.20)	(0.89)	(0.08)
δ_2	–6.71	21.89	–76.37	–0.55	–10.99	–0.46
	(1.79)	(3.55)	(6.21)	(0.03)	(0.92)	(0.03)

Note: Estimation of Equation (10). Standard errors within parentheses.

As can be seen in these tables, in general the estimated coefficients are all statistically significant, and the estimated (credibility) probabilities have a mean of 0.9, suggesting a subjective probability 0.1 of realignment. The sign of the parameters for each one of the explanatory variables is the expected one.

8. Note that this measure, when formulated in this manner, assigns credibility to any period when neither the lower bound of the confidence interval is positive nor the upper bound is negative.

9. In order to save space, we only present here the results for two explanatory variables: the interest rate differential between Ireland and Germany and between Ireland and the UK. The results obtain with the other variables can be found in Ledesma-Rodríguez *et al*. (2000).

Table 3: *Summary Statistics of the Estimated Probability*

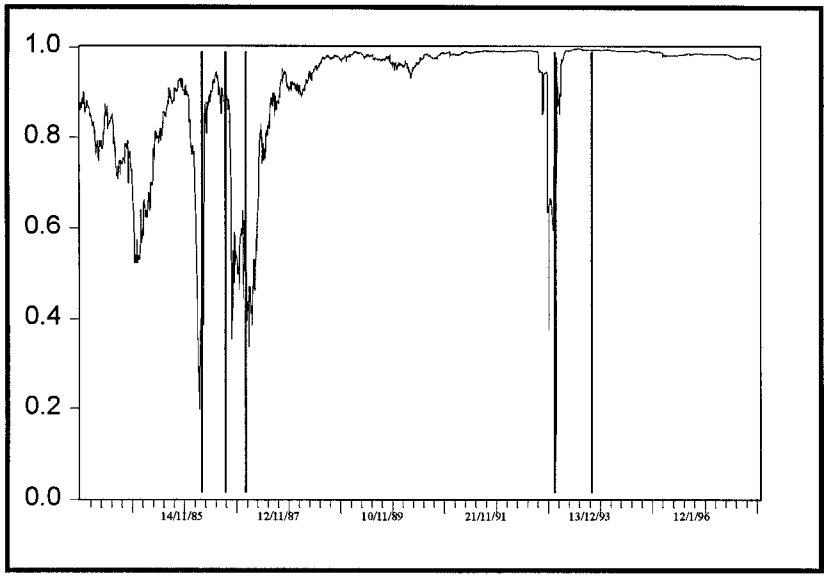
Parameters	*Irish Pound / Deutschmark Exchange Rate*	*Distance to Upper Band*	*Distance to Central Parity*	*Interest Rate Differential with Germany*	*Irish Pound / Pound Sterling Exchange Rate*	*Interest Rate Differential with UK*
Mean	0.906	0.906	0.906	0.906	0.906	0.906
Median	0.909	0.889	0.931	0.976	0.930	0.944
Maximum	0.936	0.986	0.941	0.998	0.985	0.995
Mínimum	0.854	0.869	0.398	0.087	0.634	0.010
Std.Dev.	0.019	0.034	0.072	0.140	0.068	0.134
Skewness	–0.324	1.103	–3.562	–2.206	–1.237	–3.945
Kurtosis	2.459	2.492	16.945	7.797	4.241	21.414

Note: Estimation of Equation (10). Standard errors within parentheses.

Time series of the probability of credibility have been calculated using the estimation results of Table 2. These estimations are plotted in Figures 4 and 5.

Figure 4 plots the results obtained using the interest rate differential with respect to Germany as the explanatory variable. As shown, this indicator suggests

Figure 4: *Estimated Devaluation Probabilities Based on the Irish-German Interest Rate Differential*



