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How long can a honeymoon last?. Institutional and fundamental beliefs in the collapse of a target zone

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Abstract

The long period of stability in the EMS was followed by crises and realignments which reestablished the exchange rate equilibria. We introduce dynamics into a target zone system with divergences in the fundamentals to explain this outcome. We set up a model with heterogeneous beliefs which stresses the existence of an implicit conflict in a target zone system with divergent fundamentals and show that a nominal target zone while divergences in the fundamentals persist conveys a self-defeating mechanism: it may allow deviations from the equilibrium exchange rate in the short-run, but it is an unsustainable objective in the long-run, because the band cannot attain perfect reputation. Only if the target zone becomes instrument of convergence this fateful outcome may be avoided and IT represents the case for a successful target zone.

Keywords: Target zone, heterogeneous beliefs, collapse, convergence.
JEL Classification N.: F310,F330.

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I-INTRODUCTION

The crisis and collapse of the European Monetary System (EMS) after years of exchange rate stability, gives rise to obvious doubts regarding the suitability of the current structure of the system to move the European Union towards Monetary Union.

After the Basel-Nyborg Agreements the EMS survived for more than five years without realignments. This long period of relative calm in a context of greater financial integration has been referred to as the 'new EMS' by Giavazzi & Spaventa (1990). However, the survival of ERM's target zone while fundamentals were diverging generated large implicit misalignments in the exchange rate. The apparent currency stability in this period went hand in hand with the accumulation of deeper tensions and when these tensions eventually came to light, a series of exchange rate crises and multiple realignments followed which reestablished some sort of exchange rate equilibrium.

The main goal of this paper is to show that fixing the nominal exchange rate within a band while divergences in the fundamentals persist may allow deviatons from the equilibrium exchange rate in the short-run (the so-called honeymoon effect), but it is an unsustainable objective in the long-run. The performance of the 'new EMS' and its ultimate collapse would fit this interpretation.

The existing models of target zones can explain the first part of the story. Their main insight is that when the target zone regime is credible, economic fundamentals between two countries are able to diverge more for a given exchange rate than in a floating regime due to the effect on expectations of the existence of an institutional band limiting exchange rate fluctuations. Although there have been attempts to build target zone models which explain why a target zone loses credibility and eventually collapses in the face of speculative attacks (Krugman & Rothemberg (1990), Flood

& Garber (1991)), they are unable to endogenously generate exchange rate collapses. One reason is that the time dimension is not apparent, given the structure of the basic target zone model. Furthermore, the rational expectation hypothesis (*REH*) which underlies the solution, while being essential to obtaining a closed form solution, strongly constrains the relationship between the exchange rate and the fundamentals, limiting the role of such dynamics.

We overcome these difficulties by developing in section II a model with heterogeneous beliefs; each belief is based on a different assumed model determining exchange rates. This implies departing from the expectation formation mechanism implicit in the standard models. Nevertheless, there is still a representative agent who solves an optimization problem, such that rational behaviour is preserved; he is simply faced with two different beliefs from which to make up his expectation. This specification stresses the existence of an implicit conflict in a target zone system with diverging fundamentals. After obtaining some insights from a mathematical analysis of the model in section III, this setup allows us to generate exchange rate trajectories (section IV), incorporating a time dimension in the target zone regime. We examine the characteristics of these trajectories, which depend on the degree of divergence between the economies. The observed stability of the 'new EMS' while the fundamentals between member countries continued to diverge can then be explained; we will refer to this feature of our model as the *dynamic* honeymoon effect since it evolves over time. Although the target zone may endure periods of strain (attacks), the zone necessarily collapses, given the growing exchange rate misalignments. In the next section (V), we show that this outcome can be interpreted in terms of reputation and credibility; this perspective also highlights the reasons for the empirical failure of target zone models. Finally, section VI extends the model to admit the possibility of inflation convergence which would illustrate the case of a successful target zone and justify the benefits of joining a target zone system. Section VII sums up the conclusions.

II-A TARGET ZONE SYSTEM WITH TWO TYPES OF AGENTS

It has long been recognized that structural models incorporating rational expectations have failed to explain the evolution of exchange rates after the collapse of the Bretton-Woods system. This failure has generated a series of studies on how expectations are actually formed in the market and it has opened a vast field of theoretical research in which the strongest assumptions of the *REH* have been abandoned[1].

Agents in financial markets form their expectations under uncertainty and presumably do their best in a rational way to produce forecasts. For instance, Kurz (1991) stresses that agents may exhibit drastic differences in beliefs even when they share the same information; this does not imply at all that they are inefficient, but that after efficiently processing the information, different agents draw different conclusions, according to their rational beliefs. Kurz concludes that "scientific knowledge is limited and many different theories are compatible with the behaviour of the data. The existence of wide gaps in the knowledge of the agents about the economy results in a speculative search, which forms conjectures, hypotheses or theories and these are the main source of heterogeneity of beliefs".

This heterogeneity of beliefs can be captured informally by a model in which the market expectation is the result of aggregating the private beliefs of individuals agents. Individual agents form their expectations conditionally on their information set and according to different structural

[1]-See, for instance, Frankel & Froot (1987,1988), Allen & Taylor (1989), Goodhart (1991).This departure is always hazardous since, quoting Goldberg & Frydman (1993), "the great appeal of the Rational Expectations paradigm is that ... the implied expectations of the agents have superior theoretical properties in terms of unbiasedness and consistency...and any attempt at moving away from the *RE* framework immediately implies the presence of some degree of arbritariness and inconsistency".

models, not just THE model or view of the world implied by the *REH* . The information of the agents basically consists of the observed past data and of their knowledge about the evolving environment. Notice that none of the models which agents have in mind necessarily corresponds with the 'true' model by which the exchange rate process evolves naturally. Actually, since the effective exchange rate is influenced by market expectations, it will be driven by the dominant model in which the market believes, regardless of whether it makes economic sense or not.

2.1-Fundamental and institutional beliefs

The existence of heterogeneous beliefs naturally arises in target zones regimes since it is implicit the co-existence of two different well-established models for the determination of the exchange rate. On the one hand, there is the assumption that the exchange rate has to return to its equilibrium level determined by macroeconomic fundamentals. On the other hand, when a institutional exchange rate arrangement is established - in our case, a target-zone system such as the EMS- there exists a commitment adopted by the authorities to keep to the arrangement and this commitment to defend the parities influences the expectations of the agents. Each model generates a different type of belief, which we refer to as fundamental or institutional beliefs, respectively. The market expectation will simply be an aggregate of both beliefs' so that one of the crucial questions to settle is how this aggregation is determined. First of all, we describe the forecast which each type of belief generates.

<u>Fundamental beliefs</u> (*F*). the core hypothesis of any structural model is the assumption that the exchange rate will ultimately be consistent with the level of fundamentals so that the equilibrium exchange rate ($\bar{s}$) fulfills some specific fundamental equilibrium relationship, such as Purchasing Power Parity (*PPP*). Fundamental beliefs capture this idea: we assume the

exchange rate, s, is expected to return to the equilibrium $\bar{s}$, at an adjustment speed determined by the parameter ρ:

$$F_t\colon\ \Delta s^{F}_{t,t+1} = \rho\,(E[\bar{s}_{t+1}] - s_t) \qquad \textbf{(1)}$$

The superscript (in this case F) denotes the expected exchange rate change on the basis of the corresponding type of belief; the corresponding subscript refers to expectation at time t regarding $t+1$. When the current exchange rate is lower than the equilibrium exchange rate, it is expected to depreciate and viceversa.

Institutional beliefs (I) on the other hand, are determined by the existence of a fully credible target zone. As Krugman (1991) or Froot & Obstfeld (1991) show, the commitment of the authorities to intervene just at the margins of fluctuation to defend the band influences exchange rate expectations throughout their whole range of fluctuation.

This result is formally obtained by solving a standard monetary model with rational expectations for the exchange rate, in which the fundamentals ($\bar{s}$) follow a Brownian motion process which is regulated at the margin when a target zone is set up. The solution to this model is of the following form:

$$s = \bar{s} + \Omega(\bar{s}, s_+, s_-) \qquad \textbf{(2)}$$

where s_+ s_- are the upper and lower limits of fluctuation, respectively.The non-linear component of the solution (Ω) is obtained from solving a second order differential equation The non-linearity implies a wedge between the evolution of the fundamentals, or in our case $\bar{s}$, and the exchange rate, which delivers the so-called honeymoon effect. Figure 1 displays the results of solving this model in which the exchange rate, conditional on a free float regime, follows a brownian motion with a drift equal to 1% and a standard deviation equal to 5%. We can observe that the model establishes a mapping not only between the fundamentals and the exchange rate (upper right box), but also between the position of the exchange rate in the band and the expected exchange rate changes (lower left graph), where the size of the honeymoon effect-or non linear term- can be identified.

We are especially interested in the characteristics of this second mapping, since it determines exchange rate expectations conditional to the existence of the target zone, that is, it determines the institutional beliefs (*I*) . Writing the exchange rate in terms of deviations from the central parity (*s'*=*s*-*c*), this second mapping has the following properties:

$$I_t = \Delta s^{I}_{t,t+1} = \Omega^*[s'_t]$$
$$\forall s_- \leq s' \leq s_+ \Rightarrow \Omega^*_{s'} < 0 \qquad (3)$$

where Ω^* is a non-linear function derived from Ω. The closer the exchange rate is to the upper limit-s_+ (lower limit-s_-), the larger the appreciation (depreciation) that is expected; at the limits of fluctuation the curve is tangent to the band and expectations are determined by a non-linear function of the position of the exchange rate within the band (see lower left graph in figure 1).

It is important to note that the magnitude of the honeymoon effect is basically determined by the width of the band and the drift in the fundamentals, with no explicit consideration of time and, in this sense, the honeymoon effect is static. We will see below that on the contrary our model allows the projection of the honeymoon effect through time.

2.2-Market expectations

Given the two models which potentially enter in any individual agents beliefs, the market aggregates private beliefs to form the aggregate expectation. We assume that the market is composed by an arbitrarily large number of agents (*i=1,2,...,n*), whose individual expectations ($\Delta s^i_{t,t+1}$) are a weighted average of the expectations derived from the fundamental (F^i_t)

and the institutional (I^i_t) beliefs with weights equal to w^i_t, $1-w^i_t$, respectively. It is further assumed that the expectations derived from the two types of beliefs are homogeneous across agents ($F_t=F^i_t$; $I_t=I^i_t$, *for all* i), but each agent is assumed to assign a different weight to each belief, so that individual beliefs are heterogeneous. The market aggregate expectation is then simply the weighted average of the fundamental and institutional beliefs:

$$
\begin{gathered}
\Delta s^M_{t,t+1}=\frac{1}{n}\sum_{i=1}^{n} \Delta s^i_{t,t+1}=w_t F_t+(1-w_t)I_t; \\
\Delta s^i_{t,t+1}=w^i_t F_t+(1-w^i_t)I_t; \quad w_t=\frac{1}{n}\sum_{i=1}^{n} w^i_t \qquad (4) \\
0 \le w^i_t \le 1
\end{gathered}
$$

We can then think of the market as a representative agent which forms its own forecast as a linear combination of the forecasts generated by two different models or beliefs. This sort of specification is similar to that in Frankel & Froot (1988) in which each type of belief represents a type of agent in the market. The market aims at maximizing the yield of its investment in foreign exchange and in doing so it attempts to formulate the most accurate forecast, conditional to its knowledge of the economy (conveyed by the two models) and the information contained in the data.

