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Credibility and Duration in Target Zones: Evidence from the EMS*

by

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ABSTRACT

This paper is devoted to the past, present, and future of the European Monetary System (EMS). After examining its background, the paper reviews the structure and operation of the EMS, as well as the theoretical framework used to explain exchange-rate movements inside official fluctuation bands. Moreover, we offer some comments and assessment on the EMS in the light of empirical papers examining the EMS from both the credibility and currency crisis approaches, with special emphasis on the survival of the central parities. Finally, drawing on the EMS experience, we make some remarks on new EMS, linking the currencies of non-euro area Member States to the euro, both current European Union Member States and future candidates.

JEL classification numbers: C32, C41, F31, F33
KEY WORDS: Credibility, Currency crises, Exchange rates, European Monetary System

1. INTRODUCTION

The European Monetary System (EMS) constituted an important intermediary step to European Monetary Union (EMU), which is now regarded as a very efficient monetary arrangement for most countries of European Union (UE). Indeed, the EMS is considered to be the most ambitious experiment since the Bretton-Woods system.

The aim of this paper is to provide an assessment on the past, present, and future of the EMS. To that end, Section 2 examines its background and reviews its structure and operation features, as well as offering a brief account of its historical evolution. In Section 3 we review the theoretical framework used to explain exchange-rate movements inside official fluctuation bands and comment some empirical evidence examining the credibility of the EMS. Section 4 is devoted to the theoretical models designed to examine the currency crises, and we review some empirical evidence on the relevance of this literature in the case of the EMS, with special emphasis on the survival of the central parities. Finally, Section 5 offers some concluding remarks drawing on the EMS experience, as well as some considerations on the new EMS, linking the currencies of non-euro area Member States to the euro, both current European Union Member States and future candidates.

2. THE EUROPEAN MONETARY SYSTEM

The EMS was created on account of a Resolution of the European Council on the 5th December 1978. It entered into force on the 13th March 1979, according to an agreement celebrated the same day between the central banks of the countries that formed part of the now UE. The EMS was launched as an attempt to foster economic integration and the co-ordination of economic policies in the EU. In particular, the EMS was established to achieve "a greater measure of monetary stability" among the members of the EU (Commission of the European Communities, 1979, p. 94) in a moment characterised by the excessive exchange rate volatility, that could have adversely affected the European integration process.

The EMS gave birth to a new symbolic currency, the European Currency Unit (ECU), predecessor of the euro. The ECU was a composed currency (or currency basket), formed by given percentages of each one of the participating currencies, established in function to the contribution of the respective countries to the GDP of the EU and to the intra-European trade. These weights were initially chosen so that ECU 1 be worth US$ 1. The composition of the ECU was subject to periodic reviews every five years. Table 1 shows the composition of the ECU set at each quinquennial reviews, together with the weight of each currency in the ECU. From this table we can see that the ECU consisted literally of so many Deutchemarks, so many French francs, etc. However, the actual weight of each currency in the basket changed because of exchange-rate movements, so the weights shown in the table are those prevailing in different dates. The composition of and the last weights are shown in Table 1. When the euro was introduced in 4 January 1999, it replaced the ECU at par (that is, at a 1:1 ratio), ceasing the ECU to exist. Although it was originally an accounting unit for all EU transactions and the community's internal budget, latter was used in travellers' cheques and bank deposits, though it was never issued as a note or coin.

The centrepiece of the EMS was the European Regimen Mechanism (ERM), an adjustable peg system in which each currency had a central rate expressed in terms of 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 the exchange rates could fluctuate freely. Therefore, the arrangement was designed to be both fully European (with no reference to the US Dollar or to the gold) and symmetric (no currency played any special role, in contrast to the US Dollar in the Bretton Woods system). The size if this band was initially set at ±2.25 per cent, so that the exchange rate between any two currencies could move by (at most) 4.5 per cent. For some countries (Italy until 1990, Portugal, Spain and the UK) the band fluctuation band was set at ±6 per cent, allowing a maximal range of fluctuation of 12 per cent. After almost a year of unprecedented turmoil in the history of the EMS, the fluctuation bands of the ERM were broadened in August 1993 to ± 15% except for Dutch guilder and Deutschemark, which remained with the narrow bands of ± 2.25 per cent.

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. Therefore, the responsibility for maintaining each bilateral exchange rate within its margin was explicitly shared by both countries. In return, there was a strong collective commitment to provide mutual support through bilateral, automatic and unlimited interventions. Indeed, a central bank could not stop intervening as long as its parity *vis-à-vis* any other member currency was pressed against the limit. For this purpose, special credit facilities were established. The European Monetary Co-operation Fund (EMCF) provided short- and medium-term credit facilities to its members. The most important of these instruments was the Very Short Term Financing (VSTF) facility, which provided finance for intervention in the foreign-exchange markets.

Table 1. Composition and weighting of the ECU

	Amount in one ECU			Weights (%)		
	13 Mar. 1979 through 14 Sep. 1984	17 Sep. 1984 though 21 Sep. 1989	21 Sep. 1989 through 31 Dec. 1998	13 Mar. 1979	17 Sep. 1984	31 Dec. 1998
Belgian franc	3.800	3.850	3.431	9.64	8.57	8.52
Danish krone	0.217	0.219	0.1976	3.06	2.69	2.65
Deutschemark	0.828	0.719	0.6242	32.98	32.08	31.94
Dutch guilder	0.286	0.256	0.2198	10.51	19.06	9.88
French franc	1.150	1.310	1.332	19.83	10.13	20.33
Greek drachma	n.a.	1.15	1.44	n.a.	1.31	0.44
Irish punt	0.00759	0.00871	0.008552	1.15	1.20	1.09
Italian lira	109.0	140.0	151.8	9.49	9.98	7.85
Portuguese escudo	n.a	n.a.	1.393	n.a.	n.a.	0.70
Spanish peseta	n.a	n.a.	6.885	n.a.	n.a.	4.14
UK pound sterling	0.0885	0.0878	0.08784	13.34	14.98	12.46

Note: n.a.= not applicable

Table 2: Main realignments and changes in the ERM (1979-1998)

13.03.1979	ERM starts to operate with the BFR, DKR, DM, FF, IRL, LIT and HFL. They are in the narrow band (± 2.25% fluctuation), except the LIT in the wide band (± 6% fluctuation).
24.09.1979	Realignment (DKR –3%, DM +2%)
30.11.1979	Realignment (DKR –5%)
23.03.1981	Realignment (LIT –6%)
5.10.1981	Realignment (DM +5.5%, FF –3%, HFL +5.5%, LIT –3%)
22.02.1982	Realignment (BFR –8.5%, DKR -3%)
14.06.1982	Realignment (DM +4.25%, FF –5.75%, HFL +4.25%, LIT –2.75%)
22.03.1983	Realignment (BFR +1.5%, DKR +2.5%, DM +5.5%, FF –2.5%, IRL –3.5%, HFL +3.5%, LIT –2.5%)
22.07.1985	Realignment (BFR +2%, DKR +2%, DM +2%, FF +2%, IRL +2%, HFL +2%, LIT –6%)
7.04.1986	Realignment (BFR +1%, DKR +1%, DM +3%, FF –3%, HFL +3%)
4.08.1986	Realignment (IRL –8%)
12.01.1987	Realignment (BFR +2%, DM +3%, HFL +3%)
19.06.1989	The PTA joins the ERM with the wide band (± 6%)
8.01.1990	The LIT joins the narrow band (± 2.25%). Realignment (LIT –3.6774%)
8.10.1990	The UKL joins the ERM with the wide band (± 6%)
6.04.1992	The ESC joins the ERM with the wide band (± 6%)
14.09.1992	Realignment (BFR +3.5%, DKR +3.5%, DM +3.5%, ESC +3.5%, FF +3.5%, IRL +3.5%, HFL +3.5%, LIT –3.5%, PTA +3.5%, UKL +3.5%)
17.09.1992	The UKL and the LIT suspend their participation in the ERM. Realignment (PTA –5%)
23.11.1992	Realignment (ESC -6%, PTA –6%)
1.02.1993	Realignment (IRL -10%)
14.05.1993	Realignment (ESC –6.5%, PTA –8%)
2.08.1993	The ERM fluctuation bands are widened to ± 15%, except for the DM and the HFL
9.01.1995	The ATS joins the ERM with the new wide band (± 15%)
6.03.1995	Realignment (ESC –3.5%, PTA –7%)
14.10.1996	The FIM joins the ERM with the new wide band (± 15%)
25.11.1996	The LIT re-joins the ERM with the new wide band (± 15%)
16.03.1998	Realignment (IRL +3%). The DR joins the ERM with the new wide band (± 15%)

Note: ATS, BFR, DKR, DM, DR, ESC, FF, FIM, HFL, IRL, LIT, PTA and UKL denote, respectively, the Austrian schilling, the Belgian franc, the Danish krone, the Deustchemark, the Greek drachma, the Portuguese escudo, the French franc, the Finnish markka, the Dutch guilder, the Irish pound, the Italian lira, the Spanish peseta and the Pound sterling.