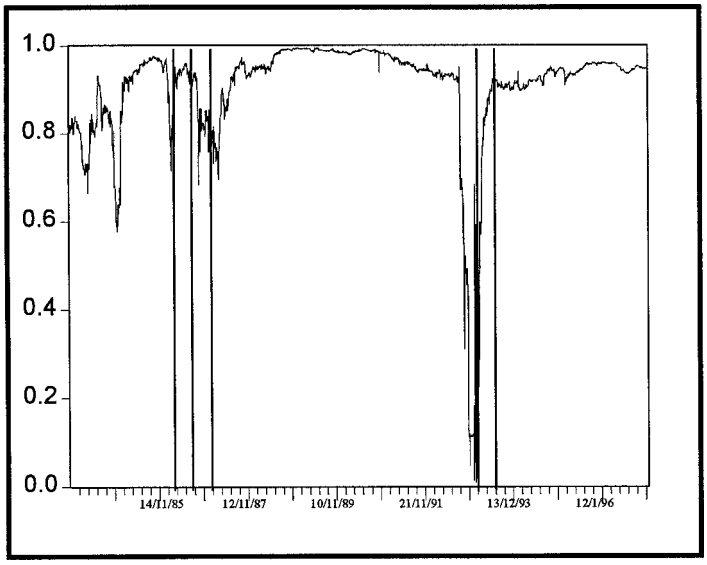
Notes: Inverse of devaluation probabilities for the Irish Pound-Deutschmark exchange rate, based on estimation results in Table 3, column 5.
Vertical lines = actual ERM realignments and broadening of fluctuation bands.

a temporary fall of credibility at the end of 1984. Furthermore, it captures both the devaluations of the Irish pound and the realignments of April 1986, August 1986, and January 1987. Moreover, it can be observed an important fall in credibility with the crisis of the ERM in September 1992.

The importance of commercial and financial relationships between Ireland and United Kingdom made us introduce the Irish pound/British pound exchange rate and the interest rate differential between these economies as explanatory variables for the probability. Following Kremers (1990), Walsh (1993b), Honohan and Conroy (1994), and Thom (1995), Irish competitiveness in relation to United Kingdom may influence the degree of credibility of the Irish pound with respect to the German mark.

In Figure 5 we show the probability of credibility using the interest rate differential between Ireland and the United Kingdom. We observe that the devaluations of the Irish pound in 1986 and 1987 compensate the previous period of lack of credibility. Around the suspension of the participation of the sterling in the ERM in 1992, credibility fell dramatically. However, the devaluation of February 1993 and the broadening of the bands allowed for the return to the previous level of credibility.

Figure 5: *Estimated Devaluation Probabilities Based on the Irish-British Interest Rate Differential*



Notes: Inverse of devaluation probabilities for the Irish Pound-Deutschmark exchange rate, based on estimation results in Table 3, colum 7.
Vertical lines = actual ERM realignments and broadening of fluctuation bands.

3.4 *Marginal Credibility*

As mentioned in Section II, marginal credibility focuses on the influence of policy announcements on the expectations of private agents, and may be thought of as the weight placed on such announcements when forming expectations.

In this paper, the announcements are changes in the ERM central parity. The estimation of marginal credibility (α) is based on Equation (8), where the random disturbance u_t is normal with a zero mean and a constant variance.

Before estimating α, we have to obtain the expectations on the exchange rate. To that end, we generate the expected exchange rate using a random walk with a drift.[10]

To estimate marginal credibility, we have used the Kalman filter in order to analyse the dynamic behaviour of the estimated α_t during the sample period. As it is well known, the Kalman filter is an updating estimation method which bases the regression estimates for each time period on the last period's estimates plus the data for the current time period (i.e., it bases estimates on data up to and including the current period).

The model that has been estimated is the following:

$$y_t = w_t\beta_t + \varepsilon_t; \quad \varepsilon_t \sim N(0, \sigma^2 h_t) \tag{12}$$

$$\beta_t = T\beta_{t-1} + \eta; \quad \eta_t \sim N(0, \sigma^2 Q_t) \tag{13}$$

where y_t is a vector of differences $s_t - E_{t-1}(s_t)$, $w_t^{\copyright}$ is a row vector made of one and differences $c_t - E_{t-1}(s_t)$. Equation (13) is called the transition equation (which describes the evolution of a set of state variables), whereas Equation (12) is the measurement equation (which describes how the data actually observed is generated from the state variables). β_t is the state vector and it follows a random walk; and T is an identity 2x2 matrix. The initial conditions are established by $\beta_0 \sim N(\beta_0, P_0)$, where P_0 is a variance-covariance matrix for the initial conditions. Finally, h_t is the variance of the errors in the measure equation and Q_t is the variance-covariance matrix for the errors in the transition equation.

