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Monetary Policy on the Road to EMU:

The Dominance of External Constraints on Domestic Objectives

V. Anton MUSCATELLI, Patrizio TIRELLI, Carmine TRECROCI *

ABSTRACT. – We estimate forward-looking interest-rate reaction functions Exchange Rate Model for four ERM countries. Reputational factors and convergence to the German inflation rate are found to be the main policy goals. We cannot detect evidence that the target zone band was exploited to implement countercyclical policies: Thus, their enthusiastic joining of EMU is not particularly surprising, as the ECB's policies are more likely to take into account their national preferences than the Bundesbank did under the ERM regime.

La politique monétaire vers l'UEM : la prépondérance des contraintes extérieures sur les objectifs intérieurs

RÉSUMÉ. – Nous évaluons les fonctions de réactions du Modèle de Taux de Change pour quatre pays du MTC. La réputation et l'ajustement au taux d'inflation allemand se révèlent être les principaux objectifs. Rien ne semble indiquer que la fourchette cible de la zone de référence ait été exploitée pour mettre en œuvre des politiques contre-cycliques. L'adhésion de ces pays à l'UEM n'est donc pas surprenante étant donné que la politique de la BCE est susceptibles de tenir compte des préférences nationales.

* V.A. MUSCATELLLI: University of Glasgow; P. TIRELLI: Università Milano-Bicocca; C. TRECROCI: Università di Brescia.

1 Introduction: The Existing Literature and Key Results

Classical target zones models (KRUGMAN [1991]) show that the central bank may exploit the bandwidth to pursue domestic objectives. In this paper we assess how monetary policies in a number of European countries (France, Italy, Belgium and Ireland) reacted to domestic conditions under the constraints imposed by ERM membership.

In retrospect, the ERM years may be seen as a prolonged period of macroeconomic convergence that eventually led to EMU. However, the transition to a new regime characterised by low inflation and disciplined fiscal policies was slow and painful. Especially in the countries considered in this paper (France, Italy, Belgium and Ireland) markets were skeptical of policymakers' ability to meet their commitments: domestic real interest rates commanded substantial risk premia and inflation expectations remained stubbornly high for a prolonged period. Furthermore, the ERM went through a number of important changes, from the early period, when it resembled a crawling peg, to the 'Hard ERM' phase, and later on to the 'wide band' arrangements that came into being after the 1992-93 crises. Thus, any attempt to model monetary policies within the ERM should be conducted on the assumption that agents gradually learned about the actual features of the exchange rate regime.

Our econometric modelling strategy is based on the estimation of forward-looking reaction functions. Basically, the reason for doing so is twofold. First, we are able to test a reaction function that is formally derived from a simple theoretical model of monetary policy design. Second, we use a Kalman filter procedure for the estimation of inflation expectations that is consistent with the hypothesis of structural change and gradual learning. Third, we investigate whether the adjustment of expectations followed institutional and regime changes, or it was rather forced by restrictive policies. Hence, we indirectly test the role of institutions in shaping expectations, a central tenet of the *Lucas critique*.

Our estimates identify a common policy pattern, based on the dominance of external constraints over domestic objectives. We also find that reputational factors, *ie*, exchange rate risk, explain the most salient features of the interest rate policies followed by these countries quite well. Moreover, those interest rate policies appear strikingly consistent throughout the sample period, despite the 1992-93 crises and the widening of exchange rate bands. Theoretical models of monetary policy design emphasise the role of institutions in shaping expectations. Popular models of the ERM under Bundesbank leadership have accepted this institutionalist view. The empirical evidence we present here is consistent with a quite different story. Actual policies, as opposed to the announcement of institutional innovations, were essential to achieve macroeconomic convergence. Furthermore, our results confirm the view that, without fiscal discipline, the reform of monetary institutions is of limited effect.

The rest of the paper is organised as follows. Section 2 outlines the benchmark theoretical model used to derive the reaction function subsequently estimated. Section 3 sets out our estimation methodology. In Section 4 we briefly examine monetary policy developments in the four countries in our sample, and comment our results. Section 5 summarizes our main conclusions in the light of the establishment of the Single Currency.

2 Interest Rate Reaction Functions and the Theory of Monetary Policy Design within the ERM

In this section, we show how a forward-looking interest rate reaction function can emerge from a simple *Barro-Gordon*-type theoretical model of monetary policy design. Consider the following model for current inflation in the presence of costly price-adjustment as in CALVO [1983], or ROTEMBERG [1983] (ROTEMBERG and WOODFORD [1999], propose a sticky-price model that has similar implications):

$$\pi_t = p_t - p_{t-1} = \beta \pi^e_{t+1} + \varphi \left(y_t - y^* \right) \tag{1}$$

where current inflation π_t depends on inflation expectations and the current output gap, and y^* is potential output. The output gap is given by:

$$y_t - y^* = -\delta \left[\left(R_t - \pi^e_{t+1} \right) - r^* \right] + \varepsilon_t \tag{2}$$

Output deviations from the natural rate depend on a supply shock ε_t, and the deviations of the ex ante real interest rate $\left(R_t - \pi^e_{t+1} \right)$ from its long-run equilibrium (where R_t is the policy instrument).

The next step requires a characterisation of both the institutional setting and the sequence of events. The government is entrusted with fiscal policy and the definition of the nominal exchange rate parity. The central bank manages the short-term interest rate to stabilise the exchange rate. The strategic interaction evolves as follows: *i)* The government announces the central parity; *ii)* Inflation expectations are formed; *iii)* An idiosyncratic shock hits the domestic economy; *iv)* The central bank sets the interest rate; *v)* At the beginning of the following period, this sequence is repeated.

We identify two distinct disturbances. The first is the demand shock defined in equation 2. For sake of tractability, we assume that this will never trigger a realignment. The second disturbance is a fiscal shock such that the central bank loses control of the price level. In line with the so-called ‘fiscal theory of price level determination’ (CANZONERI, CUMBY and DIBA [1998]; COCHRANE [2000]), we label the latter scenario as a switch to a regime of fiscal dominance (FD). In this case, a realignment always takes place. Under FD, the bank will fully accommodate. In the absence of a fiscal shock, *ie,* in a regime of central bank dominance (CBD), the bank sticks to the announced exchange rate commitment, and exploits the bandwidth to pursue domestic objectives. Given the assumed sequence of events, realignments take place at the start of each period or after a shock.