The EMS was a system of pegged, but adjustable, exchange rate in which the central parity grid could be altered to take into account changing economic conditions and relative performance of the participant economies. If they decided by mutual agreement that a particular parity could not be defended, realignments of the central rates were permitted. This consensus rule implied that, in effect, each country gave up exclusive control of its own exchange rate. Table 2 shows the main realignments and changes in the EMS during the 1979-1998 period. As can be seen, there were nineteen realignments in the EMS history, being twelve of them prior to the currency turmoil of the subperiod 1992-1993. On the other hand, many changes affected more than one currency, such as the bands increase. In general, high-inflation countries needed to periodically devaluate their currencies with respect to the ECU in order to maintain competitiveness in relation to a low-inflation country such as Germany. In this respect, early proponents of the EMS stressed the point that the frequency of realignments should not be regarded as a criterion of success or failure of the system (Commission of the European Communities, 1979, p. 78).

Figures 1a to 1h show the evolution of the exchange rates during the ERM history [1]. Following De Grauwe (2000), we can distinguish four different subperiods in the experience of the ERM. The first subperiod extended from the ERM inception, in March 1979, to January 1987. During this subperiod, the relatively large fluctuations bands in the EMS (compared to those in the Bretton Woods system), together with relatively small and frequent realignments, helped to reduce the size of speculative capital movements and stabilised the system. The second subperiod, the so-called "New ERM", lasted from 1987 to the end of 1991, coinciding with increasing confidence in the ERM, the removal of capital controls, and a greater convergence in the economic fundamentals. During these years there was not any realignment[2]. The third subperiod covered successive crises of September 1992 and August 1993, where the evolution of the EMS into a truly fixed exchange rate system with almost perfect capital mobility led to credibility losses in a context of policy conflict among EMS countries about how to face the severe recession experienced in 1992-93. Finally, a fourth subperiod initiated after the crisis of 1993, when the EMS changed its nature in drastic ways: the EMS gained credibility with the enlargement of the fluctuation bands to ±15% (reducing the scope for large speculative gains) and with the fixed exchange rate commitment among potential EMU member countries. As a result, speculation became a stabilising factor and the market rates converged closer and closer to the fixed conversion rates, although the world was hit by a major crisis during the second half of 1998 (De Grauwe *et al.*, 1999).

[1] The fluctuation bands were built following Honohan (1979). We took 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.

[2] The 1990 technical realignment was due to the switching of the Italian lira to the narrow ±2.25 per cent band, bringing its central parity closer to its weak margin.

Fig 1a: BFR/DM exchange rate
(including ERM intervention limits)

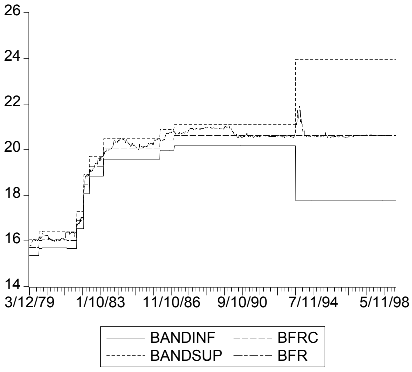


Fig 1b: DRK/DM exchange rate
(including ERM intervention limits)

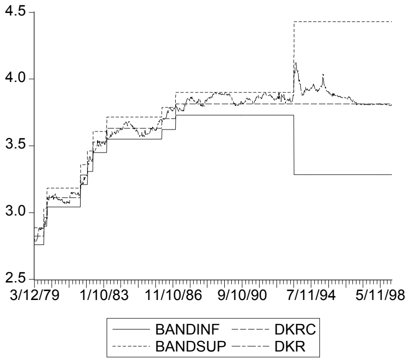


Fig 1c: ESC/DM exchange rate
(including ERM intervention limits)

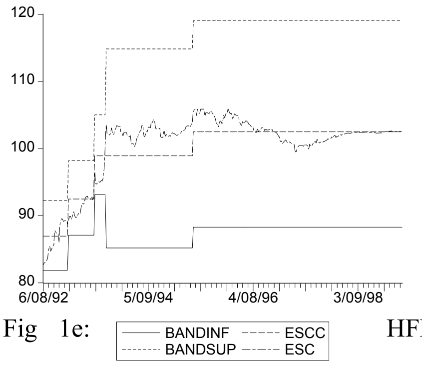


Fig 1d: FF/DM exchange rate
(including ERM intervention limits)

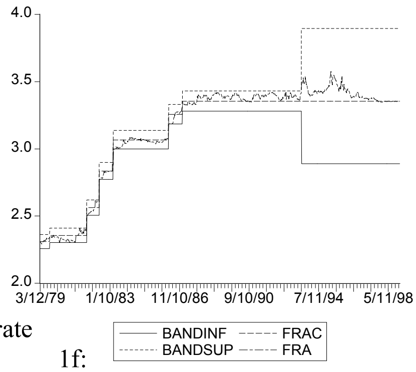


Fig 1e: HFL/DM exchange rate
(including ERM intervention limits)

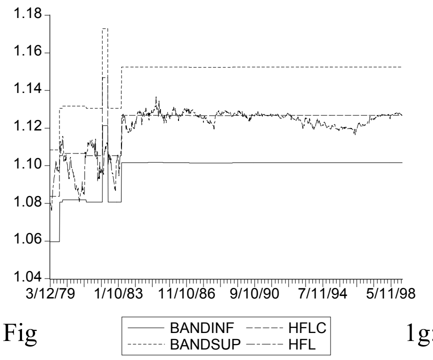


Fig 1f: IRL/DM exchange rate
(including ERM intervention limits)

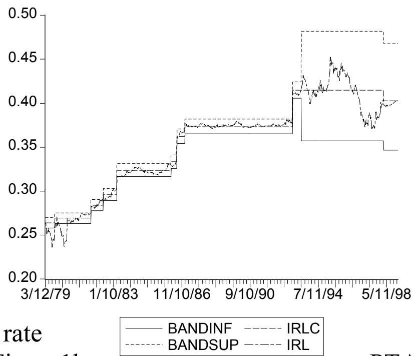


Fig 1g: ITL/DM exchange rate
(including ERM intervention limits)

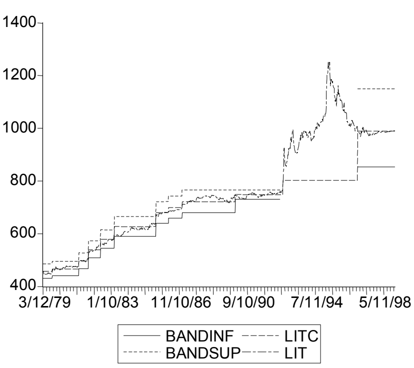
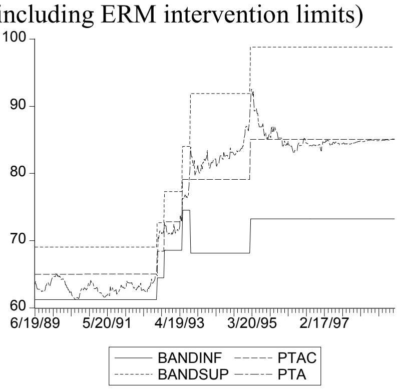


Fig 1h: PTA/DM exchange rate
(including ERM intervention limits)



As mentioned above, although initially designed as a symmetric system around the ECU, a general consensus emerged that the EMS worked in an asymmetric way, with Germany assuming the leading role and the remaining countries passively adjusting to German monetary policy actions. In their turn, the follower countries found beneficial to behave in such a way, since they could take advantage of the firmly established anti-inflation credibility of the German Bundesbank (see, e. g., Giavazzi and Pagano, 1988, or Mélitz, 1988). On the other hand, these countries would have retained during some time some degree of monetary autonomy by resorting to capital controls, which would have allowed them to dissociate the evolution of domestic (i. e., onshore) interest rates from those prevailing in the Euromarket (i. e., offshore) (see Rogoff, 1985, or Giavazzi and Giovannini, 1989).