The Kalman filter is a recursive method that computes the optimal estimate of the state variables in period t, based on information available in time t. For each period, we use a conditional maximum likelihood to the information set up to that period. The logarithm of the likelihood function is defined as follows:

$$\log L = -\frac{T}{2}\log 2\pi - \frac{1}{2}\log \sigma^2 - \frac{1}{2}\sum_{t=1}^{T}\log f_t - \frac{1}{2}\sum_{t=1}^{T}\xi_t^{\copyright} f_t \xi_t \tag{14}$$

10. Other specifications, such as traditional ARIMA models, were also tried but they did not change the qualitative results.

where σ^2 is computed from the recursive residuals, $f_t = w_t' P_{t/t-1} w_t + h_t$ is a scalar and $\xi_t = y_t - E_{t-1}[y_t]$.

The use of an econometric technique that allows for changes in the values of the parameters along time may be appropriate for the study of credibility in a target zone, i.e., stabilising interventions by the central banks, speculative movements by private agents, and realignments modify the parameters of the process along the period studied. In fact, this possibility was pointed out by Weber (1991a, 1991b) after the monetary turmoil of September 1992, and more recently by Darvas (1998).

Table 4 shows the estimation results. Note that the upper panel in that table reports OLS estimates of α as a benchmark for comparisons.

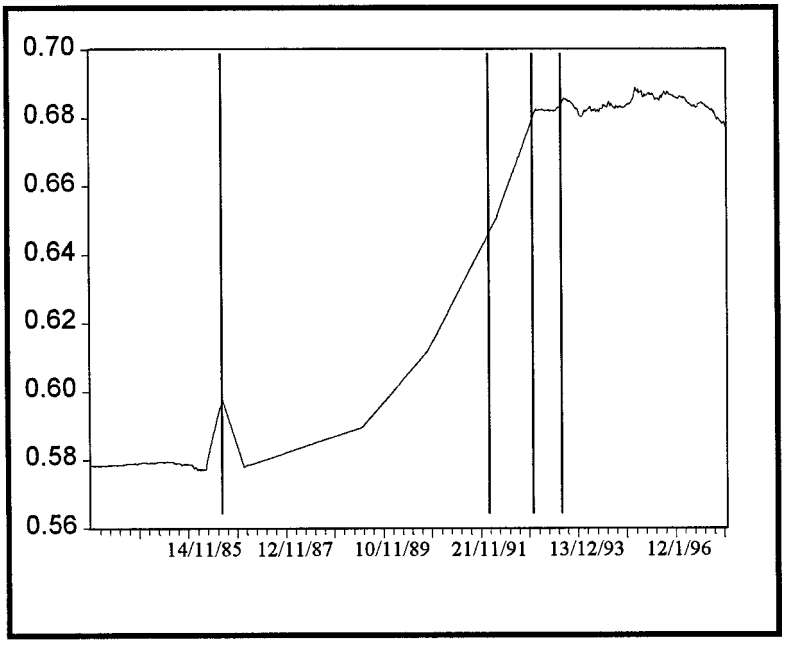
Table 4: *Kalman Filter Estimates of Marginal Credibility*

α (ML)	0.6773
	(0.05)
Mean	0.62
Median	0.60
Maximum	0.69
Minimum	0.57
Std. Dev.	0.04
Skewness	0.33
Kurtosis	0.32

Notes: Estimation by maximum likelihood (ML).
Standard errors within parentheses.

Figure 6 displays the evolution of the estimated marginal credibility when the expected exchange rates are based upon a random walk model with a drift. As can be seen in this figure, the dynamic behaviour of the credibility indicator is not as irregular as previous indices. Indeed, we only detect two significant episodes: a temporary increase in credibility from 23 March 1986 (observation 590) up to just after the realignment of the Irish pound on 4 August 1986 (observation 679), followed by a reduction in credibility until the realignment of 12 January 1987 (observation 788). After this first episode, there is a rise in credibility until the realignment of the Irish pound on 1 February 1993 (observation 2,289). At the end of 1992 and begining 1993, just after the crisis, there is a stop in the improvement in credibility that led to the devaluation of February 1993. According to this indicator this realignment was not enough to return to the path of credibility gains. After the Italian lira rejoined the ERM on 25 November 1996 (observation 3,213), there is a slight decline in credibility.