Since the error variance of any linear combination of forecasts is lower than the variance of any individual forecast, the combined forecast of the models improves upon any single forecast. Consequently, the market will find it optimal to use a linear combination of forecasts (see Granger & Newbold (1986)), such as appears in (4). Therefore the problem of the market becomes one of choosing the optimal linear combination of forecasts, by selecting the weight w_t which minimizes the one-step ahead forecast errors (ξ^M_t). Subtracting (4) from the effective exchange rate change, we find the respective one-step-ahead forecast errors of the period:

$$\xi_t^M = w_t[\xi_t^F] + (1-w_t)[\xi_t^I]$$

where

$$\xi_t^M = \Delta s_{t+1} - \Delta s_{t,t+1}^M; \; \xi_t^F = \Delta s_{t+1} - F_t; \; \xi_t^I = \Delta s_{t+1} - I_t;$$

It is immediate to show that the market one-step-ahead forecast errors are minimized by obtaining the Least Square estimator of *w* from the regression:

$$Y_k = w_t X_k + u_k$$

where **(5)**

$$Y_k = \Delta s_k - I_k; \quad X_k = F_k - I_k; \quad k = 1,\ldots,t-1$$

which is equal to (4), but for the consideration of the effective exchange rate changes instead of the market forecast. The type of least squares to estimate depends however on the consideration of the past by the market. This is arbitrary up to certain extent. Nonetheless, Allen & Taylor (1989) reveal that in the foreign exchange market recent past influences more the current forecast than more distant periods. Thus, we will consider that the memory of the market is short and most recent observations carry more weight in the determination of the past so that the updated weight is obtained by computing *Discounted* Least Square (DLS) estimator:

$$\hat{w}_{t+1} = \hat{w}_t + G_t(Y_t - w_t X_t);$$

$$G_t = \frac{X_t}{\lambda[\sum_{k=1}^{t-1} \lambda^{t-1-k} X_k^2] + X_t^2} \qquad (6)$$

The estimator has been expressed in recursive form for latter convenience. The term G_t is the recursive gain (see Harvey (1981),ch.7). The parameter λ is the discounting factor; the lower λ, the more weight is carried by the most recent past and the faster expectations are updated (λ=1, in the ordinary least squares case). Thus, the optimal rule is simply a DLS updating of the parameter *w*, derived from minimizing the past forecast errors. The model which has performed better in the recent past will gain weight in the current period forecast and viceversa.

Finally, as we indicated above, structural knowledge of the economy is incomplete and the market ignores the 'true' process governing the exchange rate, which we approximate in discrete time by:

$$s_t = s_{t-1} + \theta \Delta s^M_{t,t+1} + \nu_t; \qquad \nu_t \sim N(0, \sigma_s) \tag{7}$$

This can be seen as a random walk with a drift which depends linearly on market expectations (we go into greater detail on the interpretation of the parameter θ below). This disparity between the 'true' process and the interpretation of the realizations of the process by the market provides the driving force for the model dynamics.

2.3-Divergence and conflicting expectations

Let us assume that the equilibrium exchange rate ($\bar{s}$) follows a random walk (that is the discrete time version of a Brownian motion) with drift μ, such that in each period it diverges from the central parity at an expected rate equal to μ:

$$\bar{s}_{t+1} = \bar{s}_t + \mu + \varepsilon_t; \;\; \varepsilon_t \sim N(0, \sigma_{\bar{s}}) \tag{8}$$

Recalling that the equilibrium exchange rate is given by PPP and denoting domestic and foreign prices by p and p^*, respectively, where 'foreign' can be interpreted as an average of the member countries of the zone, it follows immediately that the drift in the equilibrium exchange rate is equal to the expected inflation differential $(\pi - \pi^*)^e$ between the countries:

$$\bar{s} = p - p^* \;\Rightarrow\; \Delta\bar{s} = \Delta p - \Delta p^* = \pi - \pi^*; \qquad E[\Delta\bar{s}] = \mu = (\pi - \pi^*)^e \tag{9}$$

Therefore, we can treat the drift of the process for the equilibrium exchange rate, μ, as a measure of divergence between the economies.

Figure 2 compares the expectations generated by both models in a target zone with a 12% fluctuation band. The unit period adopted is the month, so that the plot displays monthly expectations; the exchange rate is expressed in (log) deviations from the central parity, which is set equal to one (hence, its log is equal to zero). Assuming that the equilibrium exchange rate is set equal to the central parity ($\bar{s}=c=0$), both types of belief predict that the currency depreciates when it is in the lower part of the band and that it appreciates in the upper part of the band.

What happens as fundamentals drift away from the central parity?. If we assume a positive drift, the expectation derived from the fundamental beliefs shifts upwards by a magnitude equal to the drift each period, as we can see by looking at the slashed lines in the figure 2. On the contrary, the answer is in principle ambiguous for the case of institutional beliefs, because they can be seen to be based either on the evolution of fundamentals or on the position of the exchange rate in the band; these two mappings are consistent in the static setting represented in figure 1. However, if the fundamental belief contributes to drive the exchange rate ($w>0$), the mappings become inconsistent, because the position of the exchange rate in the band will not correspond with the current level of fundamentals[2]. We assumme then that, when forming their institutional belief, agents take into account the position of the exchange rate in the band, which is immediately observable and the level of fundamentals is only used to form their fundamental belief: if the exchange rate qualitatively behaves within the band as the institutional belief implies, it

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[2]-The parameters which determine the solution to the institutionalist belief underlying model could be updated in order to reconcile both mappings. However, the dynamics of the model may be such that long deviations of the equilibrium exchange rate correspond to exchange rate equal to the central parity, and, in this case, not reasonable parameters can be found.

is reasonable to think that the expectation will be maintained, so that insititutional beliefs are static with respect to the position of the exchange rate within the band, as figure 2 displays. This is consistent with the EMS experience, where the band was expected to be maintained despite the large divergence in the fundamentals.

This being the case, the fundamental belief will eventually forecast a further depreciation of the currency even when it reaches the limit of depreciation, while the institutional belief forecasts an appreciation of the currency. Consequently, the expectations following from the different beliefs are not only heterogeneous, but also eventually conflicting; hence, one of the models must predict incorrectly. The potential for conflict cannot be ultimately avoided given the establishment of a target zone among economies with diverging fundamentals, as the EMS.

Even if the EMS parities approximately corresponded to their equilibrium exchange rate at the time they were determined, exchange rate equilibrium deviated from the central parity over time. Furthermore, the EMS has shown recurrent periods of calm which have been invariably followed by exchange rate crisis and realignments. In the light of our model, these patterns of behaviour can be interpreted as a story of underlying conflict between the two types of beliefs, where one or another belief has dominated the market at any particular moment: the endurance of EMS parities for years while fundamentals were still diverging can be thought of as periods when the institutional belief dominated the market, whereas the turbulent periods preceding the realignments of intrinsically weak currencies represent episodes when the market followed the fundamental belief. This is clearly a very simple interpretation for the evolution of the EMS, particularly when we recall the series of shocks which have led to the 1992-93 EMS crisis. These issues will be explored in our model after briefly considering the effects of interventions.

2.3-The signalling effect of interventions

When a target zone is established for an exchange rate, there is a presumed commitment to defend the band. The effect of interventions on market expectations raises the issue of the sustainability of the exchange rate commitment. We assume that the authorities only intervene at the edges of the band and that these interventions are infinitesimal[3]. Let s^* be the exchange rate for the next period if no intervention takes place, and τ the period when an intervention is necessary. Then, when the exchange rate is driven outside the (upper) band ($s_+ < s^*_\tau = s_{\tau-1} + \theta\Delta s^M_{\tau-1,\tau} + v_\tau$), a sale of reserves ($R$) will take place to keep the exchange rate at the edge of the band ($s_\tau = s_+$). For simplicity, we will assume that $\Delta R = -(s^* - s_+) < 0$. The effectiveness of this intervention can be considered from three perspectives: fundamental beliefs, institutional beliefs and the overall market expectation.

Fundamental beliefs: expressions (1) and (9) imply that interventions can affect the fundamental belief, if they are not sterilized; the monetary contraction derived from a loss of reserves could affect the price level and would consequently push down the equilibrium exchange rate, reducing the depreciation expectation arising from the fundamental belief and hence easing the pressure on the currency. Despite the appeal of introducing a more formal intervention-sterilization framework into the model, we will assume in this paper that interventions are sterilized in order to preserve its simplicity and to emphasize the role of expectations. This being the case, the authorities only intervene when it is necessary (marginal interventions) and rely completely on the signalling effect of interventions to manage the exchange rate within the band, so that fundamental beliefs are not affected.

Institutional beliefs already account for the expectation that the

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[3]-This is the assumption underlying the target zone model which determines institutionalist beliefs. It is straightforward to introduce intramarginal interventions (see Froot & Obstfeld (1991)). The result would be a higher slope of the institutionalists expectations curve.

authorities will intervene at the edge of the band when producing the forecasts. Therefore, the signalling effect of interventions is automatically incorporated into the target zone model and it generates the characteristic non-linear relationship displayed in Figure 1. Since by definition, institutional beliefs always attach perfect credibility to the band, effective interventions do not affect their expectations, either.

Market expectations are on the contrary conceivably affected by interventions and we have to devise a method so as to incorporate them into the model. Interventions may send two signals of opposite sign to the market: on the one hand, when the band is put under strain and is successfully defended, it is reasonable to think that the authorities will gain credibility (positive signal); on the other hand, interventions erode the stock of reserves of the Central Bank and the ability of the authorities to defend the band in successive periods of pressure. Furthermore, the recurrence of interventions may alert the market to the future viability of the zone and consequently about its eventual sustainability; both factors send negative signals to the market.

Thus, the question to settle is which type of belief will gain dominance when an intervention takes place. In other words, how interventions affect the dynamics of w_t, given that a net negative signal will presumably be reflected in a larger weight of the fundamental belief in the market, and viceversa. We can observe that, according to the updating mechanism of the model in (6), the *effective* exchange rate $\Delta s_\tau = s_+ - s_{\tau-1}$ should be used in the next period's estimation of the weights. This would imply taking fully into account the positive signal derived from intervention. At the other extreme, if the intervention had been dismissed by the market, an adjustment would be made as if no intervention had been carried out: $\Delta s^*_\tau = s^* - s_{\tau-1}$. The signalling effect of interventions is then easily incorporated into the model taking these two options as extreme cases, and modifying the exchange rate change which effectively enters into the updating process (Δs^{**}) in the following way:

$$\Delta s_{\tau}^{**} = \Delta s_{\tau} - \gamma_{\tau} \Delta R_{\tau} = (s_{\tau} - s_{\tau-1}) + \gamma_{\tau}(s_{\tau}^{*} - s_{\tau}) \qquad (10)$$

where $0 \leq \gamma \leq 1$ is an increasing function of the number of interventions: $\gamma = \#\Delta R - 1 / \#\Delta R + 1$. It is immediately seen that the highest positive signal is thus obtained with the first intervention, and it decreases thereafter; in the limit, the market will update as if there would have been no intervention at all. This mechanism conveys the intuition that the negative influence given by the drain of reserves eventually offsets the positive signal derived from a successful defence of the band.