We now model the exchange rate. Standard models of target zones[1] do not account for policymakers' concern with domestic objectives. Our model departs substantially from these contributions. Our interest here is not in providing a detailed description of exchange rate dynamics within the band. Instead, we wish to highlight the trade-off faced by a policymaker who is concerned with the conflicting objectives of exchange rate stabilisation and control of domestic objectives. Therefore, we posit that shocks induce no persistence. Consequently, a standard parity condition links the nominal exchange rate to the current interest rate differential and to the expectation of future realignments. In this case, the following holds:

$$\begin{aligned} e_t &= (1-q)\left[\bar{e} - \left(R_t - F_t^G\right)\right] \\ &= \bar{e} - \left(R_t - F_t^G\right) + q\left(e^* - \bar{e}\right) \end{aligned} \tag{3}$$

where F_t^G is Germany's short term interest rate, e_t defines the (log of the) exchange rate, $\bar{e}$ represents the current central parity,[2] and e^* is the expected parity in case of realignment. Note that in equation 3 q is the probability that financial markets assign to a regime shift, and e^* defines the exchange rate parity consistent with the new FD regime.

Suppose that the monetary policy-maker's loss function is given by:

$$\begin{aligned} L_t = \chi\left(\pi_t - \pi^G\right)^2 + \left(y_t - \tilde{y}\right)^2 \\ +\rho_1\left[R_t - E\left(R_t\right)\right]^2 + \rho_2\left(e_t\right)^2 + \rho_e\left(R_t - R_{t-1}\right) \end{aligned} \tag{4}$$

The output target $\tilde{y}$ exceeds the natural level y^* (as in BARRO and GORDON, [1983]). ERM membership entails that the inflation target is given by the German inflation target,[3] π^G, and that the central bank dislikes deviations of the exchange rate from the pre-determined parity (normalised at zero). Stabilisation policy *via* interest rate changes is costly,[4] and for this reason shocks are never fully stabilised in the long run. Finally, the latter term in (4) motivates the sluggish response of the monetary policy instrument to shocks.[5]

1. See KRUGMAN [1991], MILLER and WELLER [1991], FLOOD, ROSE, and MATHIESON [1991], BERTOLA and CABALLERO [1992], DELGADO and DUMAS [1993], GARBER and SVENSSON [1995], BARTOLINI and PRATI [1999], AVESANI, GALLO and SALMON [1999]. COLES and PHILIPPOPOULOS [1997] allow for within-the-band time-inconsistency in the conduct of monetary policy, but assume that the central parity is fully credible. Moreover, to maintain analytical tractability, their analysis is essentially deterministic and neglects the role of domestic countercyclical policies.
2. Henceforth we assume, for simplicity, that the value of the parity is zero.
3. This is consistent with traditional models of the ERM. See GIAVAZZI and PAGANO [1988], and GIAVAZZI and GIOVANNINI [1989].
4. See GOODHART [1996, 1999] for some justification.
5. This assumption is widely accepted in empirical models of monetary policy. The theoretical rationale for it is discussed in CLARIDA, GALÍ and GERTLER [1999].

We assume that the central bank minimises (4) with respect to the nominal interest rate, taking expectations, and the exchange rate, as given. Observe that in our framework the credibility of the exchange rate parity entirely rests in the hands of the fiscal policymaker and is independent from central bank's actions. The impossibility for monetary policy actions to affect inflation expectations is in line with the fiscal theory of the price level and explains why the loss function (4) is static.[6]

Substituting equations 1, 2, and 3 and minimizing eq. (4), yields an interest rate reaction function of the form:

$$R_t = \theta_r r^* - \theta_{\widetilde{y}\pi^G} + \theta_\pi \pi^e_{t+1} + \theta_\varepsilon \varepsilon_t + \theta_R R_{t-1} + \theta_{e^*} e^* + \theta_F F^G_t \tag{5}$$

where,

$$\begin{aligned}
\theta_r &= \frac{\delta^2\varphi^2\chi + \delta^2 + \rho_1}{\delta^2\varphi^2\chi + \delta^2 + \rho_1 + \rho_2 + \rho_3} \\
\theta_{\widetilde{y}\pi^G} &= \frac{\delta\varphi\chi\pi^G + \delta\left(\widetilde{y} - y^*\right)}{\delta^2\varphi^2\chi + \delta^2 + \rho_1 + \rho_2 + \rho_3} \\
\theta_\pi &= \frac{(\beta + \delta\varphi)\,\delta\varphi\chi + \delta^2 + \rho_1}{\delta^2\varphi^2\chi + \delta^2 + \rho_1 + \rho_2 + \rho_3} \\
\theta_\varepsilon &= \frac{\delta\varphi^2\chi + \delta}{\delta^2\varphi^2\chi + \delta^2 + \rho_1 + \rho_2 + \rho_3} \\
\theta_R &= \frac{\rho_3}{\delta^2\varphi^2\chi + \delta^2 + \rho_1 + \rho_2 + \rho_3} \\
\theta_{e^*} &= \frac{\rho_2 q}{\delta^2\varphi^2\chi + \delta^2 + \rho_1 + \rho_2 + \rho_3} \\
\theta_F &= \frac{\rho_2}{\delta^2\varphi^2\chi + \delta^2 + \rho_1 + \rho_2 + \rho_3}
\end{aligned}$$

The model could be solved assuming full information and rational expectations for the current exchange rate, inflation, and output. Here, our focus is different, as we are concerned with learning and reputation building. We postulate that:

$$q_t = \alpha q_{t-1} + \omega_t;\ 0 < \alpha \leqslant 1,\ \omega \sim N\left(0, \sigma^2_\omega\right) \tag{6}$$

The probability of a shift to a FD regime is subject to shocks, and we assume that price setters learn about it by observing past exchange rate behaviour. Therefore, the private sector will update their inflation expectations as in a standard signal extraction problem (CUKIERMAN [1992]; MUSCATELLI [1999]).

6. GALÍ [2001] shows that, in dynamic optimising general equilibrium models, the optimal monetary rule is obtained from a static loss function when the Central Bank is unable to affect future expectations through her current actions.