Figure 6: *Marginal Credibility*



Notes: Credibility indicator based on estimation results in Table 5.
Vertical lines = actual ERM realignments and broadening of fluctuation bands.

IV COMPARISON OF INDICATORS

We have carried out a study for each indicator of the changes of the first and second order moments prior to the main events of the sample period, in order to illustrate the differences among the credibility indicators used in this paper. In this way, we chose the fifteen days prior to the following events: 4 August 1986 (the devaluation of the Irish pound), 14 September 1992 (the worst moment of the monetary turmoil), 1 February 1993 (the devaluation of the Irish pound), and 2 August 1993 (the broadening of the bands).[11]

Once we calculated the mean and the standard deviation for the whole period as well as for the four subperiods, we measured the percentage differences between the values for each one of these subperiods and the corresponding values for the complete period. Then, we ordered the eight[12] indicators from the greatest

11. The choice of a subperiod prior to each one of the four selected events tries to capture the predictive quality of the different measures. Nevertheless it must be pointed out that we are not taking into account the number of events registered by each indicator; this last element could have been an alternative criterium in order to carry out the comparison.

12. The Svensson's simple test was eliminated given the mentioned sensitivity to the size of the fluctuation bands.

to the smallest degree of detection of the selected events (i.e., from the greatest to the smallest percentage difference between the subperiods and the whole period). In this way, we assigned scores from 1 to 8 according to the place occupied by each measure in each event detected. Thus, we have eight scores for each indicator corresponding to the mean and the standard deviation for the four subperiods.

In Table 5 we report the results of adding the eight scores for each one of the eight credibility indicators. As can be seen, the marginal credibility is the measure with the lowest score (i.e., with a better detection of the events). Among the logit models, the best one seems to be the one that uses the interest rate differential between Ireland and Germany as the explanatory variable. It must be pointed out that the logit using the interest rate differential between Ireland and United Kingdom appears to be a good enough indicator in relative terms, and particularly when we look at the mean differences around the events of August 1986 and February 1993. Likewise, the drift-adjustment method shows a very similar behaviour.

Table 5: *Global Scores from the Credibility Indicators (15 previous days)*

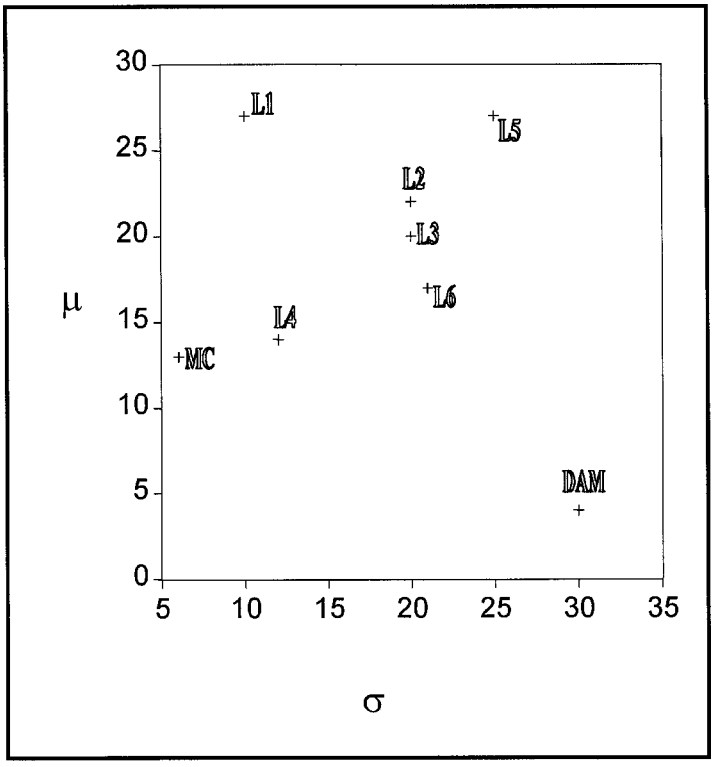
Credibility Indicator	*Score*
Marginal Credibility. (MC)	19
Logit. Interest differential (Ireland/Germany). (L4)	26
Drift-adjustment Method. (DAM)	34
Logit. Exchange rate (IRL/DM). (L1)	37
Logit. Interest differential (Ireland/UK) (L6)	38
Logit. Distance to the central parity. (L3)	40
Logit. Distance to the upper band. (L2)	42
Logit. Exchange Rate IRL/UK. (L5)	52

Note: A lower score implies a greater sensitivity of the credibility indicator.