III-MATHEMATICAL ANALYSIS

The aim of the model outlined is to explore the dynamics of the exchange rate in a target zone system, where the interaction between different and eventually conflicting beliefs in the market determines the evolution of the exchange rate. This section explores, as far as possible, the characteristics and restrictions of our model from a mathematical point of view and the next section relies on a simulation analysis to overcome the limitations of the mathematical approach.

Some restrictions are necessary to obtain explicit results from the mathematical analysis. In particular, we restrict the range of exchange rate fluctuation to explore to the upper part of the band ($s>c$) and to overvalued exchange rates ($\bar{s} > s$)[4]. These are not strong assumptions: on the one hand, for positive drifts, below the central parity fundamentalists drag the exchange rate towards the upper band, whereas institutional beliefs pull it towards the central parity, so that both forces are upwards and the

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[4] We also assumme in what follows that $\varepsilon=0$, i.e. the process for the fundamentals is deterministic and, unless otherwise stated, that $\nu=0$ too. Finally, $I(0)=0 < \mu$ which is only the case when the process assummed for the fundamentalist is driftless. These assumptions do not change the qualitative results of the analysis, but saves complicated notation of minor order terms.

exchange rate is expected to remain in the upper part of the band; on the other hand, if the exchange rate depreciates above its equilibrium level, both beliefs expect an appreciation. With these conditions, it follows that, for all t, $F_t>0, I_t<=0 \rightarrow X_t>0, G_t>0$.

The model can be expressed as a system of four difference equations, governing the market expectation s^M, the weight attributed to fundamental beliefs, w, the equilibrium exchange rate $\bar{s}$ and the effective exchange rate, s. The latter equation is redundant and the dynamics of $\bar{s}$ are exogenous; therefore after solving for I in equation (4) and substituting terms in (6), this can be seen as a system of two difference equations with a forced motion conveyed in (8). Only in the cases in which interventions are necessary, the mechanism which appears in equation (10) substitutes the effective exchange rate change. We can then write:

$$\Delta s^M_{t,t+1} = w_t F_t + (1-w_t) I_t \quad (4')$$

$$\Delta w_{t,t+1} = \begin{cases} G_t[(\theta-1)\Delta s^M_{t,t-1} + \nu_t], \quad \forall s_t < s_+ & (6') \\ G_t[(s_+ - s_{t-1}) + \gamma(s^* - s_{t-1}) - \frac{1}{\theta}[(s^*_t - s_{t-1}) + \nu_t]], \quad \forall s_t = s_+ & (6'') \end{cases}$$

$$\Delta \bar{s}_{t,t+1} = \mu + \varepsilon_t \quad (8')$$

From (6') we can see that, for the system to have endogenous dynamics, i.e: dynamics which do not depend on the stochastic terms, it is necessary that θ is different from one. The parameter θ can be interpreted as follows; there exists a group of agents which do not contemplate any particular model, but follows the mood of the market, represented by the market expectation (and consequently does not participate in forming such expectation). This group acts then as *positive feedback noise traders* or *imitators* who make the actual exchange rate overshoot or undershoot market forecasts. The magnitude of such noise trading is unknown by the market when forming expectations and this gap of knowledge is crucial in the generation of exchange rate dynamics. We will assume that θ is larger than one.

We can then think of the model as a system of recursive difference equations in which changes in the exchange rate imply changes in the same direction in the weights (intuitively, when the exchange rate depreciates, the fundamental belief gain weight, because the institutional belief is predicting worse). However, the contrary does not necessarily hold, see equation (13) below. This 'asymmetry', along with the forced motion component, generates the complex dynamics of the model. Nevertheless, several issues which delineate the dynamic behaviour of the model can be explored. First we study the stability of the solutions, then we obtain a sufficient condition for the collapse of the zone and finally some indicative results on the dynamics are worked out.

3.1-Solutions and stability

The recursive structure of the model implies that stationary points for *s (S)* are also stationary points for *w (W)*. We can concentrate on the solution for the weights. From (4'):

$$W = w_{t+1} = w_t = -\frac{I[s_t]}{F_t - I[s_t]} = -\frac{I[s_t]}{\rho(E(\bar{s}_{t+1}) - s_t) - I[s_t]} \qquad \textbf{\textit{(11)}}$$

The value of this solution depends basically on two factors: non-linearly on the position of the exchange rate in the band and on the equilibrium exchange value, which is in turn a function of time. The complexity of the system makes it infeasible to find a general closed form solution. Nonetheless, since the values of the weights are bounded between zero and one an important question to investigate is whether the process will converge to those points and, in this case, whether these are stable solutions. It follows immediately that $W=0$ ($\rightarrow S=c=0$) and $W=1$ ($\rightarrow S=\bar{s}$) do constitute solutions to the system. In fact, they correspond to the phase planes displayed in figure 2. The critical question is whether these solutions are stable. Taking the total differential to the expression above, where $d\bar{s}/dt=\mu;\ dt/dt=1;\ ds/dt=\nu_t$ (note that disturbances are now being considered), we obtain:

$$\frac{\partial W}{\partial T}=\frac{\partial W}{\partial \bar{s}}+\frac{\partial W}{\partial s}=A^{-1}\ I[S](\rho(\mu t-\nu_t)-I'_s(\rho(\mu t-S)) \qquad (12)$$

$$A=(\rho(\mu t-S)-I[S])^2$$

Let us now evaluate the sign of these derivatives at the solutions

$$\frac{\partial W}{\partial T}\Big|_{W=0}=-A\frac{I'_0}{\rho\mu t}\nu_t;\forall\nu_t>0\ \Rightarrow\ \frac{\partial W}{\partial T}\Big|_{W=0}>0.$$

$$\frac{\partial W}{\partial T}\Big|_{W=1}=A\frac{\rho}{I[\bar{s}]}(\mu-\nu_t);\forall\nu_t>\mu\ \Rightarrow\ \frac{\partial W}{\partial T}\Big|_{W=1}>0.$$

Therefore, when there is a positive disturbance at $W=0$ the system will follow an unstable trajectory, since the increase in w will provoke an exchange rate depreciation (if $\bar{s}>s$) and this will translate in a further increase in w, and so on. The inverse process occurs for $W=1$ when the disturbance is larger than the drift in the fundamentals.

Relaxing the assumptions used in this analysis (i.e. no disturbances in the equilibrium exchange rate, no drift implied in institutional belief) adds complexity to the above expressions but does not change the conclusion, which is that the system is potentially unstable at the extreme market beliefs.

3.2-Sustainability of the target zone and collapse condition

The second issue to explore is the potential for collapse of the target zone or, in other words, the sustainability of the band. The eventual collapse of the band is provoked by the persistence of market expectations which drive the exchange rate beyond its limit of fluctuation. The trigger for this depends on the behaviour of the system at the edges of the band. Let us retake the previous discussion on intervention and assume again that the exchange rate increases and eventually the edge of the target zone band is breached at some time τ, so that a Central Bank intervention is necessary to defend the band. From (4), next period's change in the market expectation is:

$$\Delta s^{M}_{\tau,\tau+1} = \Delta s_{\tau-1,\tau} + \Delta w_{\tau,\tau+1}\{F_{\tau} - I[s_{\tau}]\} + w_{\tau}\Delta F_{\tau,\tau+1} + (1-w_{\tau})\Delta I_{\tau,\tau+1}; \quad \textbf{(13)}$$

This expression has no definite sign. When it is negative the exchange rate returns to the band with no further intervention. However, when this expression is positive, a second consecutive intervention will be necessary to keep the exchange rate at the edge of the band. Since $\Delta F_{\tau+1} \approx 0, \Delta I_{\tau+1} = 0$ and $I_{\tau+1} = I[s_{+}]$, updating (13) for the period of the second intervention simplifies to:

$$\Delta s^{M}_{\tau+1,\tau+2} = \Delta s^{M}_{\tau,\tau+1} + \Delta w_{\tau+1,\tau+2}\{F_{\tau+1} - I[s_{+}]\} \quad \textbf{(14)}$$

The sign of this expression only depends on the change in the weight (the rest of the terms are positive). Consequently, a sufficient condition for (14) to be positive is that $\Delta w_{\tau+1,\tau+2} \geq 0$. The sign is determined from (6''): while the gain G is positive, the term in brackets may be negative. Ignoring the stochastic term, and taking into account that $s_{\tau+1} = s_{+}$, this term simplifies to $(\gamma - 1/\theta)(s^{*} - s_{+})$ so that a necessary and sufficient condition for a positive increase in the weight in the period is that $1/\theta < \gamma_{\tau+1} < 1$.

When that is the case the market will expect further depreciations. More importantly, since γ is an increasing function of the number of interventions, the above condition for increasing weights verifies thereafter ($1/\theta < \gamma_{\tau+1} < \gamma_{\tau+2} < \ldots < 1$), so that additional interventions are required for the band to be defended. Given the dynamics of the system, these new interventions drain stock of reserves but are unable to reverse the expectations of the market. At this point, the band will be perceived not to be sustainable and institutional beliefs will swiftly be abandoned, precipitating the realignment.

This sufficient condition for collapse may seem quite complicated, but actually we can restate it in a practical rule: *for* $1/\theta<\gamma_{\tau+1}<1$ *and positive misalignments* ($\bar{s}$-*s* >0) *the target zone will collapse when two consecutive interventions are necessary, i.e. when the exchange rate does not re-enter the band after one intervention*[5].

3.3-*Fixed points*

Up to this point we have shown that the system is potentially unstable and under certain circumstances, it may collapse. In this sub-section we aim at getting some understanding on the complex dynamics of the model by exploring the characteristic of the fixed points and dynamic mappings of the exchange rate (*s*) and weight (*w*).

Figure 3.a,b maps the current value on the future value of *s* and *w*, respectively, obtained from expressions (4,6). Each line represents the corresponding mapping for <u>given</u> values of *w* and *s* respectively. This analysis is merely indicative and we have made several simplifications, such as keeping the gain and the equilibrium exchange rate fixed ($\bar{s}$ =*10%* larger than the upper limit of fluctuation) and dismissing the effect of interventions on the mapping. The intersection of the lines with the 45° line

[5]-This proposition restricts the parameters of the model, especially the way that the market considers interventions (the parameter γ), but it is important to bear in mind that the band may collapse even if this condition is not fulfilled, due, in practical terms to the exhaustion of reserves. However, this would imply considering explicitly the stock of reserves; although it would be an interesting extension, it would add complexity to the model.The simple, intuitive way which market deals with intervention overcomes these complications.

represents a fixed or equilibrium point of the mapping. Observe that the different equilibrium points are stable for the mapping (s_t, s_{t+1}) , although for high values of w the equilibria are beyond the target zone. On the contrary, the equilibrium points are unstable for the mapping (w_t, w_{t+1}).

This is a partial picture of the system dynamics, since it lacks the link between both parts. As a matter of fact, the evolution of the system makes the mapping switch between curves, so that the actual mapping is obtained by joining points between different lines. We use this intuition to draw a non-collapse (*NC*) and a collapse (*C*) trajectory in the (w_t, w_{t+1}) mapping which highlights the sort of dynamics expected in the model and sums up the results obtained in this section. In principle, the non collapse trajectory differs from the collapse path only in the magnitude of the perturbation, $v^C > v^{NC}$, but the difference in the outcome is dramatic. In the latter case, the exchange rate reaches the upper limit above the 45° line and this generates an intervention spiral which causes the band to collapse.