3 Empirical Issues

3.1 The Context: Existing Literature

There have been a number of recent contributions to the literature on estimated interest rate reaction functions. We begin by distinguishing our study carefully from the contributions of previous authors. In general, three broadly different approaches have been used in modelling monetary policy behaviour. First, a number of researchers have used Vector Autoregressions (VARs) to estimate the way in which policy actions depend on a set of macroeconomic indicators, and how in turn policy actions are transmitted to key macro variables. BERNANKE and BLINDER [1992] use the Federal Funds rate to analyse the transmission mechanism in the US. CHRISTIANO *et al.* [1994] and BERNANKE and MIHOV [1997, 1998], *inter alia*,[7] have refined this approach by analysing alternative measures of monetary policy and identification mechanisms for the estimated VARs. Second, some researchers have focused on estimating single-equation (structural) reaction functions for monetary policy instruments (see for instance, GROENEVELD *et al.*, [1996], MUSCATELLI and TIRELLI [1996], CLARIDA and GERTLER [1997], and CLARIDA *et al.*, [1998], MUSCATELLI, TIRELLI and TRECROCI [2002]). Third, RUDEBUSCH [1995, 1998] uses data from forward-looking financial markets to construct measures of unanticipated shocks to monetary policy.

In this paper, we adopt the second of these approaches. The third approach, which uses financial market data, is less useful in detecting major changes in monetary authorities' policy behaviour and the implications of any changes for the stance of monetary policy. The VAR approach has some advantages, in that it allows one to jointly model both the endogenous policy response and the impact it has on key macroeconomic indicators. Early proponents of the approach argued that, based on a minimal number of restrictive assumptions, VAR models would identify monetary policy shocks and their transmission across policy regimes. For this reason the VAR approach appeared as the empirical complement to the *Lucas* research programme for the analysis of monetary policies. However, there is now considerable skepticism about this claim. First of all, structural analysis conducted on VAR models identify a regime-invariant transmission mechanism conditional to the assumption that only unanticipated money matters (COCHRANE [1998]). The 'New neoclassical synthesis' models (GOODFRIEND and KING [1997]), where nominal rigidities play a fundamental role and anticipated money matters, have gained growing consensus based on their ability to explain some stylised facts of the business cycle. Second, the results from VAR models do seem to depend critically on the assumptions made about which variables to include in the VAR, and on the existence of a time-invariant transmission mechanism and reaction function (see RUDEBUSCH [1998]). Given the number of variables (7 or more) one usually includes in a VAR of the transmission mechanism, and the limited

7. For an excellent survey, see CHRISTIANO *et al.* [1998] who analyse the advantages and pitfalls of the VAR approach to identifying monetary shocks.

number of observations, it becomes difficult to conduct any stability analysis by, say, using 'rolling VARs'. This is especially the case if there have been frequent changes in either the policy regime or in the financial system which might affect the timing of the policy response and the nature of the transmission mechanism.[8] Third, as noted by CHRISTIANO *et al.* [1998], the interpretation of VAR estimated coefficients in terms of policy coefficients is particularly troublesome if the actual policy rule is forward-looking. Instead, VAR models are primarily designed to construct measures of monetary policy shocks for use in analysing the transmission of monetary shocks.[9] Overall, it does seem that VARs are less useful in undertaking an empirical analysis of regime changes in the conduct of monetary policy. One possible exception to this is the use of procedures aiming at obtaining time-varying VAR coefficients. For instance, MUSCATELLI and TRECROCI [2002] follow a Bayesian approach to VAR estimation, which allows the parameters of the VAR to evolve as more observations are added. This has intuitive appeal in modelling a situation where monetary policy changes occurred, as regime changes in this area are likely to involve a gradual evolution of responses. In the context of our analysis of ERM, however, the number of endogenous variables involved makes such an attempt simply not viable.

Our focus here, as in CLARIDA and GERTLER [1997] and CLARIDA *et al.* [1998], is on single-equation (forward-looking) structural reaction functions that allow us to analyse shifts in monetary policy regimes using simple recursive estimation techniques. In this respect, CLARIDA *et al.* [1998] find that actual interest policies in France and Italy, even prior to the 'Hard ERM' phase, were markedly tighter than those implied by domestic inflation/output conditions. The models by CLARIDA *et al.* [1997, 1998] are estimated using GMM, where future inflation is taken as a measure of expected inflation and instruments are used to take account of the 'errors-in-variables' problem. The GMM method exploits the orthogonality conditions imposed by rational expectations (see HAMILTON [1999]).

One disadvantage of any estimates of rational expectations models which do not take account of possible regime changes is that the econometrician ignores the way in which economic agents reacted to the regime change (in this case in the formation of inflation expectations). By estimating their GMM model over a full sample (and across the 'soft ERM' and 'hard-ERM' regimes), CLARIDA *et al.* do not take account of potential learning effects.

We extend these earlier studies in the following ways. First, by presenting recursive estimates of these reaction functions, we can detect marked changes in the way monetary policy has been conducted over the last two decades. Second, compared to CLARIDA *et al.*, we use alternative methods to estimate our measures of expected inflation and potential output. Our estimation approach is based on a Kalman-filter procedure. Its use recognises that both the private sector and the central bank are engaged in a learning process: the private

8. Although BERNANKE and MIHOV [1998] do allow for a limited amount of time variation in their VAR model.

9. See *eg* EICHENBAUM and EVANS [1995]. Note, however, that there are contrasting views as to the robustness and usefulness of monetary policy shock measures obtained from VARs; see RUDEBUSCH [1998], BAGLIANO and FAVERO [1998] CHRISTIANO *et al.* [1998]. In the same vein, COCHRANE's [1998] criticisms of the conventional interpretation attached to monetary policy shocks have already been mentioned in the introduction.

sector is imperfectly informed about the exchange rate regime, whereas the central bank is imperfectly informed about the permanent and cyclical components of output growth[10] (see ORPHANIDES [2000]). Third, we explicitly model the link between the interest rate and a measure of exchange rate risk. Fourth, we do not take for granted, or assume, any structural break in the behaviour of the monetary authorities. For this purpose, we conduct a recursive analysis of the regression parameters. The use of structural stability tests then enables us to detect major breaks in interest rates policy. Furthermore, by analysing the relative contribution over time of additional variables, like money growth and the change in foreign exchange reserves, we evaluate to what extent the actual policy rule was consistent with the announced regime.