A common result to most of the empirical papers in this area is the finding that, both in terms of size and persistence, the effect is stronger from German variables to the other EMS countries' variables, rather than the other way round. In other words, whereas monetary policy in the other EMS countries would have being affected not only by German actions but by the other EMS partners also, German monetary policy would have operated rather independently. This would point to a special role of Germany within the EMS, even though the hypothesis of German leadership or dominance might appear too strong. In von Hagen and Fratianni's words: "(I)n the short run, the EMS is best portrayed as an interactive web of monetary policies, where Germany is an important player, but not the dominant one (...) (I)t is tempting to conclude that many observers have mistaken German dominance with the relative strength of Germany and the relative weakness of France in the EMS" (von Hagen and Fratianni,1990, p. 373). Indeed, results in Bajo-Rubio *et al*. (2001) suggest that, for the whole period of analysis, there is two-way causality between, on the one hand, interest rates in Belgium, Denmark and the Netherlands, and, on the other hand, those in Germany. However, for the cases of France, Ireland, Italy, Portugal, Spain and the UK, causality is only found running from Germany to those countries. Overall, these results could be taken as a first indication of the special role played by Germany within the EMS, even though we cannot talk of "dominance" in a strict sense.

With the beginning of EMU, the former EMS ceased to have effect. It was replaced by the new, modified exchange rate mechanism (the so-called ERM-II) (see Deutsche Bundesbank, 1998). Under this mechanism, the four member states that did not introduce the euro for the time being were given the chance to prepare themselves for full incorporation in the euro area. Denmark and Greece took advantage of this option from 1st January 1999, while Sweden and the United

Kingdom have stayed outside. Central and intervention rates are all defined in terms of the euro. A fluctuation margin of ±2.25% was set for the DKR and a standard margin of ±15% was agreed for the Greek dracma (GRD). Participation in the ERM-II is in principle voluntary, but it is a prerequisite for introducing the euro at a later stage.

On 19 June 2000, the EU Council, having assessed that Greece fulfilled the requirements of the Treaty, approved its accession to the euro area as a twelfth member from 1 January 2001. On the same day, the Council also decided that the conversion rate between the GRD and the euro should be equal to the dracma's central rate in the ERM-II. The convergence of the GRD towards its central rate was facilitated by a 3.5% revaluation of its central rate on 17 January 2000. Given that on 28 September 2000 a majority of the Danish electorate rejected the adoption of the euro, the Danish krone is the only currency currently participating in the ERM-II.

3. CREDIBILITY

3.1. Theoretical framework

In the standard target zone model, inspired by Krugman (1991) the (log of the) exchange rate, x_t, depends both on a scalar measure of exchange rate fundamentals, f_t, and on its own expected rate of expected change, $E_t(dx / df)$, with the parameter γ indexing the importance of the latter effects:

$$x_t = f_t + \gamma E_t(dx_t / df) \qquad (1)$$

where $E_t(\bullet)$ denotes an expectation taken conditionally on the information available at time *t*.

Equation (1) is a stochastic first-order differential equation. By ruling out speculative bubbles, the forward expectations solution can be derived (Bertola, 1994) where the saddle path exchange rate is equal to the discounted value of the future expected fundamentals:

$$x_t = \frac{1}{\gamma}\int_t^{\infty} E_t(f_\tau) e^{-(\tau - t)/\gamma} d\tau \qquad (2)$$

In order to obtain a relationship between the contemporaneous exchange rate and the fundamentals:

$$x_t = x(f_t) \tag{3}$$

additional assumptions on the stochastic process of the fundamentals are needed.

3.1. 1. The free-float case

In the absence of intervention, f_t, is assumed to follow a Brownian motion process with drift μ and rate of variance σ^2:

$$df_t = \mu dt + \sigma dW_t \tag{4}$$

where dw_t is a standard Weiner process. Then, integrating (2) yields:

$$x_t = f_t + \gamma\mu \tag{5}$$

Therefore, in a free-float exchange rate regime characterized by no interventions, there would be a linear relationship between the contemporaneous exchange rate and the fundamentals. In the simplest case when the drift μ is zero, such relationship could be represented as the 45 degree line (see Figure 2). Therefore, the freely floating exchange rate must not deviate excessively from the fundamentals when the latter takes arbitrary large (positive or negative) values.

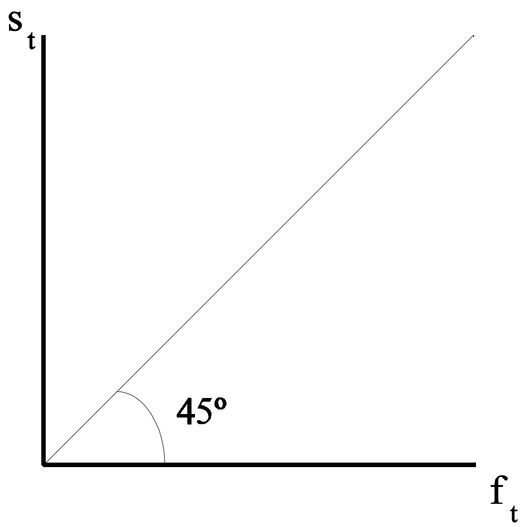
3.1.2. A target zone with perfectly credible bands

In Krugman's (1991) basic target zone model, it is assumed that monetary authorities intervene in order to keep the exchange rate within a specific band around a central parity:

$$\underline{x} \leq x_t \leq \overline{x} \tag{6}$$

where $\underline{x}$ and $\overline{x}$ are the lower and upper edges of the exchange rate bands. From (6), the fundamental indicator is restricted to a band that corresponds to the exchange rate band:

Figure 2:
The exchange rate-fundamental relationship under the free-float case



$$\underline{f} \leq f_t \leq \overline{f} \tag{7}$$

where the lower and upper edges of the fundamental band satisfy $\underline{x} = x(\underline{f})$ and $\overline{x} = x(\overline{f})$.

In order to derive the exchange rate function (3) for the target zone case, and assuming that interventions in the exchange rate market are marginal, the expected exchange rate depreciation term in (1) can be derived using Ito's lemma. This results in a second-order differential equation for the exchange rate as a function of the fundamentals, with general solution as follows:

$$x_t = \gamma\mu + f_t + A_1 e^{\lambda_1 f_t} + A_2 e^{\lambda_2 f_t} \tag{8}$$

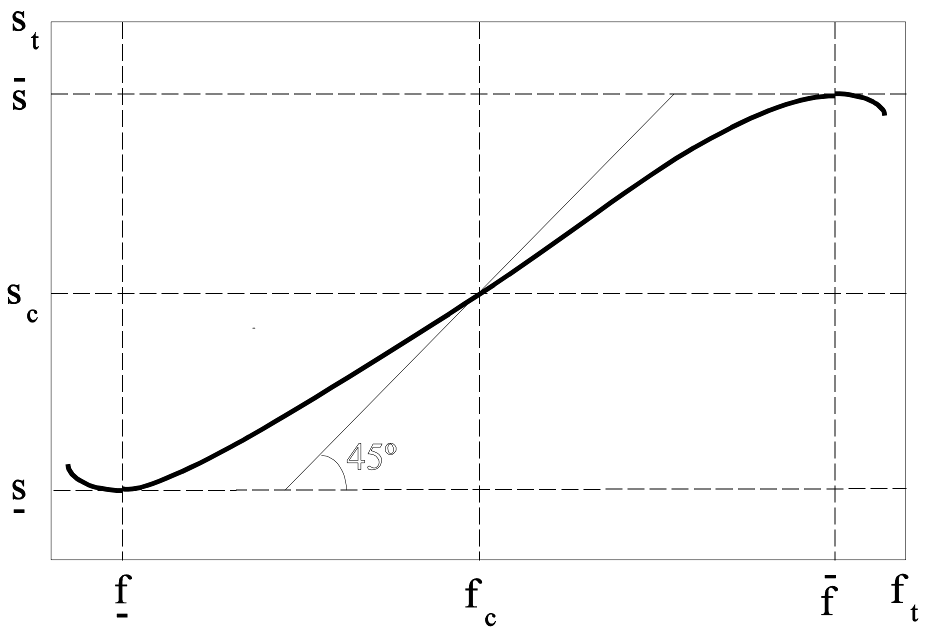
where $\lambda_1 > 0$ and $\lambda_2 < 0$ are the solutions of the characteristic equation

$$\lambda^2 \alpha\sigma^2 / 2 + \lambda\alpha\mu - 1 = 0 \tag{9}$$

and the constants of integration constants A_1 and A_2 being determined by the conditions that the exchange rate function $x(f)$ is flat at the edges of the fundamental band.