The analysis carried out in this section has provided useful insights on the workings of the model, but it is constrained by the complexity of this non-linear dynamic system. The chaotic feature above suggests that the outcomes are dependent on the magnitude and distribution of the shocks. We turn then to a simulation analysis, in which exchange rate trajectories are generated in order to fully investigate the characteristics of the model.

IV-THE DYNAMIC HONEYMOON EFFECT

The formal evaluation of the model does not show how the honeymoon effect is projected in time. By simulating exchange rate trajectories, we intend to characterize the evolving divergence between exchange rate and fundamentals. We will also be able to demonstrate that the conflict derived from the co-existence of a target-zone and an increasing exchange rate misalignment (overvaluation) results in the eventual collapse of the zone. Since this conflict arises from the existence of divergences in the process driving the equilibrium exchange rate, the drift parameter μ becomes essential and we will analyze the outcome for different drifts in the equilibrium exchange rate process.

4.1-Exchange rate trajectories

We intend to generate exchange rate trajectories that have similar characteristics to the recent EMS experience: a pattern of quiet and turbulent periods, periodic interventions by the authorities and realignments. These features depend on the values assigned to the parameters, so they will be chosen accordingly. In the previous section, some restrictions on the parameters were suggested; furthermore, in the choice of parameters, we have applied other principles. First, the white noise terms (ν, ε) are chosen to have a low variance, such that they do not dominate the drift in the fundamentals and they introduce low *'a priori'* volatility in the exchange rate; secondly, the weights and the exchange rate should be allowed to vary widely in time, so as to generate the required features mentioned at the beginning of this paragraph[6].

The initial setting is the following: a 12% fluctuation band with respect to the exchange rate central parity c is established between two countries. The central parity is set equal to the equilibrium exchange rate at the starting period ($t=0$). We also assume that the exchange rate then fulfills its initial equilibrium condition ($s_0=c=\bar{s}_0=1$). Finally, the market is assumed to initially maintain fundamental beliefs ($w_0=1$). A positive drift

[6]-Given these considerations, we have chosen as benchmark parameters for the simulation:

$$\sigma_{\bar{s}}=0.05\mu;\ \sigma_s=0.005;\ \rho=0.5\ \theta=10;\ \lambda=0.8$$

Also note that, given the function for γ, the sufficient condition for collapse applies from the beginning.

is asummed, in other words, inflation rates have not yet converged among the countries, inducing an upward trajectory in the equilibrium exchange rate process. We take one month as unit of time so that all plots refer to monthly observations.

With these initial conditions and for the chosen parameters, exchange rate trajectories can be generated from the model, which can be seen as a data generation process (DGP). We will first consider a particular draw from this DGP to explain how the model works and then we will replicate the process one thousand times in order to infer more robust conclusions.

Figure 4.a displays a realization of the exchange rate trajectory, where the equilibrium exchange rate *($\bar{s}$)* is driven by a drift equal to 1% per year. Although the equilibrium exchange rate eventually exceeds the upper band, the target zone lasts much longer before it collapses (162 instead of 75 periods). We can see that periods of calm and turbulence alternate in the exchange rate, while the misalignment ($\bar{s}$-s) tends to widen. This trajectory can be explained by Fig 4.b. The solid line represents the relative weight given to fundamental beliefs by the market (*w*; the institutional weight is *1-w*); the slashed line and the asterisks display the evolution of fundamentalist and institutional beliefs, respectively. The relative weight assigned to each type of belief by the market evolves in time. When the market 'goes institutional' the exchange rate remains close to the central parity, but it can be seen that there are periods in which the fundamental beliefs gain strength in the market and the exchange rate depreciates.

The magnitude of such depreciation is determined by equation (4). Nevertheless, there is a remarkable feature in figure 4: the relative weight of fundamental beliefs tends to decrease, but in spite of it, the exchange rate jumps to its fluctuation limit with small increases in *w*. The resolution to this apparent paradox is the size of the misalignment *($\bar{s}$ - s)*. On the one hand, as the misalignment increases, market expectations have decreasing effects on the weight attached to fundamental beliefs; more intuitively, as fundamental beliefs depart from the actual exchange rate evolution, they tend to lose appeal in the market; on the other hand, large misalignments imply that small increases in the weight given to the fundamental beliefs can cause a large exchange rate depreciations. We will return to this point in the next section.

Actually, the conflict and interaction between both types of expectations is the critical aspect of the model. Further insight into the conflicting beliefs underlying this outcome can be obtained from Figures 4.c and 4.d, which display the expectations for both types of beliefs derived from the model with respect to the position of the exchange rate in the band. As pointed out above, while the institutional beliefs lead to an expectation which is constant relative to the position of the exchange rate in the band (Fig. 4.d), the phase plane diagram of the fundamental beliefs show the divergence in time (the line in 4.c follows an upwards spiral trajectory). Once the equilibrium exchange rate has exceeded the upper limit of fluctuation, the exchange rate may be driven above the band and an intervention is necessary[7]. The target zone finally collapses (when our collapse condition is fulfilled), and the exchange rate equilibrium is reestablished in the form of a realignment ($\bar{s}=c$).

Preliminarily, the main implication of the model can be advanced: despite the underlying potential for collapse, the realignment only takes place long time after the equilibrium exchange rate surpasses the upper band. Hence, the zone allows a wide divergence between the level of fundamentals (embedded in $\bar{s}$) and the effective exchange rate which is reflected in the exchange rate misalignment. This divergence can be seen as a dynamic variant of the honeymoon effect stressed in the target zone literature. It has two different dimensions, since it can be measured both

[7]-We define attacks as episodes of strain for the band in which interventions are necessary; each attack may last several periods. In the drawing shown in the graphs, no attack can be sustained by the target zone.

in magnitude by the size of the misalignment and duration by the time interval between the equilibrium exchange rate surpassing the band and the realignment.

2.2-Degree of divergence and collapse of the band

The timing of the collapse, given the rest of parameters, essentially depends on the magnitude of the drift. Furthermore, we have intuitively shown above that slightly different disturbances may lead to completely different outcomes. The working of the model has been explained with the help of one particular realization of the DGP, whose results cannot be readily generalized. To draw more robust conclusions, one thousand draws have been made from the DGP *(D=1000)* for a wide range of drifts ($0.2\% \leq \mu \leq 5\%$). Figure 5 and Table I summarize the results of these simulations. Plots in Figure 5 display the period of collapse histograms, for selected drifts. In the first place, it is remarkable that the distributions are not normal and become increasingly skewed to the left, suggesting again the chaotic nature of the model. Looking at the table we can see that both for the first intervention distribution (i.e. when the exchange rate reaches for the first time the upper limit of the band) and for the collapse distribution, the statistical tests reject the hypothesis of symmetry and normality for the distributions. We can also identify the existence of several peaks in the distributions, and some of them are bimodal. In these latter cases, the reason is the existence of one or more sustained attacks, which spread out the distribution and generate the possibility of large outliers on the right of the distributions; these outliers imply that, when the target zone resists more than one or two attacks, the collapse time is postponed considerably in time (see range for the collapse time in the table). Looking at the table, we can also observe that the mean of number of attacks sustained is lower than one and the mode is zero for all the drifts, although its range is wide.

These are general results derived from the simulations. Further inference regarding the effect of different drifts have to be made within the appropiate framework for hypothesis testing. The resulting non-normal distributions prevents us from using the central moments for inference. Actually, although the mean of the distributions is very close to the median (see table), the standard deviation can be misleading. Instead, having the empirical distributions, gives us the chance to make inference directly on them[8].

Figure 6.a shows the mean, median and fifth quantile of the collapse time distribution. Figure 6,b gives us an equivalent picture, but relative to the *'a priori'* collapse time (denoted by *APCT*) defined as the period in which the equilibrium exchange rate is expected to break through the band ($APCT_{\mu}=s_{+}/\mu$). This value appears in the first entry of the table. In the former figure, we can see that the collapse time period decreases with the size of the drift, as expected. From the table, we can also see that the first intervention and the mean for the number of attacks follow the same pattern. Figure 6,b tells us about the spell of the honeymoon effect, defined as the ratio between the corresponding values of the simulations (median,fifth and tenth quantiles) and the respective $APCT_{\mu}$. It suggests that the length of the period tends to decrease with higher drifts. The hypothesis of a significative spell in the honeymoon phase is also shown in the graphs (see footnote 8): the spell turns out to be significant for all the drifts, but for $\mu=4.7\%,5\%$., at a 90% significance level, and for drifts smaller than 4,5% for a significance level of 95%.

What about the magnitude of the dynamic honeymoon effect?. Given the process for the equilibrium exchange rate and the stochastic terms, we

[8]-For any null hypothesis to test, it will be rejected at, for instance, 95% significance level, if the 95% of the distribution does not comply with the hypothesis. Hence, the null hypothesis in Figure 6, H_0:*'a priori' collapse time = effective collapse time* , is tested by obtaining the fifth quantile of the collapse distribution. If that value is higher than the 'a priori' collapse time, the null hypothesis is rejected.

can derive a direct link between spell and magnitude, such that the previous inference is also valid for the magnitude[9]. The difference between this equilibrium exchange rate at the time of collapse and the upper part of the band measures the magnitude of the effect. The median values of the magnitude of the honeymoon effect appear in the last column of the table, where we can see that it decreases with the size of the drift.

V-PESO PROBLEMS, CREDIBILITY AND REPUTATION

Up to this point, we have just described the numerical results of the model. The outcome could shed some additional light on the reasons for the empirical failure of target zone models. Figure 7 shows the scatterplot of the effective exchange rate changes with respect to the position of the exchange rate in the band for the draw appearing in Figure 4. This sort of relationship (using interest rate differentials to approximate the exchange rate changes) has been widely used in the literature (see, for instance, Flood et al. (1991)) to test (and reject) the basic target-zone hypothesis. Looking at the graph, we would have difficulties not to reject the target zone hypothesis, since the co-existence of two models interacting in the foreign exchange market disturb the basic target-zone relationship.

Let us imagine, for instance, an analyst attempting to test the target zone model on a data sample generated by our model, where a realignment has not yet occurred. Let us recall that the institutional beliefs rest upon the assumption of a perfectly credible target zone. Since the curve representing institutional expectations has a negative slope, the simplest way to test the hypothesis of a credible target zone formally, albeit dismissing non-linearities, would be to estimate the regression $\Delta s_{t,t+1}=a+bs'_t+u_t$ and to test

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[9]-Substituting in the above expression the effective collapse time for $APCT_\mu$ and solving for the exchange rate (s instead of s_+), the expected equilibrium exchange rate at the collapse time is obtained.

for b having a negative sign .This test, performed on our simulated data for μ=1% rejected the hypothesis the 61% of the replications. The analyst would then explore the reasons for this rejection; following the literature (Svensson (1991), Bertola & Svensson (1993), Lindberg & Soderlin (1991), etc), he would probably point out that there exists a realignment risk implied in the expectations.

This realignment risk comes about because of the existence of two different (and conflicting) perceptions which break the theoretical relation derived from either one of the models. This result can be explained in a peso problem framework (See Lizondo (1983)). Indeed, equation (4) is equivalent to a peso problem specification, where two regimes are possible: (a) that the system prevails or (b) that a realignment comes about. To each of these events the market assigns a probability ($1-w,w$, respectively). If during the period under study there has been no realignment (that is, the event has not occurred) but that possibility affects expectations (and forward exchange rates) in the form of a realignment risk, the data will show anomalies with respect to the target zone hypothesis, and this hypothesis could be rejected. More precisely, the realignment risk is given by the divergences between market expectations and institutional beliefs : $\Delta s^M_{t,t+1}-I_t = w_t(F_t-I_t)=w_tX_t$.