3.2 Modelling Strategy

We estimate reaction functions of the following type:

$$R_t = B + \sum_{i=1}^{k} \alpha_i R_{t-i} + \gamma E_t \pi_{t+j} + \lambda\,(y_t - \widetilde{y}_t) + g S_t + h F_t^G \tag{7}$$

One can estimate a forward-looking reaction function for interest rates along the lines of 8 by constructing a series for expected inflation and the expected supply shock (or equivalently the expected output gap), using an optimal updating scheme, such as the *Kalman* filter (see section 3.3 below). Expected exchange-rate realignments are also not observable, therefore one would also need a measure of exchange rate risk. In our model, a shift to a FD regime causes a speculative attack and an immediate realignment. The long-term yield spread vis-à-vis Germany,

$$S_t = LR_t - LR_t^G \tag{8}$$

should therefore capture the perceived risk of a regime shift.

In this vein, FAVERO, GIAVAZZI and SPAVENTA [1997] study the daily behaviour of the spread on the 10-year benchmark bonds of Italy, Spain, Sweden, and Germany.[11] They identify and measure three components of the spread. The first is directly related to the expectation of debt monetisation. The second is due to differences in tax regimes across countries, whereas the last one reflects the market assessment of default risk. Clearly, both the first and the third component of the spread are related to the risk of exchange rate realignments. However, there is an obvious objection to a straight use of S_t in our reaction function, *ie,* collinearity with expected inflation. In a full-information, rational-expectations world the two variables are inextricably linked. However, in our model the two variables have a different informational content. Inflation expectations are predetermined relative to the shock ε_t and to the policy actions, whereas S_t is not. Therefore, compared to inflation

10. In a sense, our use of the *Kalman* filter procedure follows *Sargent*'s suggestion that in modelling expectations one should assume that "agents behave as econometricians" (SARGENT [1993]).

11. We calculate the spread on the same category of bonds.

TABLE 1
Preliminary Regressions. France, Italy, Belgium, Ireland, 1980Q1-1997Q2

	Constant	**Coefficient**	$\mathbf{R}^2$
France	0.025 (0.003)	0.659 (0.174)	0.17
Italy	0.031 (0.004)	0.400 (0.047)	0.51
Belgium	0.007 (0.002)	0.39 (0.056)	0.41
Ireland	0.033 (0.003)	0.392 (0.104)	0.17

Results are from RLS regressions of the spread between the yields on national long-term bonds and that on analogous German Bunds on expected inflation (standard errors in parentheses).

expectations, S_t provides the central bank with useful additional information on how the market evaluates the credibility of the central parity.[12] For our purposes, we assess the additional informational content of the spread. We do so by filtering the component of the spread directly associated with expected inflation, obtaining the component of exchange rate risk that is orthogonal to (predetermined) inflation expectations. We thus perform recursive regressions of the interest spread on expected inflation for each country (see Table 1), and use the residuals from those recursive regressions (*Adjspread*) as regressors in our baseline reaction function, along with expected inflation, the output gap, and other explanatory variables.

The theory of monetary policy offers little guidance as to the definition of the optimal lag length in interest rate reaction functions. Typically we find that a lag length of $k = 1$ is usually sufficient to capture the degree of interest-rate smoothing. Having estimated the basic reaction function in 8, we then extend the information set on which our baseline reaction function is based (as in CLARIDA *et al.*, [1998]). We introduce some additional variables, like monetary aggregates and forex reserves, that were often perceived, or announced, as intermediate policy targets, or that the central bank would have tracked if it were to stick to the ERM constraint. This should not be interpreted as an attempt to introduce ad hoc variables in order to improve our estimates. To the contrary, we are trying to test whether the actual policy rule was consistent with the announced regime.

3.3 Measuring Inflation Expectations and the Output Gap

There are different methods to obtain measures of inflation expectations and the output gap.[13] CLARIDA *et al.* [1998] use a quadratic trend to obtain a measure of potential output and hence deviations of actual output from this trend and, as noted above, use actual future inflation in a GMM model.

12. This essentially captures the fact that expectations in financial markets respond more quickly to perceived policy actions and exogenous shocks compared to expectations-formation in the goods and labour markets.

13. An interesting attempt in this sense, involving EMU-wide measures of output gaps, can be found in GERLACH and SMETS [1999]. GERLACH and SCHNABEL [2000] instead perform a brief exercise aimed at estimating a *Taylor* rule for the EMU area centred on the latter part of our sample.

Turning first to the output gap, any use of a trend filter (linear or not) involves the use of full sample information, and hence implicitly assuming that the policymaker has information on the future path of output in evaluating the potential output trend. As noted above, rational expectations models (estimated using GMM or not) estimated over a full sample do not take into account gradual learning by economic agents, which might be important during regime changes (see CUTHBERTSON *et al.* [1992]).

Instead we employ the Structural Time Series (STS) approach proposed by HARVEY [1989] to generate series for the output gap and expected inflation, which are then employed in our reaction functions. There are several advantages in using this approach. The first is that it provides a useful and intuitive way of decomposing a series into trend and cyclical components, which is particularly helpful when one tries to estimate a series for an unobservable trend such as potential output. Second, the modelling approach lends itself readily to using a *Kalman* Filter estimation procedure, which allows one to proxy the learning process by policymakers and economic agents. Third, the structural time series models are parsimonious models that have reasonably rich ARIMA processes as their reduced forms.

Essentially, we estimate models for real GDP and inflation for each country, seeking to disentangle the trend, cycle and irregular components.[14] In the case of GDP, a convenient decomposition of the series was made possible by applying the *Kalman* filter on the trend component. Subsequently, the latter was computed based on one-step-ahead predictions of the state vector. This way, estimates of potential output are obtained using only past information, rather than the full sample.

In the case of inflation, we simply computed one-step-ahead prediction errors from a univariate STS model to obtain a measure of expected and unanticipated inflation. Again, the model parameters are updated only as new data is added. In both cases, the STS methodology assumes that agents make the best use of all available knowledge in a regime of imperfect information.