These boundary conditions are generally called "smooth pasting", which require that the path of x_t be tangent to the band, removing the possibility of one-way bets on the exchange rate at it approaches the boundaries. This smooth pasting property is one of the two main results of Krugman's model and implies that the exchange rate should be a non-linear function of the underlying fundamentals. The second main result is that the exchange rate function $x(f)$ looks life the S-curve in Figure 3 (again drawn for the simplest case when the drift μ is zero). Note that the exchange rate lies below the 45 degree line in the upper half of the figure and above it in the lower half. This is the so-called "honeymoon" effect: in a perfectly credible target zone, the expectations of future interventions to stabilize the exchange rates drag it towards the middle of the band, making it more stable than the underlying fundamental. Algebraically, this "bias due to the band" is represented by the exponential term in (8).

Figure 3:
The exchange rate-fundamental relationship under a perfectly credible target zone



3.1.3. A target zone with credibility problems

Unlike Krugman's model, exchange rate realignments do occur fairly frequently, as seen in Section 2. Bertola and Caballero (1992) present a simple model of discrete exchange-rate intervention that allows for stochastic realignments. In addition to the fundamentals, the (log of the) central parity c_t, which is also a stochastic variable, is included in the determination of the exchange rate. For convenience, define:

$$x_t^{'} \equiv x_t - c_t \tag{10}$$

$$f_t^{'} \equiv f_t - c_t \tag{11}$$

so that $x^{'}$ and $f^{'}$ represents, respectively, the log deviation of the exchange rate and the fundamental from central from central parity. Using these identities, equation (1) can be re-written as:

$$x_t^{'} = f_t^{'} + \gamma E[(dx_t + dc_t)/dt] \tag{12}$$

Bertola and Caballero (1992) consider it possible for the official authorities to change the central parity only when the exchange rate reaches the bands. As a consequences, the term:

$$\frac{1}{dt}E[dc_t]$$

in (12) is zero inside the band, and therefore the solution is:

$$x_t^{*} = \gamma\mu + f_t^{*} + Ae^{\lambda_1 f_t^{*}} + Ae^{\lambda_2 f_t^{*}} \tag{13}$$

where λ_1 and λ_2 depend again on the parameters α, μ and σ, and only one constant, A, is to be determined since we are assuming a symmetric band.

Using identities (10) and (11), equation (13) can also be expressed in terms of the fundamentals and the central parity:

$$x_t = \alpha\mu + f_t + Ae^{\lambda_1 (f_t - c_t)} - Ae^{\lambda_2 (f_t - c_t)} \tag{14}$$

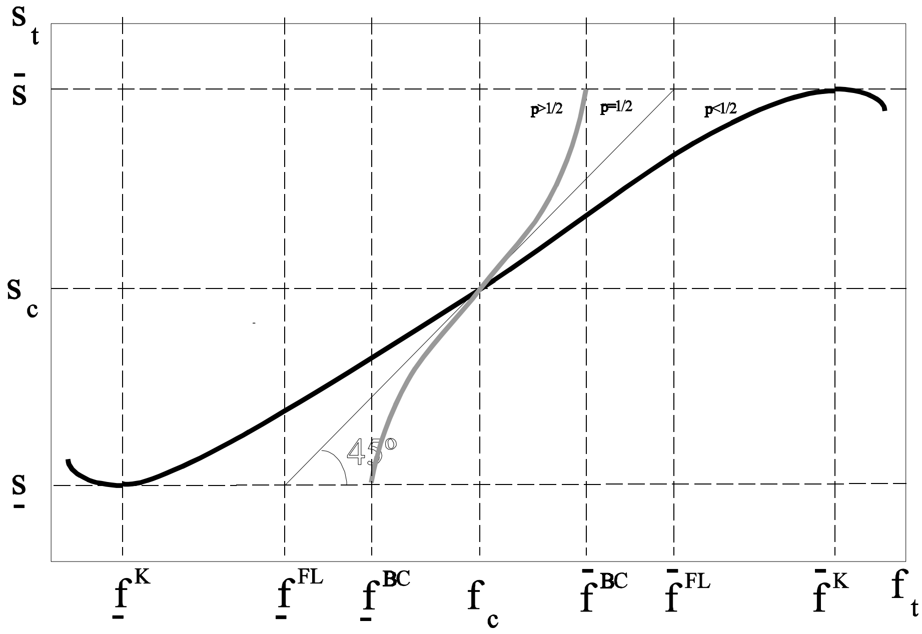
When f reaches either of the boundaries, the authorities may either intervene to bring the exchange rate back to the initial central parity (c_t) (i.e. defend the current parity) or declare a new fluctuation band $c_{t+1} = c_t \pm (\overline{x} - \underline{x})$ and unchanged width (i.e. realign the central parity). Probabilities $(1-p)$ and p are assigned respectively to these two options. As a result, depending on the value of p, the relationship between the contemporaneous exchange rate and the fundamental $[x_t = c(f_t)]$ assumes different shapes. When $0 < p < \frac{1}{2}$, the perfect credible target zone model is obtained, producing the S-shaped relationship. When $p = \frac{1}{2}$, the market evaluates as equally probable both an intervention and a realignment, the solution then coinciding with the free-floating 45 degree line. Finally, when $p > \frac{1}{2}$ expectations of future changes in the exchange rate are triggered even before the exchange rate reaches the boundaries, the $x(f)$ function being everywhere steeper than it could be under free float. Therefore, the solution locus becomes an inverted S, now the band for fundamentals being smaller than the exchange rate band (see Figure 4, drawn for the simplest case when the drift μ is zero).

3.2. The credibility issue

Credibility can be defined as the degree of confidence that economic agents assign to the announcements made by policymakers. In a 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 that the official authorities change the central parity could be anticipated by the economic agents, triggering expectations of future changes in the exchange rate that could act as a destabilising element of the system.

In this section we present four credibility measures developed in the literature. Some of them have been widely employed in empirical works, while others, like the marginal credibility indicator, have received much less attention.

Figure 4:
The exchange rate-fundamental relationship under an imperfectly credible target zone



3.2.1. 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, a more recent variant of the former is usually estimated**.**

To that end, we can calculate a 100% confidence interval for the expected rate of realignment of the exchange rate under study *vis-à-vis* the German mark, using the three-month interbank rate. Taking into account the UIP hypothesis, the expected rate of realignment is bounded according to:

$$i_t - i_t^* - (\overline{x}_t - x_t)/\tau \leq E_t\left[\Delta c_{t+\tau}\right]/\tau \leq i_t - i_t^* - (\underline{x}_t - x_t)\ /\tau \qquad (15)$$

where x_t is the deviation of the log exchange rate s_t from the log central parity c_t, $\underline{x}_t$ and $\overline{x}_t$ are the lower and upper bounds of the exchange rate bands, τ is the maturity (valued at 3/12 for a 3-month maturity), $i - i^*$ is the interest rate differential and $E\,[\bullet]$ is the expectation operator.

3.2.2. The drift-adjustment method

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

In this method, the expected rate of devaluation g^{τ}_t is obtained from:

$$g_t^{\tau} = i_t - i_t^* - E_t\left[\Delta x_{t+\tau} \middle| nr\right]/\tau \qquad (16)$$

This procedure implies estimating the expected rate of depreciation within the band in absence of realignment (*nr*) [the last term on the right-hand side of equation (16)], and then computing the expected rate of devaluation g^{τ}_t. Once g^{τ}_t has been estimated, the corresponding 90 percent confidence intervals can be calculated. These intervals can be directly compared with those of the more recent version of Svensson's simple test.