Underlying the peso problem there is a problem of imperfect credibility of the target zone. The above expression has also been used by Cukierman & Metzler (1986) in a different context to define the average credibility ($AC=\Delta s^M_{t,t+1}-I_t$) of monetary announcements. The smaller AC, the higher the credibility of the announcement. The monetary announcement in our context is the target zone, so that exchange rate expectations in a perfectly credible target zone should follow the institutional beliefs. This only happens in the periods when institutional beliefs dominate the market ($w=0$) and the average credibility is zero.

Figure 8 shows w and AC. The plot suggests that the model endogenously generates dramatic changes in the credibility of the target zone. At this point, it is important to distinguish between credibility and reputation (see Weber (1990)). Reputation can be seen as a stock variable which conveys the accumulated knowledge or history about the system, and it interacts with the credibility of the system which evolves as a flow. We want now to describe this feedback in our model.

The parameter driving the credibility of the model is the weight *w*, and its dynamics are determined by equation (6'). There appears the gain G_t which contains information about the past performance of the model, in particular on the expectations generated by both beliefs in the past ($X_k=F_k-I_k$, $k=1,...,t-1$). Consequently, there may exist a link between the gain and the reputation of the system. Indeed. On the one hand, the gain is a positive term which determines the loss of credibility induced by exchange rate shocks; the larger the gain, the larger loss of credibility in the face of a shock, since $d\Delta w/dv=G(\theta-1)>0 \rightarrow AC>0$. On the other hand, if we take the derivative of the gain with respect to the exchange rate misalignment, we can show that the gain decreases with with the size of the misalignment:

$$\frac{\partial G}{\partial(\bar{s}-s)}=\frac{\rho(\lambda\Sigma-X^2)}{(\lambda\Sigma+X^2)^2}<0 \qquad \textit{(15)}$$

$$\Sigma=\sum_{k-1}^{t-1}\lambda^{t-1-k}X_k^2<X^2$$

From both results, it follows that the marginal credibility loss is reduced with the size of the gain. Now we have the elements to define a measure of reputation. We observed in the simulations that the model generates widening realignments; the fact that the target zone survives with widening realignments should strengthen the reputation of the system and this is reflected in lower marginal credibility losses, as the analytical result shows. Hence we can define the inverse of the gain G^{-1}_t as a measure of reputation, such that a small gain derived from a large misalignment is the observable measure of a high reputation[10]. The feedback between credibility and reputation can be observed in Figure 8 by noting that the increases in *w* are inversely relationed to the degree of reputation (G^{-1}_{t}). The opposite feedback can also be identified in the plot: losses in credibility erode the reputation of the system, because larger values of *w* are associated with narrowing misalignments, which, in turn, increase the value of the gain.

Several points are important to stress. Firstly, the concepts of credibility and reputation just presented are defined with respect to the relative performance of both models, such that the credibility and reputation of the target zone (with respect to the fundamental beliefs) will be high as long as the expectations are conflicting. Secondly, perfect reputation ($G_t=0$) is not feasible and consequently the danger of collapse is always present even in systems with high reputation; this means that, in the presence of large misalignments, the exchange rate may be driven outside the band, because losses in credibility, albeit small, are always possible. Finally, the results above showed that the magnitude and spell of the dynamic honeymoon effect tend to decrease with larger drifts; the reason is that large drifts make the equilibrium exchange rate diverge more rapidly, preventing the cumulation of enough reputation to postpone further the collapse time.

All in all, the exchange rate misalignment is the decisive factor for the collapse of the zone even if the system enjoys high reputation. This highlights the existence of a perverse self-defeating mechanism built in a target zone between divergent economies: the exchange rate misalignment

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[10]-This inverse relation between reputation and the value of the gain is equivalent to the interpretation given in Basar & Salmon (1989), where our concepts correspond ther to information-credibility and Kalman gain, respectively. Furthermore, deriving the gain with respect to the discounting parameter $dG/d\lambda<0$, we obtain a positive relationship between sluggishness in the adjustment of expectations (high λ) and reputation, which also confirms their results.

that the target zone permits becomes the ultimate cause for the collapse of the system. Only if the target zone becomes an instrument of convergence may this fateful outcome be avoided. We now consider this possibility.

VI-ENDOGENOUS DRIFT

Given the pessimistic conclusion regarding the fate of target zone systems when persistent divergences exist in the economies, one could reasonably wonder what are the advantages of joining a target zone regime. In the first place, one of the main appeals of a target-zone system for high inflation countries is to attain convergence in the rates of inflation with the core low inflation countries of the zone. In this section, we briefly consider the deflationary effect exerted by an overvalued currency through the trade balance, but the effect of the target zone on inflation expectations is dismissed. This latter channel has been strongly stressed by the literature, but there is little empirical evidence that it has actually existed in the EMS (see Giavazzi & Pagano (1988) on the theory and Gros & Thygesen (1992) for a summary on the empirical evidence).

Let us express the domestic price index as a weighted average of national (p_n) and foreign prices (p_n^*): $p = hp_n + (1-h)p_n^*$, where h is the relative contribution of national goods to the domestic price index, such that $(1-h)$ approximates the share of imports in GDP. If we assume that the national component of the price index adjusts for previous inflation (thus dismissing the effect of the target zone on inflation expectations), we can see that positive misalignments exert a deflationary bias on prices. Rearranging terms and substituting the equilibrium exchange rate into the equation we can write:

$$\Delta\mu_t = (h-1)[\Delta(\bar{s}_{t-1} - s_{t-1})] \qquad \textbf{\textit{(16)}}$$

which is appended to the original model. It is important to notice that an eventual collapse would wipe out all the inflation convergence; this can be checked by integrating the above expression, noting that after the realignment $\bar{s}$-s returns to zero. In any case, for a given misalignment, the higher the share of imports, the larger the deflationary effect of the exchange rate overvaluation, through the reduction in the drift. This result affects the dynamics of the model.

Figure 9 displays one draw from the (modified) DGP for different values of import shares and an initial *1%* drift, and Table II presents a summary of the results from 1000 draws. The drift decreases, as expected, due to the overvaluation which the target zone grants and this reduction bends down the trajectory of the fundamentals (fig 9 also displays the path of the fundamentals with fixed and endogenous drift) and postpones the collapse time. Table II displays the minimum values which the drift achieves for different import shares. We can observe that for values of $(1\text{-}h$ $)$ large enough *(≥8%)*, the drift may become negative; negative drifts can even be attained within the band, for values higher that *14%*[11]. This raises the possibility of non-collapse of the target zone. To sum up, we can distinguish three different outcomes: **(i)** positive drifts-collapse, **(ii)** negative drifts-collapse and **(iii)** negative drifts-non collapse.

The first case is verified for low import shares $(1\text{-}h<8\%)$ and the final outcome is simply a postponement of the realignment, as Figure 9,a shows. Case **(ii)** holds in general for the range *[8%,20%]*; for the lower values of this range, the negative drift is achieved outside the band, and the equilibrium exchange rate does not return to the band, so that it finally collapses. For values larger or equal than *14%*, the negative drift is achieved within the band, but subsequently it turns positive again (due to

[11]-This latter result can be formally obtained from the integral of (16). The maximum misalignment possible within the band, is $\bar{s}\text{-}s=s_{+}\text{-}c=s_{+}$. Therefore, solving for the import share, we can obtain the value which cancels the drift: $1\text{-}h=\mu/s_{+}$. For a drift equal to 1%, this value is 14%.

a narrowing in the misalignment) and $\bar{s}$ breaks through the band, provoking the final collapse. Finally, for parameters larger or equal than *18%*, the varying drift usually keeps the equilibrium exchange rate within the band, granting its sustainability, as can be seen from Figure 9,d. When the import share is around *20%*, two different outcomes have been obtained and that is why this value is included both in (ii) and (iii). We can observe in the table that in 82% of the draws the band collapses, as is the case in Figure 9,b.; on the contrary in the remaining 18%, the band is sustained. The reason, as fig. 9.c. shows, is that after surpassing the band, $\bar{s}$ eventually returns to it and stays.

In the table a sort of trade-off can be observed between the dynamic honeymoon effect and the share of imports: the former narrows as the import share increases (also notice that it is negative for the non-collapse cases, which represent the value around which the equilibrium exchange rate stabilizes). This somehow striking result can be explained from the reputation process. Once the equilibrium exchange rate bends down, expectations based on fundamental beliefs expectations become less inaccurate and reputation builds up more slowly; as a consequence small shocks to the exchange rate may have large effects on the credibility of the band and drive the exchange rate out of the band, provoking the collapse.

In any case, we can observe that joining a target zone can be beneficial for relatively integrated countries, when the inflation differentials converge and keep the equilibrium exchange rate within the band (case iii). This conclusion has been reached, dismissing the effect of the target zone on inflation expectations; its consideration would presumably further strengthen the case for a successful target zone.

VII-CONCLUSIONS

This paper has presented a model which makes explicit the simultaneous accumulation of both reputation and future instability. This seems to have been neglected by policy makers, who instead enjoyed the vision of a golden path to Monetary Union.

The 'new EMS' developed a high reputation during the last years, in the face of the large misalignments of the high-inflation currencies. The existing parities were credible because the market tended to hold an institutional view which was self-sustaining and avoided tensions. When diverse shocks hit the system, its credibility and the reputational gains were eroded and the market judged that the parities were unsustainable, provoking the speculative attacks that followed.

The model is designed to reproduce these features of the EMS. The main conclusion is that a target zone can indeed last for a long time despite divergences in the fundamentals (i.e. a dynamic honeymoon effect) and even endure attacks against the parities, thanks to the accumulated reputation. However, this undeniable short run success is eventually confronted with the existence of large fundamental exchange rate misalignments, <u>which are generated by the target zone itself</u>. This internal inconsistency characterizes the outcome: a honeymoon effect which vanishes abruptly. We have actually highlighted the existence of a continuous clash between backward looking expectations, which feed the credibility of the zone, and forward looking expectations which foresee the return of the exchange rate to its equilibrium level. This conflict can only be avoided or postponed if a link between both is allowed; this was done by considering the possibility of an endogenous drift, which may deliver convergence and prompt the case for an ultimately successful target zone.

All in all, this paper should be contemplated as a contribution to the current debate on the future of the European Monetary System. It subscribes to the view that a rigid target zone regime in a world of integrated financial markets faces important problems in the presence of divergences in the economies; although the system can deliver stability for a long time and even contribute to the convergence of the economies, exchange rate disequilibria are simultaneously built up and this leads to the eventual collapse of the target zone. This work is intended to highlight this perverse mechanism built into the EMS structure which eventually renders the system unstable.

In our opinion, the direct implication of this intrinsic instability is the need for a reform of the system, which renders it more in line with the behaviour of the fundamentals and, as a consequence, more stable. Even in the case when divergences are being reduced, the suitability of a realignment should be recognized . The introduction of more flexibility into the system, either in the current framework or through a reform of the system, may allow an everlasting honeymoon which culminates with the birth of a common currency.