4 Estimating Policy Rules

Before we comment on the estimates,[15] we present a brief narrative description of institutional and policy innovations in each country. This generally

14. The STAMP 5.0 software was used to estimate the STS models. Output and inflation were found to be I(1), and to have a significant cyclical component. The estimates STS models are available on request from the authors. For a similar approach to forecasting inflation in the presence of potential structural breaks, see STOCK and WATSON [1999]. GERLACH and SMETS [1999] employ an unobservable component method to estimate the impact of changes in the output gap on short-term interest rates in an aggregate sub-sample of euro area countries.

15. We estimated interest rate reaction functions using quarterly data for each country. In each case the policy instrument has been chosen following widespread consensus in the literature on the transmission of monetary policy impulses, and in all cases but Italy coincides with the call money rate. Further details on the single series are contained in the Data Appendix. The sample chosen is 1980(1)-1997(2) for all countries.

shows that: a) the fiscal stance was a key factor in determining the credibility of the central parity; b) several modifications in the ERM rules of the game did in fact occur, de iure or de facto, and each time the private sector had to adjust to the new scenario. Finally, we provide a justification for the inclusion in our estimates of additional regressors, such as monetary aggregates that were often cited in official documents as intermediate targets for monetary policy.

During its first four years (1979-83), the ERM more closely resembled a crawling peg rather than a fixed exchange rate regime: seven realignments (out of a total of twelve) took place during these first years.[16] Over time the system evolved towards a more rigid regime, and the years between 1987 and the 1992-93 crises witnessed no adjustment at all. From 2 August 1993, the exchange rate bands were widened to ± 15.

The *Banque de France* has repeatedly argued that since late ’70s its policy had relied on two fundamental intermediate objectives: strict adherence to the ERM, and money supply growth targets (FRATIANNI and SALVATORE [1993]; OECD, [1999c]). Since 1977, the Bank has set targets for monetary growth: M2, from 1988 to 1990, and M3 thereafter. In the early eighties the French government engaged in a unilateral fiscal expansion aiming to boost output and employment. The ensuing inflation outburst and the speculative attacks against the franc forced a quick policy reversal. Since then French policies, both fiscal and monetary, were geared towards reputation building. In fact, the spread with German rates remained stubbornly high despite the relatively rapid convergence of inflation towards German levels. In the ’90, the exchange rate was steered within a much narrower band than required by the ERM rules, and the central par was never revised.

The Bank of Italy gained some degree of formal independence in 1981. In 1984, the Bank announced the first M2 official target.[17] A loose fiscal policy stance and the mounting public debt, however, cast a recurrent shadow on the ability of Italian monetary authorities to control inflation.[18] During the ‘hard ERM’ period the bank managed to defend the parity, but there was growing skepticism concerning the long-term compatibility of the public finances with the Maastricht Treaty provisions.[19] The dramatic exit of the lira from the ERM in 1992 was probably a direct consequence of these concerns. In November 1996, Italy rejoined the ERM, and in 1998 the Bank of Italy became one the 11 founding members of the Eurosystem.

In Belgium, after the 8.25% devaluation in February 1982, monetary policy was essentially designed to maintain a stable exchange rate. As in Italy, the very high debt-to-GDP ratio generated relatively high real interest rates throughout the ERM period. However, a medium-term strategy of fiscal consolidation narrowed the scope for speculative attacks (see IMF [1998]; PEROTTI, STRAUCH and VON HAGEN, [1998]).

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16. See FRATIANNI and VON HAGEN [1992], amongst others.

17. The official intermediate objective of the Bank had previously been total domestic credit. This, as discussed in SPINELLI and TIRELLI [1993], and FRATIANNI and SPINELLI [1997], entailed large crowding-out of private-sector credit and lack of control on monetary aggregates, in presence of large government budget deficits.

18. For an effective assessment of the effects of these considerations on currency markets, see GIORGIANNI [1997].

19. Between 1981 and 1991 the ratio of central government deficit to nominal national income almost doubled (FRATIANNI and SPINELLI [1997]).

TABLE 2

Estimated Interest Rate Reaction Functions. France and Italy, 1980Q1-1997Q2. Static Long-Run Solutions.

Regr./Country		**France**		**Italy**
CONSTANT		0.032 (0.005)		0.069 (0.008)
EXPINF		0.558 (0.115)		0.707 (0.075)
OUTPUTGAP		0.152 (0.133)		– 0.158 (0.360)
GERFIBOR		0.856 (0.070)		0.205 (0.125)
ADJSPREAD		0.862 (0.079)		0.964 (0.147)
Variable Addition Tests	M3Growth	0.086 (0.062)	M1Growth	0.135 (0.059)
	Δ Reserves	– 0.014 (0.007)	Δ Reserves	– 0.015 (0.009)
Summary Statistics	R^2: 0.919 σ: 0.010 DW: 1.81 AR 1-5 F(5, 60): 0.531 [0.7522] ARCH 4 F(4, 57): 3.516 [0.0124] Normality χ^2: 23.248 [0.0000] RESET: 1.787 [0.1860]		R^2: 0.95 σ: 0.08 DW: 1.45 AR 1-5 F(5, 60): 1.707 [0.1469] ARCH 4 F(4, 57): 0.81 [0.5227] Normality χ^2: 16.113 [0.0003] RESET: 7.646 [0.0074]	

All results are obtained from Recursive Least Squares regressions of the monetary instrument on a constant, the indicated regressors, and one lag of the dependent variable. Regressors are defined in the main text. Asymptotic standard errors in parentheses. We tested for the addition of other regressors. Zero restrictions on lagged money growth and the 4-quarter change in the (log of) official reserves of foreign currency were tested by including them in the baseline regression. Asymptotic standard errors are in parentheses. AR is a LM test for the hypothesis of no serial correlation; ARCH checks whether residuals have an ARCH structure, with no ARCH as the null; Normality tests the normality of residuals; RESET tests the null of no functional mis-specification. P-values in brackets.