The expected rate of depreciation within the band can be estimated using a linear regression model where the exchange rate and the domestic and foreign interest rates are taken as explanatory variables:

$$\frac{x_{t+\tau} - x_t}{\tau} = \sum_j \alpha_j d_j + \beta_1 x_t + \beta_2 i_t^* + \beta_3 i_t + \varepsilon_{t+\tau} \tag{17}$$

where $x_{t+\tau}$ and x_t are the exchange rate (log) deviation from the central parity in period $t+\tau$ and t, respectively, and where i_t and i_t^* are the national 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.

3.2.3. Models of discrete choice

This kind of models aims to estimate the probability of realignment by means of econometric techniques. To that end, explanatory variables are used to compute that probability, assuming normal or logistic distributions. Among the explanatory variables, it is usual to include the interest rate differential, the inflation differential, the current account balance, and the unemployment rate, leading to estimates using monthly or quarterly data.

A logit model based on the following equation could be estimated:

$$P_t = P(y_t = 1) = \Phi(z'_t\,\delta) = \frac{e^{z_t^{'}\delta}}{1 + e^{z_t^{'}\delta}}; \qquad \mathrm{z}_\mathrm{t}^{'}\delta = \delta_1 + \delta_2 z_{1t} \tag{18}$$

where $\Phi(\bullet)$ is the logistic distribution function ($\Phi(\lambda)$ is the probability that a 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 equation (18) are estimated by maximizing the logarithm of the likelihood function with respect to individual observations:

$$LogL = \sum_{t=1}^{T} y_t \log \Phi(z'_t\,\delta) + \sum_{t=1}^{T} (1 - y_t) \log\left[1 - \Phi(z'_t\,\delta)\right] \tag{19}$$

The drift-adjustment method estimates the 90% confidence interval. If both limits of the interval were simultaneously greater than, or less than, zero, the agents would have expected realignments with 90% confidence. 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 both simultaneously greater than or less than zero. When y_t=1 this does not occur. This strategy allows us to obtain the probability that agents assign to the credibility of the exchange rate regime at each moment of time.

3.2.4. Marginal credibility

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

$$s_t - E_{t-1}\left[s_t\right] = \gamma + \alpha_t\left[c_t - E_{t-1}\left[s_t\right]\right] + u_t \qquad (20)$$

where the expectation operator is conditional on the information available in *t-1*, and u_t is a random disturbance.

Ledesma *et al.* (2003) applied these credibility indicators to weekly exchange and interest rate data from eight ERM countries (Belgium, Denmark, France, Ireland, Italy, the Netherlands, Portugal and Spain) covering the complete EMS history. Their empirical application differs from previous studies in the literature in three main respects. First, their main contribution is the use of several credibility indicators, some of which have never been applied before to all of the currencies under study. This allows them to strengthen the results obtained in this paper. Second, they analyse a longer period than that of previous studies, covering the complete EMS history. Third, they have carried out a comparison of the prediction qualities of the different indicators, in order to explore their ability to capture the main ERM events (realignments, changes in the fluctuations bands and speculative pressures).

The country-by-country analysis made by Ledesma *et al.* (2003) led them to the following main conclusions:

(i) before the currency crisis in late 1992 and for most of the countries, the exchange rate policy was credible, except for the Italian case (a similar conclusion is derived in Weber, 1991).

(ii) the 1992 currency turbulence was accompanied, in the first instance, by credibility losses in all countries, except Belgium and the Netherlands. This is consistent with the fact that the Dutch guilder and the Belgian franc, along with the Deutschmark, were the only currencies that were not affected by speculative attacks during the fall of 1992

(iii) after the widening of the fluctuation bands there was a gain in credibility for the currencies participating in the ERM, with the exception of the Belgian franc and the Irish pound. This is consistent with, and tends to confirm, the claims by both Ayuso *et al.* (1994) and Sosvilla-Rivero *et al.* (1999) that the broadening of the bands led to a decrease in volatility to levels comparable to those prevailing before the crisis.

4. CURRENCY CRISES

In the last decade, some experiences as the turbulence of the European ERM in 1992-93, the Turkish lira crises in 1994 and 2001, the collapse of the Mexican peso in 1994, the East Asian turmoil during 1997-98, the Russian currency disturbances in 1998, or the crisis of the Brazilian real in 1999, have renewed the interest in the analysis of the potential causes of currency crises. Accordingly, an extensive literature has sprung up in order to explore the underlying factors behind such phenomena. Two are the main strands of research, the so-called First and Second-Generation currency crises models.

In this section, we briefly review this literature at both theoretical and empirical level. In addition we present the main results of our recent empirical investigation about the potential causes behind the subsequent devaluation episodes within the EMS, a work that can be considered as a first attempt to reconcile the implications of these two predominant theories, often viewed as mutually excluded.

4.1. Theoretical framework

4.1.1 First Generation Models of Currency Crises

First generation literature is built on Krugman's (1979) seminal paper, whose partial-equilibrium scenario points out the incompatibility of overly expansionary policies and the indefinite maintenance of a fixed exchange rate regime. Such policies arise as a result of weak economic fundamentals and are materialised in an excess of internal credit relative to money demand growth. Then, sustaining the exchange rate parity requires the gradual reduction of foreign reserves that, following a simple arbitrage argument, leads to a speculative attack against the currency. This attack forces authorities to abandon the fixed regime, switching to a flexible exchange rate one.

Let's highlight the basic lines of the model. Consider a simple monetary economy in which the (real) demand for domestic money depends negatively on the domestic nominal interest rate (i_t):

$$\frac{M_t}{P_t} = \alpha_0 - \alpha_1 i_t \ , \quad \alpha_1 > 0 \tag{21}$$

where M_t is the nominal money demand and P_t is the domestic price level. Under capital mobility, perfect asset substitution and perfect foresight, the domestic nominal interest rate is linked to the foreign rate (i^*) - which is fixed since our focus is on an small open economy - by the interest parity condition:

$$i_t = i^* + \frac{\dot{E}_t}{E_t} \tag{22}$$

where E_t is the exchange rate, expressed as units of foreign currency per domestic currency, and $\frac{\dot{E}_t}{E_t}$ represents the expected (and actual, given the perfect foresight assumption) rate of change in the exchange rate. Domestic and foreign prices are related through Purchasing-Power Parity condition:

$$P_t = P^* E_t \tag{23}$$

in which the foreign price level (P^*) is assumed constant as long as the small open economy hypothesis holds.

Finally, the money supply is determined by two components: the domestic credit, or the stock of domestic assets owned by the central bank, and the foreign reserves:

$$M_t = C_t + \bar{E} f_t \tag{24}$$

where C_t is the domestic credit, $\bar{E}$ the fixed exchange rate and f_t represents the stock of international reserves expressed in foreign currency units.

Since the exchange rate is fixed, the central bank must intervene in the money market to make domestic monetary conditions consistent with the fixed rate. To get this goal, authorities have two instruments at their disposal: variations in C_t and/or in f_t. However models *à la* Krugman establish a restrictive premise about the evolution of the domestic credit, that is assumed to grow at an exogenous (positive) constant rate γ:

$$\frac{\dot{C}_t}{C_t} = \gamma \,,\ \gamma > 0 \tag{25}$$

Under this strong assumption, the sole instrument available to defend the exchange rate is the persistent exhaustion of the foreign reserves stock at the same rate as the domestic credit grows, given that the fixed rate implies a constant money demand:

$$\frac{\dot{f}_t}{f_t} = -\gamma \tag{26}$$

Rational investors, who hold assets in domestic currency and know the finite stock of reserves committed to defend the currency, realise that in absence of an speculative attack they will incur in a capital loss, given that reserves will continue declining through time while authorities keep their promise to convert national into foreign currency at a fixed price. Then investors launch an attack that anticipates the date at which authorities would have run out of reserves and forces them to abandon the fixed rate switching to a float one. This is the basic framework of first generation models, also named *exogenous policy* models, in which rational financial markets respond to expansionary monetary policies that, in the long run, are inconsistent with the maintenance of a fixed exchange regime.