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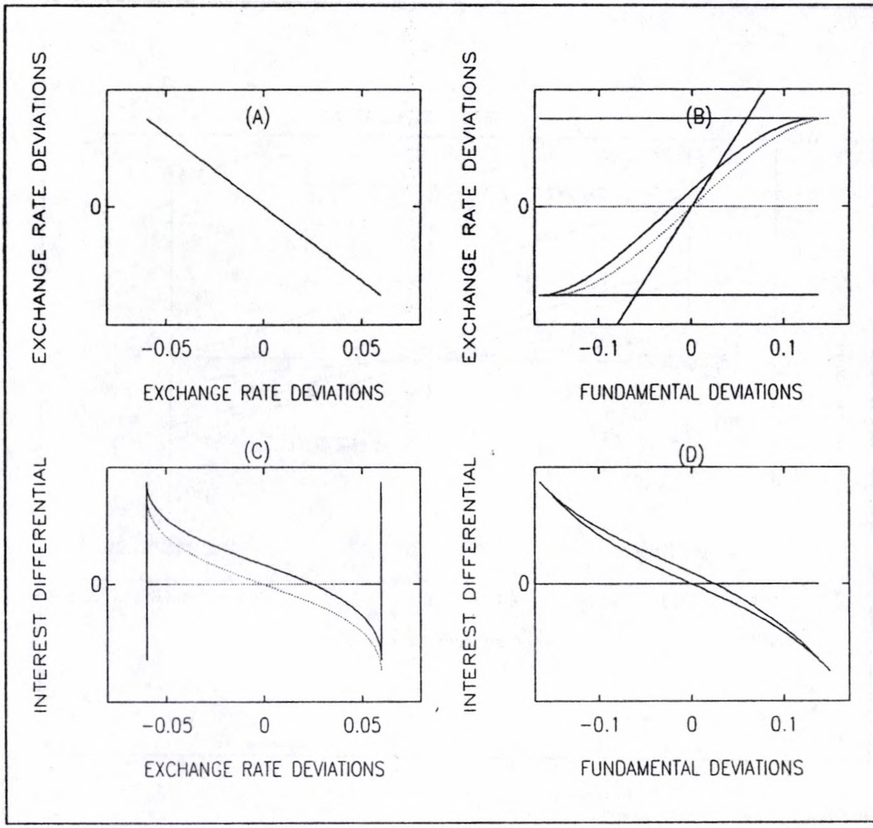


Fig.1-Relation between exchange rates, fundamentals and interest rates.

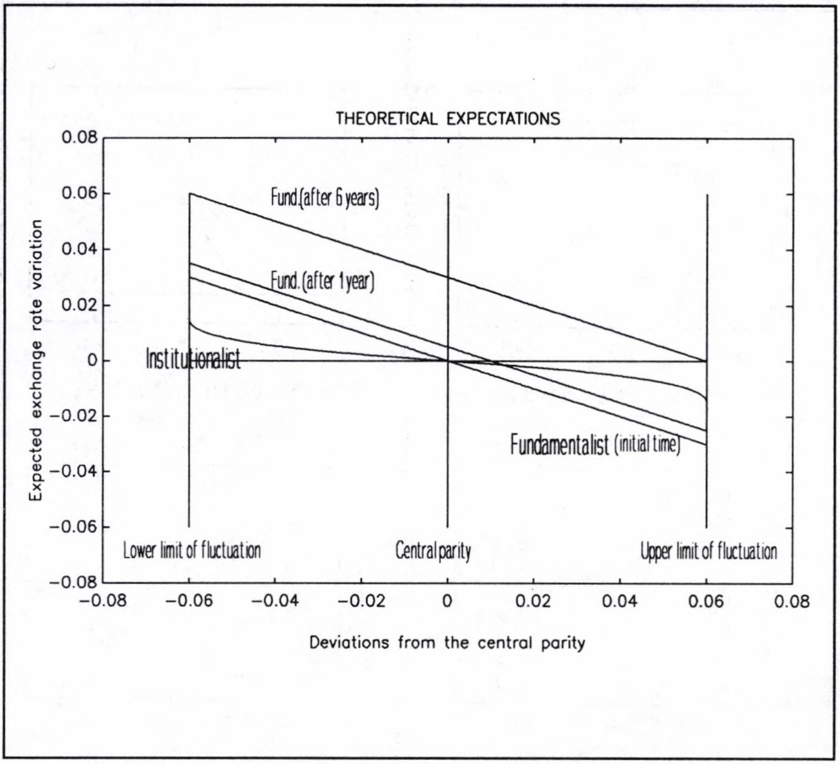


Fig 2- Exchange rate expectations: Fundamentalists and institutionalists.
Fundamentalists have linear expectations but, if there exists divergence in the fundamentals, their expectations are not constant with respect to the position of the exchange rate in the band. Institutionalists have non-linear expectations which are constant with respect to the exchange rate position within the band.

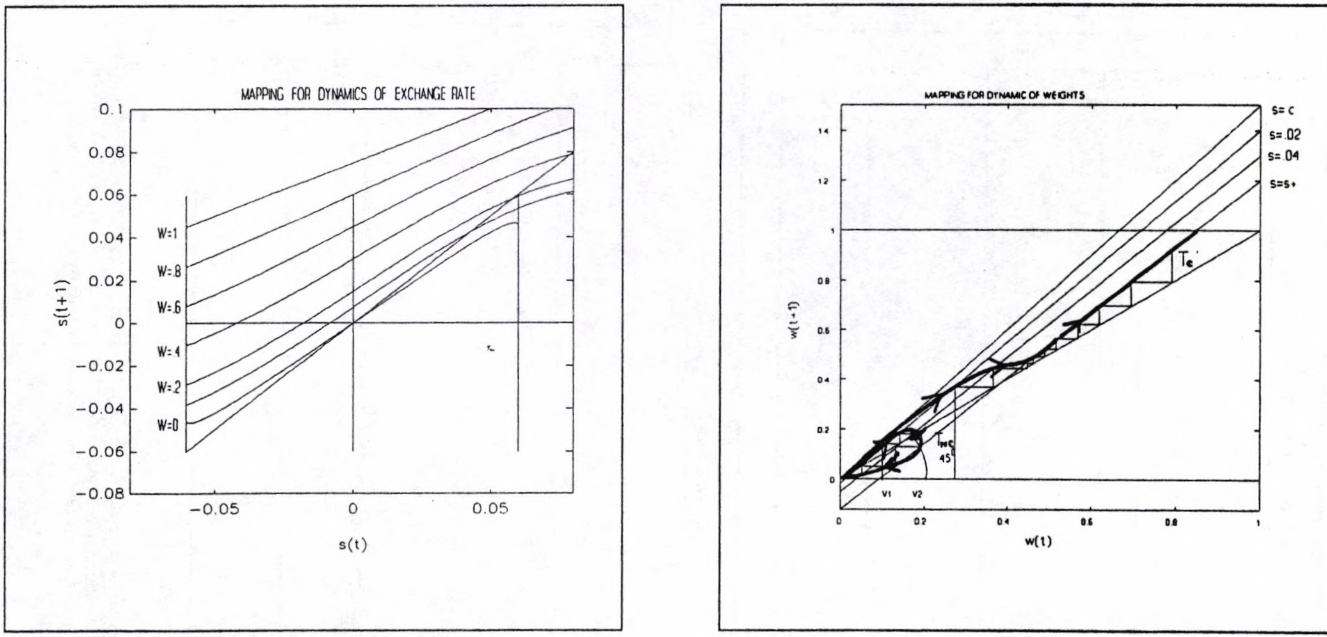
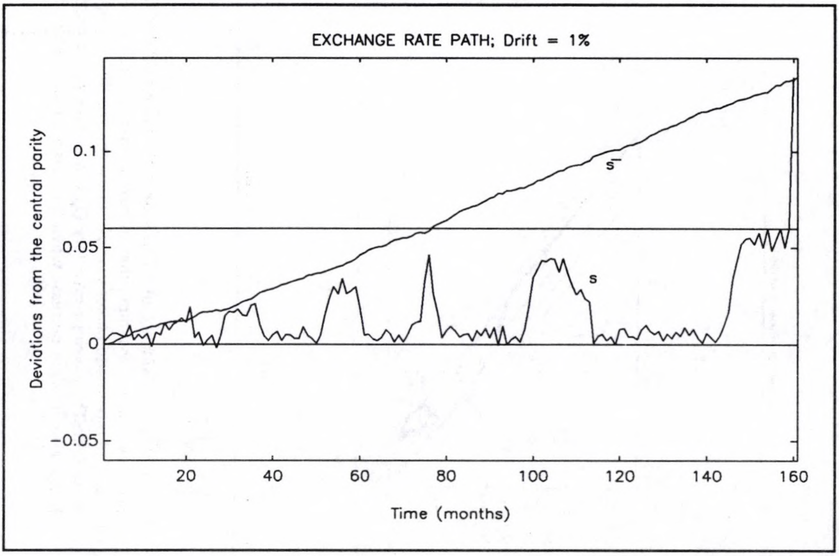


Fig 3,a,b.-Dynamic evolution of s,w, for given weights and exchange rates, respectively. In the right plot, we assumme an initial state $w_0=0$ and a perturbation at time 1 v^{NC} in the exchange rate, such that $s_1=.02$. Following the corresponding mapping, w increases, and we assumme that in next period $s_2=.04$, with the corresponding switch in the mapping and increase in w. Finally, the exchange rate reaches the band and an intervention takes place, but now the weight decreases. The inverse process follows and reductions in exchange rate are accompanied by reductions in the weight. The envelope trajectory (T_{NC}) bends back to the origin, suggesting a cyclical movement. The trajectory of collapse (T_e') displays the case in which the exchange rate does not decrease when the upper band is reached.



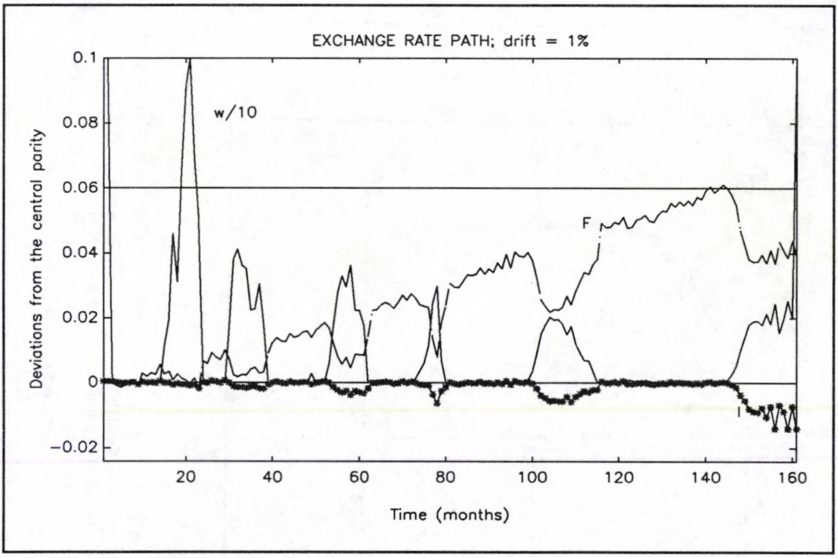


Fig 4.a,b-Exchange rate trajectories simulated by the model. The upper graphs display the trajectories of the equilibrium ($\bar{s}$) and effective (s) exchange rates. The lower graph presents the evolution of fundamental (F) and institutional (I) beliefs in that period with the trajectories of the weights.