In Ireland, substantial budget imbalances recurrently put the currency at risk of speculative attacks during the first half of the 80s. However, the severe macroeconomic adjustment carried out since 1984 did produce some effects in the second part of the decade, when the risk premium on the D-mark fell. Subsequently, a mix of tax cuts, parity realignments, and wage moderation boosted competitiveness, stimulating economic expansion from 1994 onwards. Ireland is seen as one of the few cases of 'expansionary fiscal retrenchment' in the recent literature on budget consolidation (see ALESINA and PEROTTI [1997]; GIAVAZZI, JAPPELLI and PAGANO [2000]).[20] The monetary authorities then allowed the punt to significantly appreciate *vis-à-vis* the D-mark: in 1998, a 3% revaluation of the punt was the last official realignment in ERM history.

We now turn to our results. Tables 2 and 3 display the solved long-run static reaction functions, while the recursive graphs in Figures 1-4 show the esti-

20. For a short but effective account of those Irish events, see OBSTFELD [1998].

TABLE 3

Estimated Interest Rate Reaction Functions. Ireland and Belgium, 1980Q1-1997Q2. Static Long-Run Solutions.

Regr./Country		Belgium		Ireland
CONSTANT		0.014 (0.004)		0.046 (0.015)
EXPINF		0.144 (0.066)		0.531 (0.186)
OUTPUTGAP		– 0.030 (0.051)		0.196 (0.227)
GERFIBOR		0.877 (0.068)		0.912 (0.212)
ADJSPREAD		0.881 (0.108)		1.074 (0.217)
Variable Addition Tests	M3Growth	0.028 (0.025)	M3Growth	– 0.005 (0.057)
	Δ Reserves	– 0.015 (0.006)	Δ Reserves	– 0.077 (0.021)
Summary Statistics	R^2: 0.942 σ: 0.006 DW: 2.09 AR 1-5 F(5, 60): 0.546 [0.7409] ARCH 4 F(4, 57): 0.308 [0.8715] Normality χ^2: 21.288 [0.0000] RESET: 3.775 [0.0565]		R^2: 0.67 σ: 0.03 DW: 1.92 AR 1-5 F(5, 60): 0.532 [0.7508] ARCH 4 F(4, 57): 0.064 [0.9922] Normality χ^2: 128.99 [0.0000] RESET: 2.178 [0.1449]	

All results are obtained from Recursive Least Squares regressions of the monetary instrument on a constant, the indicated regressors, and one lag of the dependent variable. Regressors are defined in the main text. Asymptotic standard errors in parentheses. We tested for the addition of other regressors. Zero restrictions on lagged money growth and the 4-quarter change in the (log of) official reserves of foreign currency were tested by including them in the baseline regression. Asymptotic standard errors are in parentheses. AR is a LM test for the hypothesis of no serial correlation; ARCH checks whether residuals have an ARCH structure, with no ARCH as the null; Normality tests the normality of residuals; RESET tests the null of no functional mis-specification. P-values in brackets.

mated coefficients within 2-standard error bands[21] – and *Chow*'s tests of structural stability. The study of single recursive coefficients' path over time can provide a useful description of possible shifts in the monetary authorities' preferences. However, the relevance of these changes can be fully gauged only with reference to historical events, and their impact on the estimated reaction function as a whole.

As one might expect, for each equation the 1-step *Chow* tests detect a break in 1992. However, with the notable exception of Italy, the recursive graphs suggest that the 1992 crisis was just an episode. In fact, the central banks of the other countries broadly reverted to the pre-1992 interest rate rules as soon as speculative pressures faded. This pattern clearly emerges for France, Belgium and Ireland (ERM continuers henceforth), whereas the Bank of Italy seems to have followed a somewhat different policy rule after the 1992 ERM

21. Recursive estimates are obtained with a GAUSS code, and plotted using GiveWin. Stability tests are from PcGive 9.1.

FIGURE 1

France, 1980Q1-1997Q2

Recursive coefficients between ±2 standard-error bands; 1-step up and N-step down Chow tests (5%)

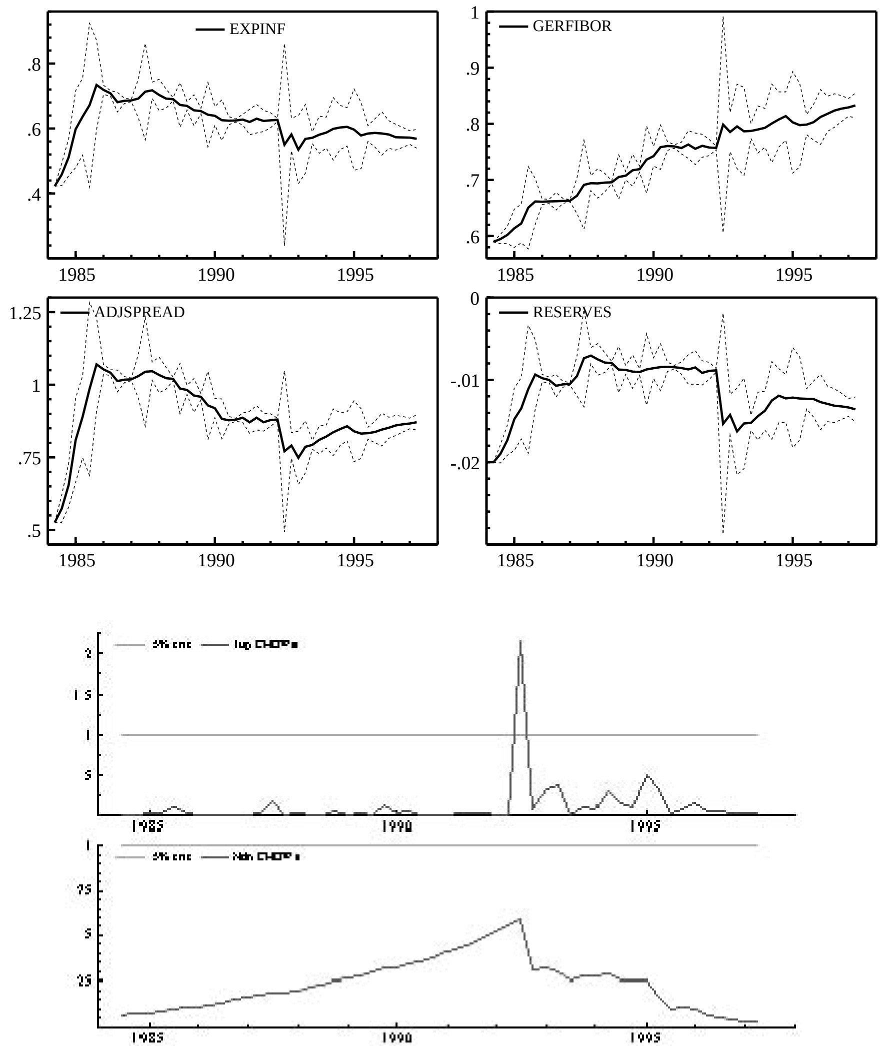


FIGURE 2

Italy, 1980Q1-1997Q2

Recursive coefficients between* ±2 *standard-error bands; 1-step up and N-step down Chow tests (5%)