Several papers have extended Krugman's model in several directions. Flood and Garber (1984) introduce the notion of shadow exchange rate, named the floating rate that clears the foreign exchange market in the precise time when collapse takes place. Other papers consider imperfections in the markets for goods (i.e. sticky prices) and assets (i.e. imperfect capital mobility) [see, e. g., Calvo (1987) and William (1988)], introduce uncertainty about the threshold of foreign reserves committed to defend the currency [see Otani (1989) and William (1989), among others] or regarding the domestic credit expansion [see Blanco and Garber (1986) and Dornbusch (1987)]. Finally, other contributions propose some policy prescriptions to preserve a fixed rate regime; among others the introduction of controls on short-term capital movements (see Eichengreen *et al*., 1995) or the introduction of an international lender-of-last resort to provide cash on demand under certain circumstances (see Kindleberger, 1996).

Empirically, first generation models have been extensively applied to the analyses of currency crises in developing economies, especially Latin-American countries. Blanco and Garber (1986) estimate the one-step-ahead probability of devaluation for the Mexican peso from 1973 to 1982 using quarterly data; their results show how the estimated probabilities of devaluation jumped to peak values of 20 per cent in the preceding moments of the two most important peso devaluations occurred in 1976 and 1982, respectively. The growth of the domestic credit played a central role in explaining these devaluations.

Cumby and Van Wijnbergen (1989) find similar results in their case-study of Argentina. Using monthly data from 1979 to 1981, they focus on the one-step-ahead probability of collapse; their results highlight the incompatibility between the domestic credit policy followed by the authorities and the maintenance of the crawling peg system as the major source of the peso collapse, at the beginning of 1981.

The rationale of first generation models have also been used to explain some episodes in target zones. In their study of 16 devaluations occurred in Denmark, Finland and Sweden between 1979 and 1989, Edin and Vredin (1993) estimate the one-step-ahead probability of devaluation, and its expected size (measured as the change in the central parity of the target zone) conditional on a devaluation taking place. Their empirical model included a broad set of fundamentals: money supply, output, foreign interest rates, foreign price levels, international reserves and real exchange rates. Among them, the indicators with a higher explanatory power were money supply, output and the stock of reserves; the remaining variables were statistically insignificant in explaining the probability and the expected size of devaluations.

Ötker and Pazarbaşioğlu (1997) evaluates the role of macroeconomic fundamentals in generating episodes of speculative pressures on six currencies (e.g., Belgium, Denmark, France, Ireland, Italy and Spain) participating in the ERM, between 1979 and 1993. The observed regime changes are first estimated using a set of speculative pressures that includes short-term interest rate deviations from the anchor country (Germany), the deviation of the spot rate from the central parity and the change in official foreign reserves. The contribution of a group of variables representing the state of the economy (i.e. central banks' domestic credit, output, the short-term interest rate and price level of the anchor country and the real exchange rate) is then evaluated. The results show how episodes of speculative pressures were generally preceded of a deterioration in economic fundamentals, particularly in France, Denmark, Ireland and Spain.

A common criticism to first generation models is the overly simplistic scenario that they set out. The passive behavior of the monetary and fiscal authorities compared to the "rational" disposition of private agents is quite far from reality (Saquib (2002)). Moreover, at the empirical level, these models failed in providing an adequate explanation of the ERM crisis during 1992-93 or the Mexican collapse in 1994. These and other shortcomings moved the literature towards a new line of research.

4.1.2 Second Generation Models of Currency Crises

In a sound contribution to this emerging literature, Obstfeld (1986) showed how speculative attacks could arise even when the stance of monetary and fiscal policies was consistent, at least in the short-run, with the exchange regime. This was the pioneer work for a new generation of models that emphasized the key role played by self-fulfilling expectations in explaining currency crises.

A crucial assumption in this setting is that authorities do not fix their policy stance in a mechanical way as first generation models suggested. Instead of this, authorities adopt an optimizing behavior that takes into account agents' expectations. At the same time, agents form such expectations using conjectures about authorities' responses. This circularity opens the door to the appearance of multiple equilibria and self-fulfilling speculative attacks, even in circumstances where the economic conditions are consistent with the maintenance of a fixed rate.

As a conclusion we might say that while in first generation models rational financial markets anticipate the crises, in the second generation framework crises are provoked by markets themselves. We present a simple model by Sachs *et al.*

(1996) that highlights the main implications of these also called *endogenous-policy* models.

Let consider an small open economy with a policymaker and a private sector composed of many (atomistic) agents. As typically in this framework, the policymaker wants to minimize a quadratic loss function subject to his budget constraint:

$$\begin{cases} \underset{\{x_t,\pi_t\}}{\text{Min}}\ L = \frac{1}{2}\left(\alpha\pi_t^2 + x_t^2\right),\ \alpha > 0 \\ \text{s.t. } Rb_t = x_t + \theta\left(\pi_t - \pi_t^e\right), \theta > 0 \end{cases} \tag{27}$$

Assuming purchasing power parity and interest parity hold, π_t represent the actual rate of inflation that will coincide with the expected rate of devaluation (easily derived from equation (23) in the Krugman's setting), and x_t is the (policy determined) tax revenue; the rationale for this loss function is that policymaker dislikes inflation (or devaluation) and taxes (interpreting the preferences of the private sector).

In the resources constraint, b_t represents the real stock of net commitments of the policymaker, R the real interest rate (that should equal the world interest rate, given the small open economy assumption) and π_t^e is the given expected rate of inflation (devaluation).

Solving the problem expressed in equation (27) we obtain:

$$x_t = \frac{\lambda}{1-\lambda}\theta\pi_t \text{ and } \pi_t = \frac{1}{\theta}(1-\lambda)\left(Rb_t + \theta\pi_t^e\right), \text{ where } \lambda \equiv \frac{\alpha}{\alpha+\theta^2} < 1 \tag{28}$$

Substituting into the loss function yields:

$$L^d(b_t) = \frac{1}{2}\lambda\left(Rb_t + \theta\pi_t^e\right)^2 \tag{29}$$

where the superscript *d* stands for "devaluing".

We now turn to analyze the case when the policymaker has the pre-commitment to maintain a fixed exchange rate, what means $\pi = 0$ (i.e. actual devaluation rate equals zero).

Rewriting the original problem under this assumption yields:

$$\begin{cases} \underset{\{x_t\}}{\text{Min}} \; L = \dfrac{1}{2} x_t^2 \\ \\ \text{s.t. } Rb_t + \theta \pi_t^e = x_t \end{cases} \tag{30}$$

where the corresponding loss function is given by:

$$L_t^f(b_t) = \frac{1}{2}\left(Rb_t + \theta \pi_t^e\right)^2 \tag{31}$$

where the superscript f stands for "fixing". But in this simple setting we are not taking into account some other non-economic costs associated with the decision of devaluing. We are referring to political costs (i.e., loss of pride, voter disapproval, maybe even removal from office) that the empirical evidence have shown not negligible. For simplicity we will model such cots using an exogenous (fixed) amount $c > 0$.

The policymaker will find optimal to devalue if $L^d(b_t, \pi_t^e) + c < L^f(b_t, \pi_t^e)$, what using equations (29) and (31) becomes:

$$Rb_t + \theta \pi_t^e > k \text{, where } k \equiv (1-\lambda)^{-1/2}(2c)^{1/2} > 0 \tag{32}$$

This is the central equation in the Sachs' model; it summarizes the possible set of equilibria that may arise from the interaction between the policymaker's actions and the agents' expectations. According to this condition a devaluation will take place whenever the stock of debt or expectations of devaluation are too high. But a natural question is how these expectations are formed given the temptation to devalue summarized in equation (32), or posed in a similar way, what set of values for π_t^e constitute a rational expectation equilibrium given the policymaker actions. Several outcomes are possible; let analyze the two extreme cases:

i) First assume that agents set $\pi_t^e = 0$. This will be a rational expectations equilibrium only if the policymaker opt to maintain the pre-committed fixed rate, what considering the condition stated by equation (32) means:

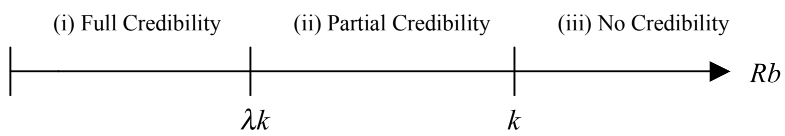
$$Rb_t \leq k \tag{33}$$

ii) Now assume perfect foresight holds (i.e. the size of expected and actual devaluation concur), then from equation (28) we obtain: $\theta\pi_t = \theta\pi_t^e = \frac{1-\lambda}{\lambda} Rb_t$. Substituting this expression into (32) yields:

$$Rb_t > \lambda k \tag{34}$$

These two conditions, depicted in Figure 5, are very useful to determine the set of plausible equilibria. As can be seen, the different levels of debt give rise to the partition of the state space in three different regions:

Figure 5: Debt levels and multiple equilibria



Full Credibility: For low levels of debt (smaller than λk) the full credible region operates, in which the only rational expectations equilibrium is not devaluing and setting expectations to zero; in fact, in this region the policymaker will opt for maintaining the fixed rate regardless of devaluation expectations.