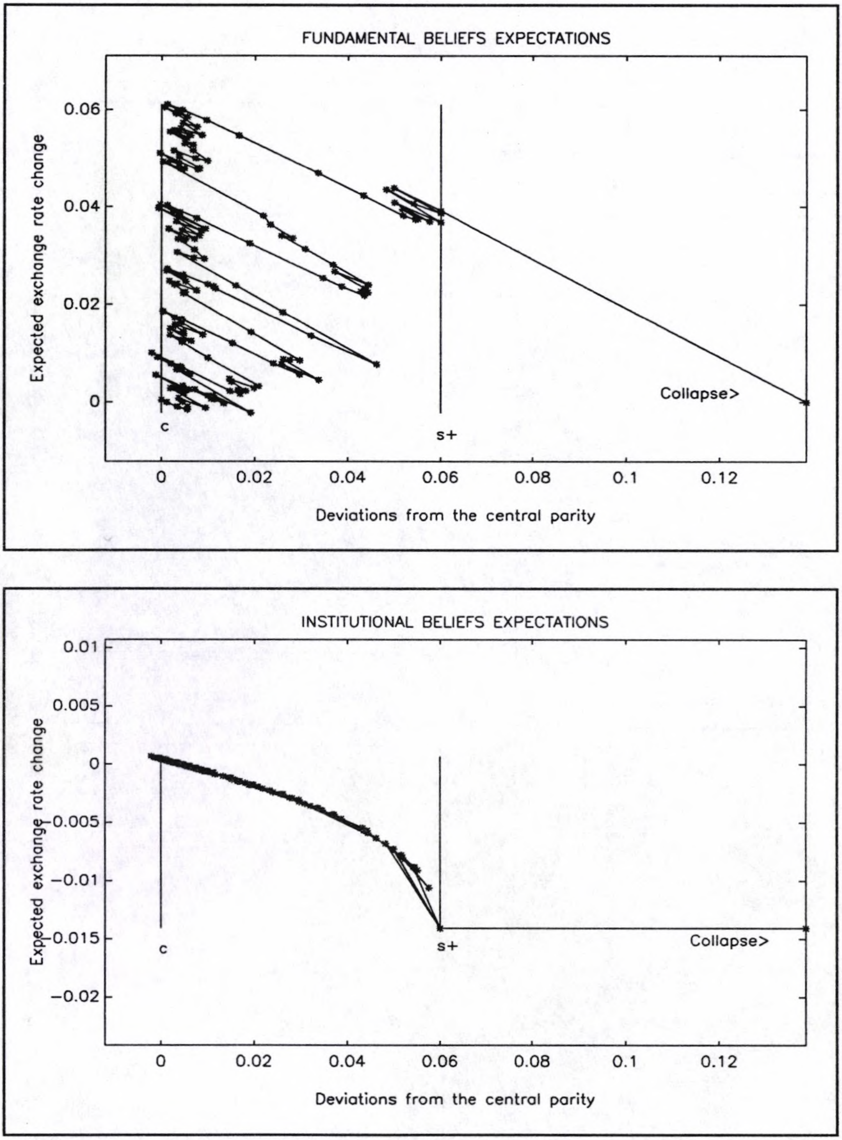


Fig 4.c,d-Exchange rate expectation with respect to the position of the exchange rate in the band

Fig.5.-Histograms of the replications for the collapse period

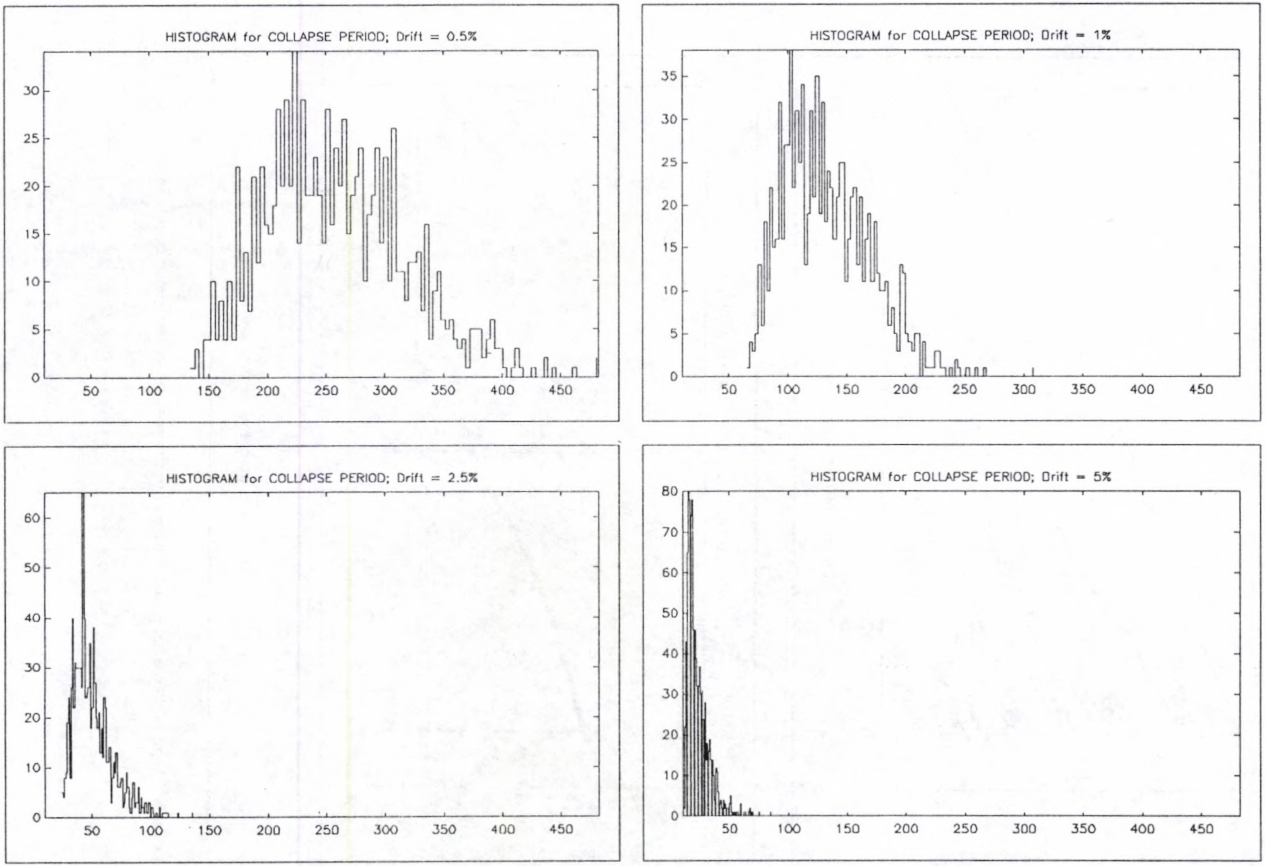


TABLE I

	APCT	ATTACKS		1st INTERVENTION					COLLAPSE TIME					DHE
μ %	$s_+\mu$	*Mean*	*Range*	*Median*	*Mean*	*Range*	*Sk.*	*Norm*	*Median*	*Mean*	*Range*	*Sk*	*No*	$(s-s_+)$
0.20	360	0.89	0-5	547	553.4	267-905	0.27	4.6	583	590.9	348-975	0.34	5.4	3.53
0.50	144	0.68	0-5	235	239.4	125-401	0.31	5.2	252	257.4	133-483	0.49	41.9	4.50
1.00	72	0.43	0-4	127	132.3	64-309	0.67	88.7	127	132.3	64-309	0.67	132.1	4.68
1.50	48	0.30	0-3	77	80.4	38-177	0.87	135.1	83	87.4	39-222	0.80	270.6	4.38
2.00	36	0.20	0-3	56	58.7	31-143	1.11	280	60	63.5	31-160	1.11	338	4.00
2.50	29	0.15	0-3	43	46.2	23-110	1.20	301.3	47	50.3	24-136	1.24	653.9	3.80
3.00	24	0.13	0-3	35	37.3	11-125	1.45	546.1	39	41.3	20-132	1.65	707.1	3.75
4.00	18	0.12	0-2	26	27.6	9-116	1.98	689.4	30	31.5	13-118	1.67	822.1	3.50
5.00	14	0.10	0-2	18	20.1	8- 79	1.65	985.1	20	22.8	10- 85	1.90	14.72	2.30

Test of skewness*. The statistic* $sk=\sigma^{-3}\ e^3/T$ *is distributed as a AN(0,6/T). Critical value at 95% is 0.1518.*
Normality*. The statistic* $no=T/6\ sk^2 + T/24\ (\sigma^{-4}\ e^4/T-3)$ *is distributed as a* χ^2_1. *Critical value at 95% is 5.99.*

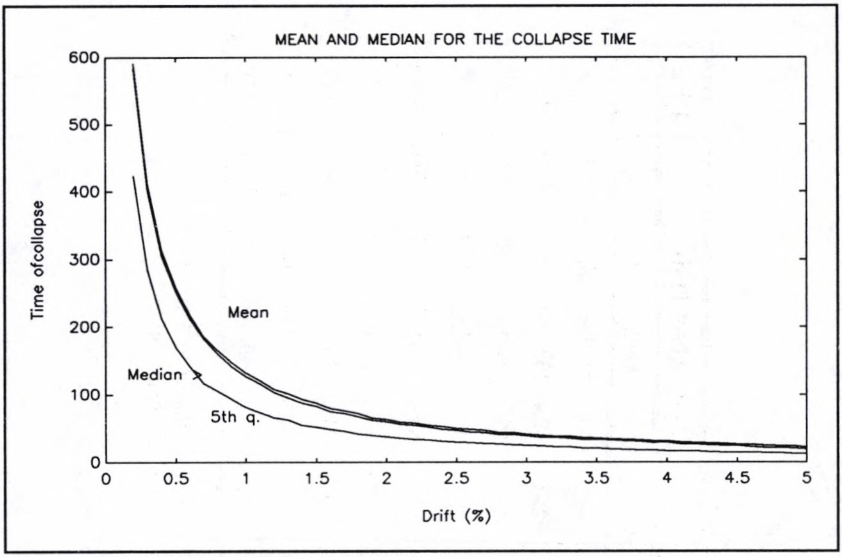


Fig 6.a-Collapse time for different drifts. The fifth quantile represents the 95% significance level

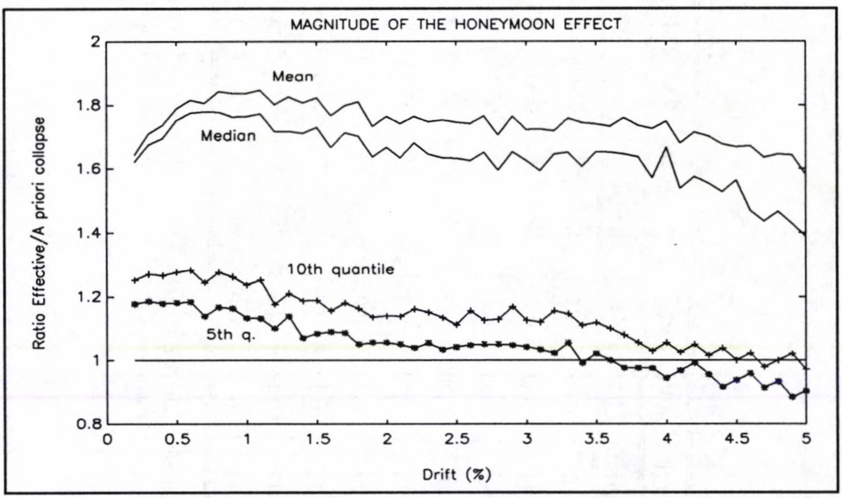


Fig 6.b-The figure shows the ratio between the respective statistics of the collapse distribution and the 'a priori' collapse time, i.e. the expected collapse when institutional beliefs play no role