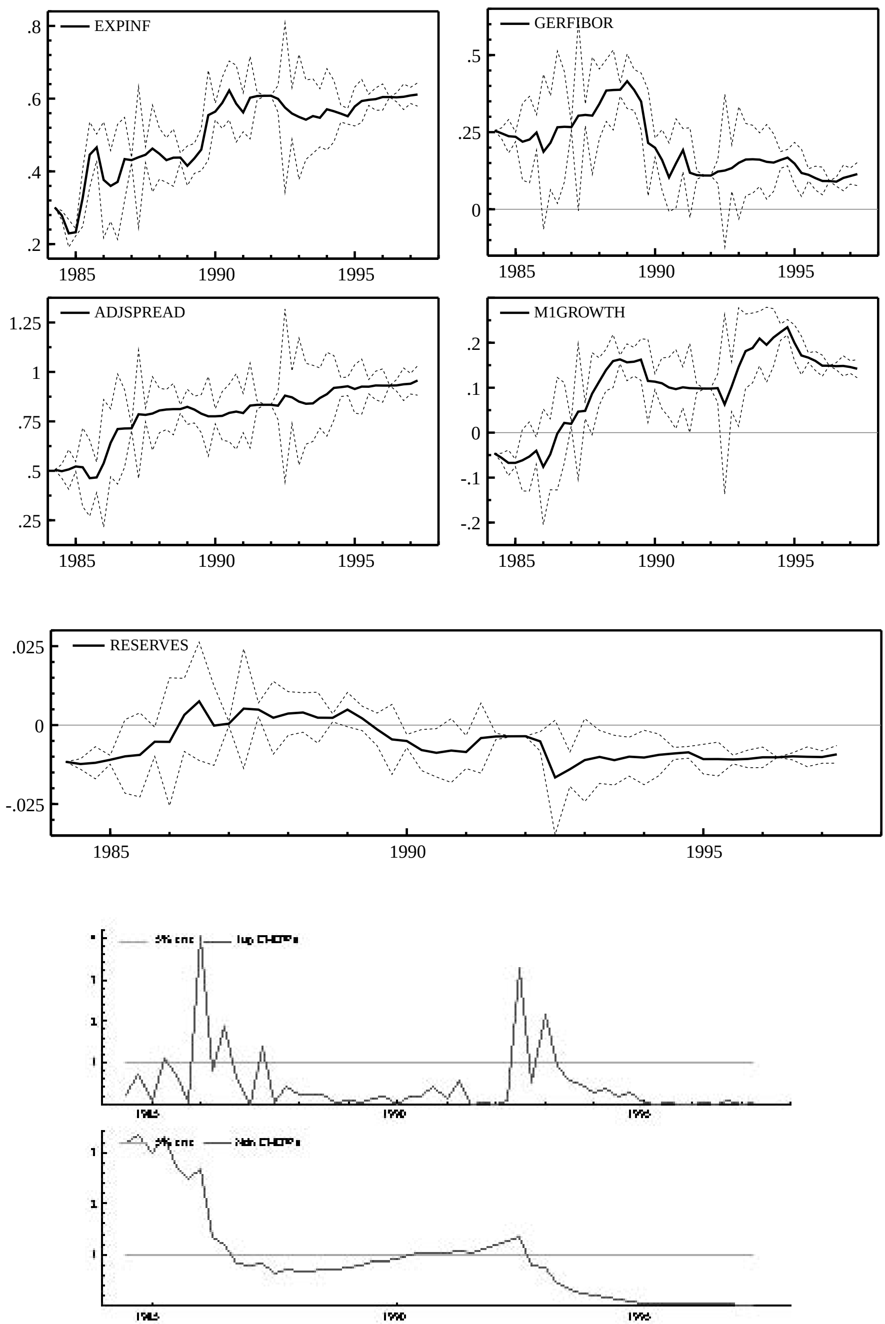


FIGURE 3
Belgium, 1980Q1-1997Q2
Recursive coefficients between ±2 standard-error bands; 1-step up and N-step down Chow tests (5%)