No Credibility: For high levels of debt (larger than k) the policymaker will inevitably devalue, independently of the agents' expectations; thus the only equilibrium arise from devaluing and setting positive devaluation expectations. This is the region where the pre-committed fixed rate is not credible.

Partial Credibility: For intermediate levels of debt (larger than λk but smaller than k) two rational equilibria arise. This is the partial credibility zone where the fixed regime may survive or not depending on the probability assigned by the private sector. If agents expect a devaluation of the precise size $\pi_t^e = \frac{1}{\theta}\left[(1-\lambda)/\lambda\right] Rb_t$, then such expectations will be validated by the policymaker since defending the pre-committed rate will not be optimal (i.e. $L^d > L^f$); on the contrary, if agents expect no devaluation, no devaluation will take place since it will be optimal (i.e. $L^d < L^f$) for the policymaker to keep the fixed regime.

Summarizing these results, this model offers a very simple setting to demonstrate how self-fulfilling speculative attacks can cause the collapse of the fixed regime. It is important to note the two main implications of this model: a)

Self-fulfilling episodes do not occur at any level of economic fundamentals, represented in this setting by the the real stock of debt. Only for intermediate levels of debt, in the range of the partial credibility zone, multiple equilibria may arise; b) Devaluation expectations are self-fulfilling because they tend to validate themselves since they make it more costly for the policymaker to maintain the pre-committed fixed regime. This cannot be the case if the level of debt is too high (low), then devaluation expectations becomes irrelevant since the unique optimal option for the policymaker would be to maintain (renege) the fixed rate.

Second generation models offer an appealing scenario to explain some currency crises occurred in the mid-90s, especially the 1992-93 EMS turmoil and the crisis of the Mexican peso in 1994. Eichengreen and Wyplosz (1993) analyze the realignments within the EMS during the two-year period 1992-93. They find that the origin of the speculative pressures suffered by the participating currencies was a sudden change in the agents' expectations, prompted by the strict requirements established in the Maastricht Treaty (1992) and the gradual removal of capital controls.

Jeanne (1997) compares the role of fundamentals and speculative pressures in the case of the French franc 1992-93 crisis. He concludes that self-fulfilling speculation was at work although weak fundamentals might have prepared ground for speculation.

Agénor and Masson (1999) analyze the collapse of the Mexican peso trying to identify the factors underlying such crisis. They propose a model in which interest rate differentials and real exchange rate appreciation are used to evaluate the credibility of the policymaker in maintaining the pegged rate; estimation results indicate that prior to the peso collapse there was no significant increase in devaluation fears and no perceived shift in the authorities' policy preferences, but the increase in the interest rate differential that occurred after the devaluation may have resulted from such a shift.

On the contrary, second generation models fail to provide an adequate conceptual framework when applied to more recent episodes, mainly the East Asian 1997-98 crisis. This have prompted the arising of a new generation of models that stress the relation between financial and currency crises, treating them as "twin" phenomena. These constitute the so-called Third-Generation currency models, whose scope goes beyond our focus. For interested readers some customary references are Chang and Velasco (1998), Corsetti *et al*. (1999) and Krugman (1999).

Other promising lines of research that concentrates an increasing proportion of present literature are the analysis of contagion effects, deeply treated in Schmukler and Zoido (2003) and Rigobon (2003), and the application of the tools of microstructure finance. The latter approach permits to take into account not only relevant economic fundamentals but also market participants sentiments by incorporating both macro (interest rates, money supply, foreign reserves, etcetera) and micro variables (order flow, inventory, etcetera) [see Frankel *et al.* (1996), Evans and Lyons (1999) and Lyons (2001)].

4.2. Empirical evidence for the EMS

Maroto-Illera *et al.* (2002) depart from the previous papers by using duration analysis to examine the survival of the central parities in the ERM. They applied this approach to eight currencies participating in the ERM, using quarterly data of exchange rates *vis-á-vis* the Deustchemark for the first quarter 1979 to the fourth quarter 1998 period, covering the complete history of the EMS.

These authors make use of the two main theoretical frameworks (first- and second-generation models of currency crisis), as well as considering an eclectic model that combines features of both models. Following the empirical applications of the first generation models, they start by estimating the probability of a regimen change as a function of economic fundamentals. As domestic factors, the money supply, the current account balance, the unemployment rate, the price level, the production level, the central parity, the level of international reserves and the real exchange rate are included. As for the foreign factors, they consider the money supply, the current account balance, the price level and the production level of the anchor country. In contrast with the first generation models of currency crisis, second generation models emphasise the role of speculative proxies as potential causes of such crises. Following the empirical literature in this area, they examine the role of the following variables in explaining the probability of a regimen change: the level of international reserves, the interest rate differential with respect to Germany, a credibility measure, the share price index and the central parity deviation. Finally, in an attempt to improve the explanatory power of these two approaches, the eclectic model combine the explanatory variables suggested by both models. Given that they examine the entire ERM history (from 1979 to 1998), combining features of both approaches could be a sensible option in order to take into account the possibility of different type of crises during the eighties (perhaps more related with weak county fundamentals) and the nineties (when the beliefs of foreign exchange market participants and the policy makers' reputational capital seemed to play a major role).

In the context of a target zone, like the ERM, the analysis of the duration of the central parities is a very interesting question given the central role played by credibility, as we have seen in previous sections. If the dependence on duration is found to be positive (i.e. as time passes the probability of a change in the regime takes place increases) then economic fundamentals would have played a key role in the establishment of the exchange regimes. This view could be supported by the strict requirements imposed in the Maastricht Treaty (1992) to the potential candidates to join the Economic and Monetary Union (EMU). On the contrary, if the dependence on duration is found to be negative (i.e. as time passes the probability of a regime change decreases), then credibility would have been the relevant question considered by the authorities in determining their exchange policies.

Maroto-Illera *et al.* (2002) conclude that the probability of maintaining the current regime decreases very rapidly for the short durations (less than 4 quarters), to register then smoother variations as time increases. Therefore, for those regimes with high durations, the ERM would have been relatively stable, while for the (more common) regimes associated with short durations would have been more unstable. The probability of maintaining a certain regime is estimated to be 0.56.

Furthermore, these authors, after undertaking an exhaustive analysis to compare and validate alternative models, find that the eclectic specification would be the most appropriate to fit their data set. Their results suggest that the real exchange rate, the interest differentials and the central parity deviation would have negatively affected the duration of a given central parity, while credibility, the level of international reserves and the price level in the anchor country would have positively influenced such duration. Therefore, the empirical evidence presented in Maroto-Illera *et al.* (2002), suggesting that the sustainability of a given exchange rate regime in the ERM was affected both by fundamental variables and by investors' expectations on government behaviour, might indicate that to prevent currency crises it is not sufficient to pursue sound economic policies, but policymakers must enhance their reputational capital with respect to their commitment to maintain the exchange rate around a central parity.

5. CONCLUDING REMARKS

This paper has been devoted to the past, present, and future of the EMS. As we have seen, the EMS was launched as an attempt to foster economic integration and the co-ordination of economic policies in the EU, giving birth to a new symbolic currency (the ECU, predecessor of the euro). The centrepiece of the EMS was the ERM, an adjustable peg system with a number of interesting features. First, it was fully European (with no reference to the US Dollar or to the gold). Second, it was initially designed to be symmetric (no currency played any special role, in contrast to the US Dollar in the Bretton Woods system). Third, the responsibility for maintaining each bilateral exchange rate within its margin was explicitly shared by both countries , establishing a strong collective commitment to provide mutual support through bilateral, automatic and unlimited interventions.