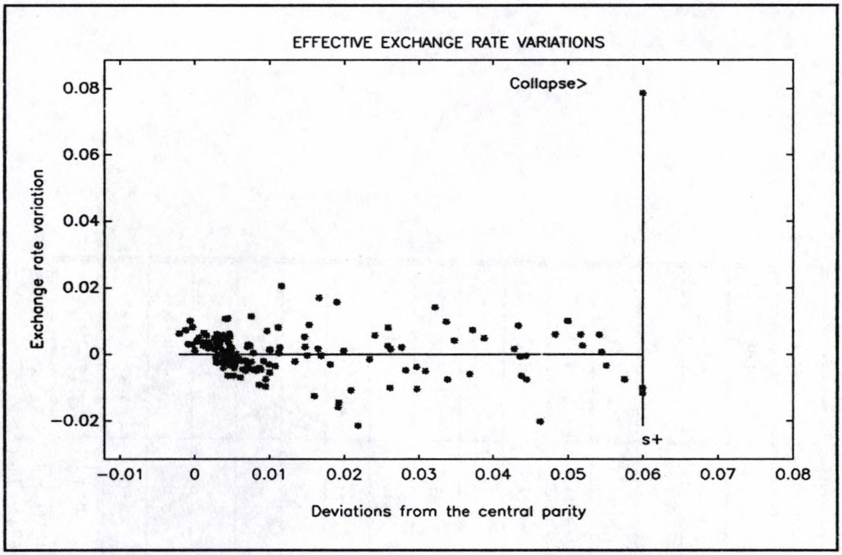


Fig 7-Position in the band and exchange rate variations for a particular realization of the process

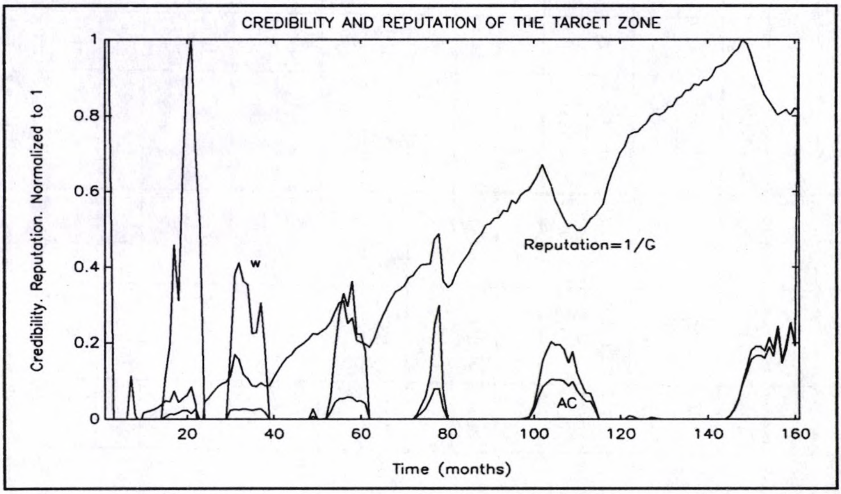


Fig 8 The figure shows the ratio between the respective statistics of the collapse distribution and the 'a priori' collapse time, i.e. the expected collapse when institutional beliefs play no role

Table II

	Collapse time			Drift value			DHE ($\bar{s}$-s_t) %
(1-h)	*number*	*median*	*range*	μ<0	*min*(μ)	*median* (μ)	*median*
0.00	100	127	64-309	-	1.00	1.00	4.68
0.01	100	133	69-299	-	0.72	0.73	4.58
0.02	100	133	68-300	-	0.64	0.66	4.52
0.03	100	141	69-323	-	0.48	0.52	4.42
0.04	100	146	66-354	-	0.38	0.39	4.37
0.05	100	151	67-443	-	0.23	0.29	4.22
0.06	100	160	74-447	-	0.11	0.20	4.15
0.08	100	171	77-577	99	-0.03	0.05	3.86
0.10	100	185	77-560	100	-0.14	-0.10	3.54
0.12	100	207	81-636	100	-0.22	-0.17	3.19
0.14	100	227	84-700	100	-0.28	-0.22	2.75
0.16	100	239	87-695	100	-0.30	-0.25	2.19
0.18	92	268*	88-698*	100	-0.46	-0.43	1.72/-0.05 *
0.20	82	249*	81-688*	100	-0.46	-0.43	1.14/-0.12 *
0.25	09	175*	86-227*	100	-0.56	-0.50	0.37/-0.46 *
0.30	03	183*	120-226*	100	-0.61	-0.54	0.13/-1.41 *

The asterisk (*) refers to the draws in which there exists collapse.
In the last row it is shown the DHE for the collapse/ non-collapse time

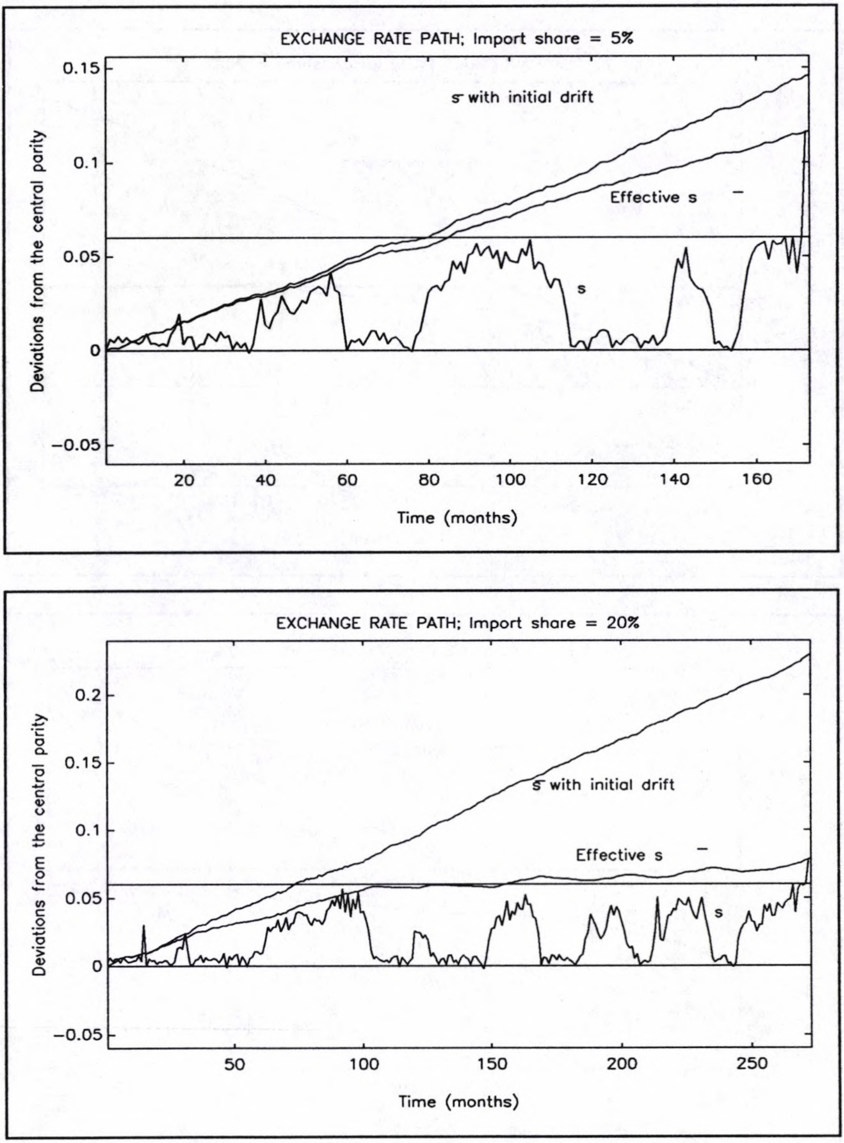


Fig 9.a,b-Exchange rate trajectories with endogenous drift. Collapse

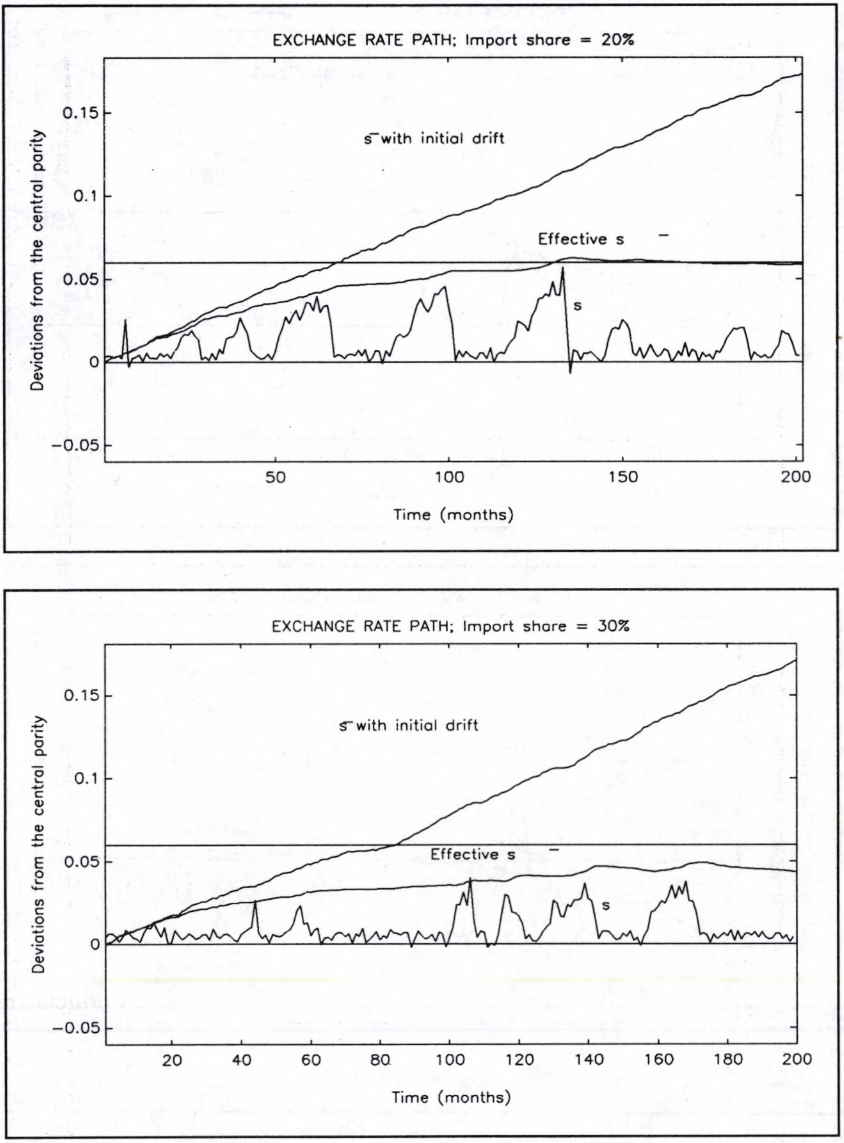


Fig 9.c,d-Exchange rate trajectories with endogenous drift. Successful cases

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