In Figure 7 we have considered for each one of the seven indicators the mean and the standard deviation separately. Thus we have added, on one hand, the four mean scores, and on the other hand, the four standard deviation scores, corresponding to the four events selected. The closest position to the origin of the marginal credibility measure indicates that it seems to be the best predictor during the fifteen days prior to the four selected events.

Furthermore, it can be observed that even though the drift-adjustment method and the logit models using the interest rate differential with respect to both the United Kingdom and Germany show good mean scores, overall they rate behind the marginal credibility. This is because the latter perform quite well in terms of the standard deviation.

Figure 7: *Scatter Diagram of Scores in Mean (μ) and in Standard Deviation (σ) for the Credibility Indicators*



Notes: DAM = Credibility indicator based on the drift-adjustment method.
L1 = Credibility indicator based on logit model with the IRL/DM exchange rate.
L2 = Credibility indicator based on logit model with the distance to the upper band.
L3 = Credibility indicator based on logit model with the distance to the central parity.
L4 = Credibility indicator based on logit model with the Irish-German interest rate differential.
L5 = Credibility indicator based on logit model with the IRL/UK exchange rate.
L6 = Credibility indicator based on logit model with the Irish-British interest rate differential.
MC = Marginal credibility indicator.

V CONCLUDING REMARKS

In this paper we have provided some new evidence on the credibility of the Irish pound in the ERM. Its main contribution is the use of several credibility indicators, some of them never applied before to the Irish case. This allows to strengthen the results obtained in this paper. We also analyse a longer period than that considered in previously available studies, covering the 21 November 1983-17 February 1997 period. Moreover, we have carried out a simple comparison of the predictive quality of the different indicators just before the main events of the history of the ERM.

Although there exists some differences among the results across measures, we can point out several common conclusions. In particular, our results suggest credibility gains (i) after the realignments of the Irish pound on 4 August 1986, on 12 January 1987 and on 1 February 1993; (ii) after the broadening of the fluctuation bands to ±15 per cent on 2 August 1993; and (iii) around the devaluation of the Spanish peseta and the Portuguese escudo on 6 March 1995. On the other hand, we detect some occasional reductions in credibility, notably before the monetary turmoil registered in September 1992 and after the Italian lira rejoined the ERM on 25 November 1996.

These results in turn suggest that the August 1986 realignment in response to the weakness of sterling outside the ERM helped credibility by making the exchange rate sustainable, opening a period of exchange rate stability for the Irish pound until 1992. Indeed, since 1987 the Central Bank adopted a "franc fort" strategy based on a rigid peg to the Deutschmark and total commitment to ERM parities (see Walsh, 1993a). This is particularly noticeable, since from 1987 there were two important developments in the EMS: the German unification (that imposed a massive asymmetric shock on the EMS) and the removal of the existing capital controls in some EMS countries. However, when the sterling left the ERM in September 1992 and depreciated against the Deutschmark, the "franc fort" policy was shown to lack credibility and speculative pressures forced a new realignment of the Irish pound in February 1993.

With the widening of the ERM bands in August 1993, the Central Bank obtained a greater degree of flexibility in determining exchange rate policy and the probability of speculative pressures was reduced. This allowed the authorities to easily accommodate the sharp depreciation of sterling relative to the Deutschmark, registered at the end of 1994 and early in 1995, in contrast with the 1992 episode (Walsh, 1995). However, when the Italian lira rejoined the ERM in November 1996, leaving sterling out of the ERM, the scenario of Ireland satisfying the Maastricht criteria but the United Kingdom opting out of Economic and Monetary Union temporarily reduced the credibility of the Irish pound.

Finally, the comparison of the indicators used in this paper shows that the

marginal credibility measure seems to be the best to capture the main events of the sample period. Therefore, the use of an econometric technique that allows the parameters to change along time seems to be quite appropriate for the study of credibility in a target zone (i.e., stabilising interventions by the central banks, speculative movements by private agents, and realignments modify the parameters of the process along the period studied).

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