We have distinguished four different subperiods in the experience of the ERM. In the first subperiod (March 1979-January 1987), the relatively large fluctuations bands in the EMS coupled with relatively small and frequent realignments, helped to reduce the size of speculative capital movements and stabilised the system. The second subperiod (January 1987-December 1991), coincided with increasing confidence in the ERM, the removal of capital controls and a greater convergence in the economic fundamentals, not registering any realignment. The third subperiod (September 1992-August 1993) was characterised by successive crises due to credibility losses in a context of policy conflict among EMS countries about how to face the severe recession experienced in 1992-93. The fourth subperiod (August 1993-December 1998) witnessed credibility gains with the enlargement of the fluctuation bands to ±15% and with the fixed exchange rate commitment among potential EMU member countries.

Following Krugman (1991), a growing theoretical literature has attempted to explain exchange rate movements inside official fluctuation bands such as those of the EMS with the help of target zone models. The basic idea is that the bands, as long as they are credible, have stabilising effects on market expectations of the future behaviour of the underlying exchange rate. Therefore, credibility becomes a key issue in examining the behaviour of the EMS, since the possibility that the official authorities change the central parity could be anticipated by the economic agents, triggering expectations of future changes in the exchange rate that could act as a destabilising element of the system.

Therefore, after revising the theoretical behaviour of an exchange rate in both a target zone with perfectly credible bands and a target zone with credibility problems, we have reviewed some empirical evidence dedicated to the analysis of the ERM credibility. Some conclusions can be drawn on this analysis of the evolution of the perception of economic agents with respect to the commitment to maintain the exchange rate around a central parity. First, before the currency crisis in late 1992 and for most of the countries, the exchange rate policy was credible, except for the Italian case. Second, the 1992 currency turbulence was accompanied, in the first instance, by credibility losses in all countries, except Belgium and the Netherlands. Finally, after the widening of the fluctuation bands there was a gain in credibility for the currencies participating in the ERM, with the exception of the Belgian franc and the Irish pound.

On the one hand, the ERM turmoil in 1992-93 renewed the interest in the analysis of the potential causes of currency crises. An extensive theoretical and empirical literature has sprung up in recent times in order to explore the underlying factors behind such phenomena. We have briefly reviewed this literature, where two are the main strands of research, the so-called first- and second-generation currency crises models. The first generation models stress the role of weak economic fundamentals, such as monetary and/or fiscal imbalances, in explaining currency crises, while the second-generation models point out that crises may arise without any noticeable change in economic fundamentals. Two crucial assumptions in these models are the introduction of nonlinearities and the reaction of government policies to changes in private behaviour. The empirical evidence examined in this paper suggest that an eclectic model that combines the explanatory variables suggested by both first- and second-generation models would be the most appropriate to fit ERM data. In particular, the real exchange rate, the interest differentials and the central parity deviation would have negatively affected the duration of a given central parity in the ERM, while credibility, the level of international reserves and the price level in the anchor country would have positively influenced such duration.

One can learn some important lessons from the experience of the EMS. First, that a regional exchange rate system constitutes a good compromise between free floating and international exchange system which is not very realistic at the moment, Second, that stable exchange rate are not sufficient to obtain better growth prospects, being the latter influenced by a host of factors (see, e. g., Blanchard *et al,*.1985) . Third, domestic monetary policy independence must be abandoned if the exchange rate is rigidly fixed. Finally, a fixing exchange rate can only work as a transitory device towards full monetary policy (see De Grauwe, 2000).

Regarding the future of the EMS, we have to remember that in 2004 ten new countries (i.e., Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia and Slovakia) will become EU members states, although this will not imply immediate membership in EMU. After a two-year derogation period, their convergence will be evaluated on the basis of the Maastricht Treaty. But, in contrast to the past experiences of United Kingdom and Denmark, these

Accession Countries (AC) will not be granted with opt-out clauses in joining the EMU. In other words, the way toward the adoption of the euro is a non-return one.

Among the four convergence criteria (i.e., price stability, sustainable fiscal position, exchange rate stability and low interest rates) that will be used in evaluating the catching-up process of these economies, the exchange rate stability[3] is perhaps the most striking one, given the crucial role that exchange regime plays in determining macroeconomic stability and investment climate.

Since the assessment of exchange rate stability includes as a mandatory the participation in the Exchange Rate Mechanism II (ERM-II) for at least two years, most of the AC are expected to join it. In fact, over the past years the euro has increasingly gained importance as the main reference currency in both the pegged and managed regimes prevailing in the AC countries: Estonia and Lithuania have a currency board pegged to the euro, while Cyprus and Hungary unilaterally shadow ERM-II (with an official announced central rate and fluctuation bands of ± 15%) .

The ERM-II is a pegged but adjustable system in which central parities are defined against the euro and not between all other participating currencies. Hence, this bilateral nature, in contrast to the multilateral one of its predecessor the ERM, is expected to reduce the frequency and the scope of interventions. Central rates and fluctuation bands are set by common agreement involving the ministers of the euro zone, the European Central Bank (ECB) and National Central Bank (NCB) governors of the AC.

The standard fluctuation band is ± 15%, while not excluding the possibility of setting a narrower band. Intervention support of the ECB to the National Central Banks (NCB) is automatic at the margins of the band (marginal interventions), any interventions within the band (intra-marginal interventions) need not be (but may be) supported by the ECB. Finally, realignments of central parity are made by the common procedure, which both the ECB and the member states have the right to initiate.

As any other fixed regime the ERM-II is expected to be "leading", strictly meaning that the design of economic policies must take into account the

[3] The EU in its documents on the fulfillment of the exchange-rate convergence criterion clearly states: "the observance of the normal fluctuations margins provided for the exchange-rate mechanism of the European Monetary System, for at least two years, without devaluing against the currency of any other Member State", *Treaty on European Union, Article 121 (1*).

maintenance of the pre-committed rate. Hence, participation in the system is expected to play a stabilizing role in AC's economies.

First of all, ERM-II will contribute to get exchange rate steadiness. "Its stabilizing role should derive from the announcement of the central parity, which should provide the markets with a lead and thereby reduce exchange rate fluctuations" (Czech National Bank, 2003, p. 5). This role must be enhanced by the ECB's intervention assistance, though in principle such support is only planned at the margins.

Moreover, arguments in favor of the ERM-II highlight its function in disciplining national authorities to pursue consistent macroeconomic policies. In particular, past experiences show the importance of price stability and sustainable public finances for maintaining a credible fixed regime.

However a carefully revision of recent episodes should warn us about some potential problems associated with the participation in a system like the ERM-II. With limited exchange rate flexibility and an environment of increasing capital mobility, the large capital inflows that will be directed towards these economies (mainly in the form of foreign direct investment) are expected to exert appreciating pressures on domestic currencies. Alarmingly, large capital inflows figured in virtually every financial crisis of the 1990s.

Other features that characterized recent crises, and that are still present in accession economies, are the basic development of their financial systems, limiting to a great extent the managing of interest rates as a defensive device, and the higher levels of inflation, pushing up real exchange rates and increasing the probability of future realignments be needed.

Finally some credibility problems may arise from the fact that central parities are subject to realignment: In the case of such transition economies involved in a catching-up process the credibility of the central rate may be eroded over time.

These and other potential shortcomings have not gone unnoticed for some of the AC. For example in the Czech Republic (one of the most likely members to join the ERM-II in the next two years), its National Bank in a brief report that analyses the exchange rate convergence criterion states: "The ERM-II has certain stabilizing potential. This potential, however, is dependent on the level of transformation of the economy, the degree of alignment of economic cycle, and on economic policy consistency. For transition economies or for countries with insufficiently consolidated structural or fiscal policies, the balance of the costs and benefits of joining the ERM-II is not necessarily clear-cut" (Czech National Bank, 2003, p. 6) . Furthermore, it is stated that "[s]taying in the ERM-II for longer than the minimum required period is not deemed desirable or beneficial to macroeconomic stability" (Czech National Bank, 2003, p. 10).

A deep look into the evolution of the ERM indicate that to prevent a currency crisis is not sufficiently to pursue sound economic policies, but policymakers must enhance their reputational capital with respect to their commitment to maintain the exchange rate around the central parity. This is a very valuable lessons that AC's authorities must not forget in their way toward formal entry into the EMU.

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