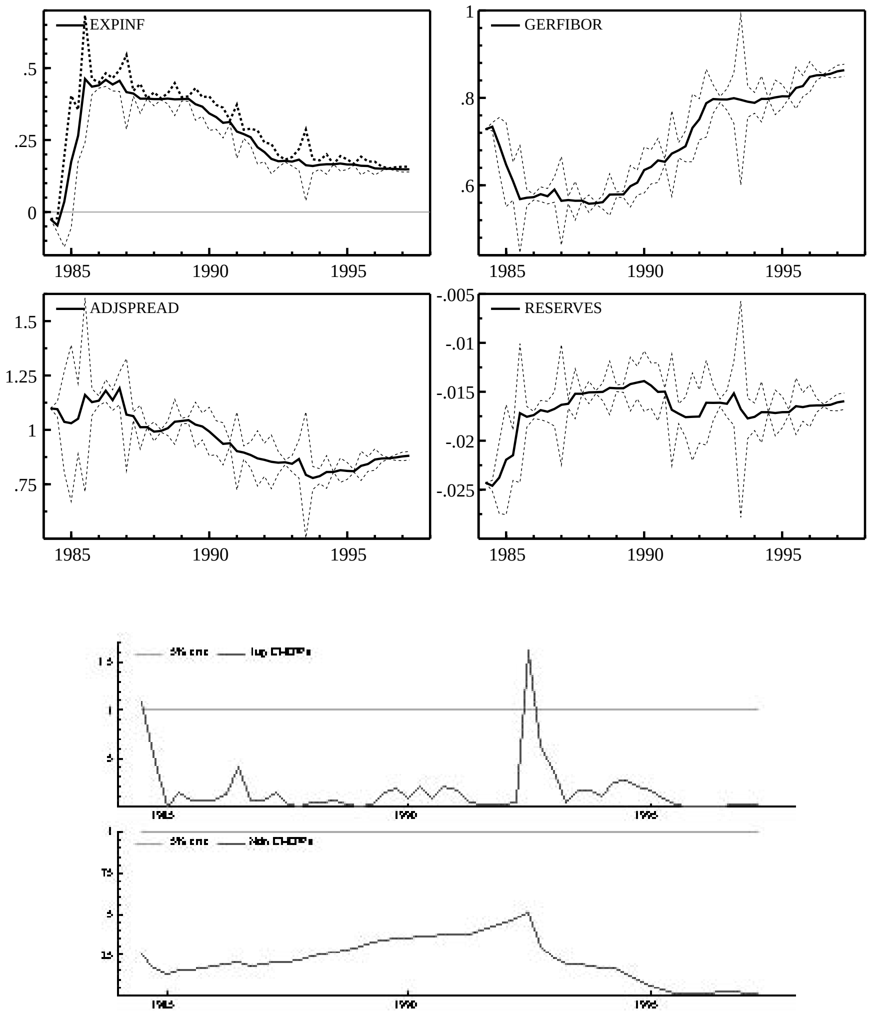


FIGURE 4

Ireland, 1980Q1-1997Q2

Recursive coefficients between ±2 standard-error bands; 1-step up and N-step down Chow tests (5%)

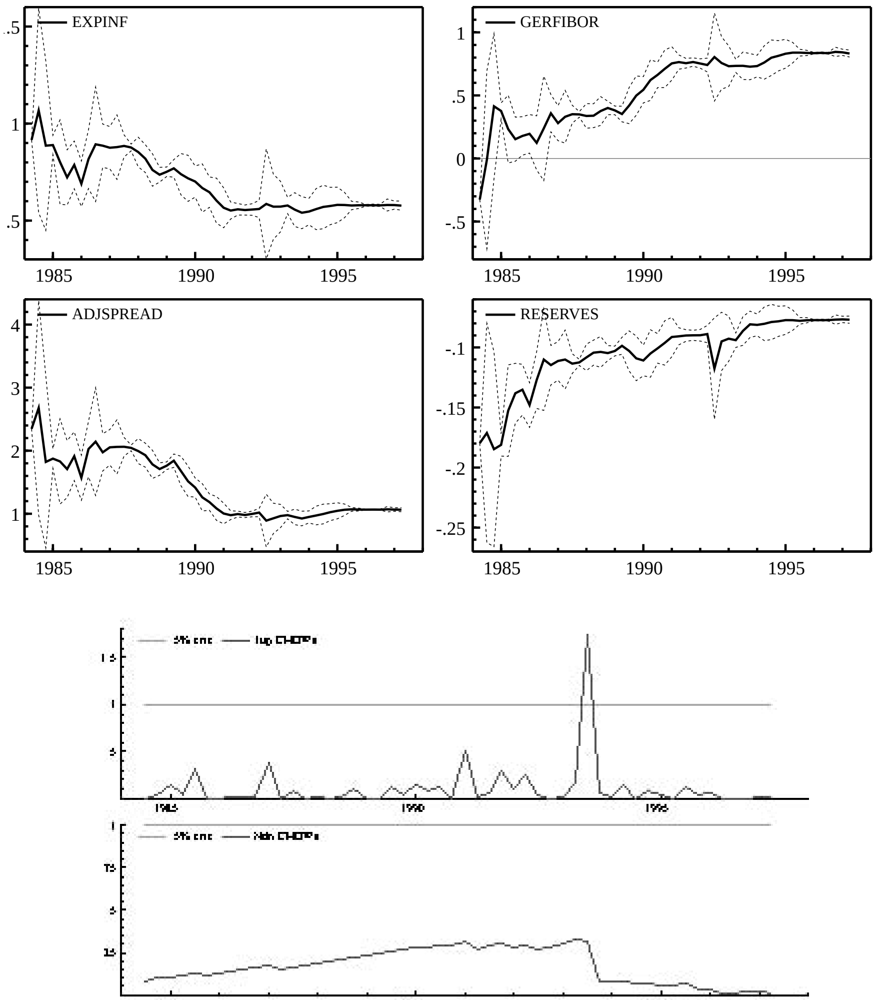
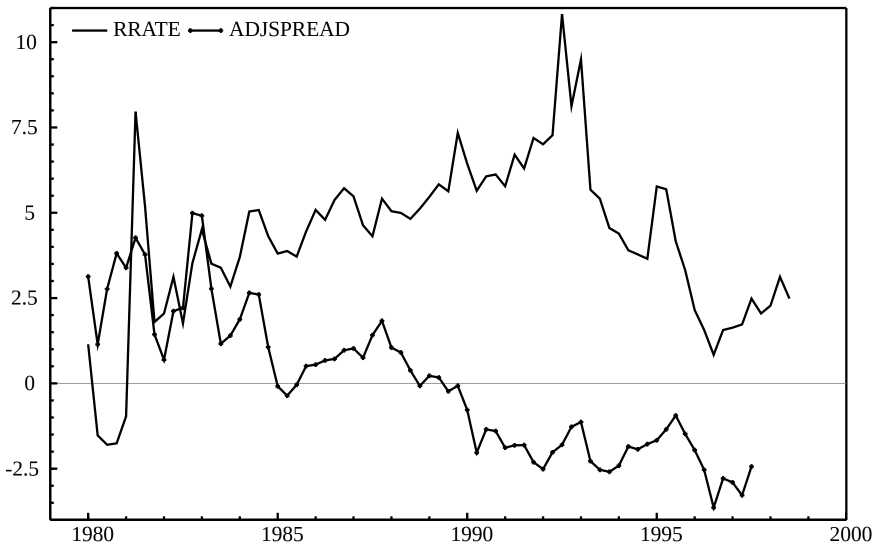
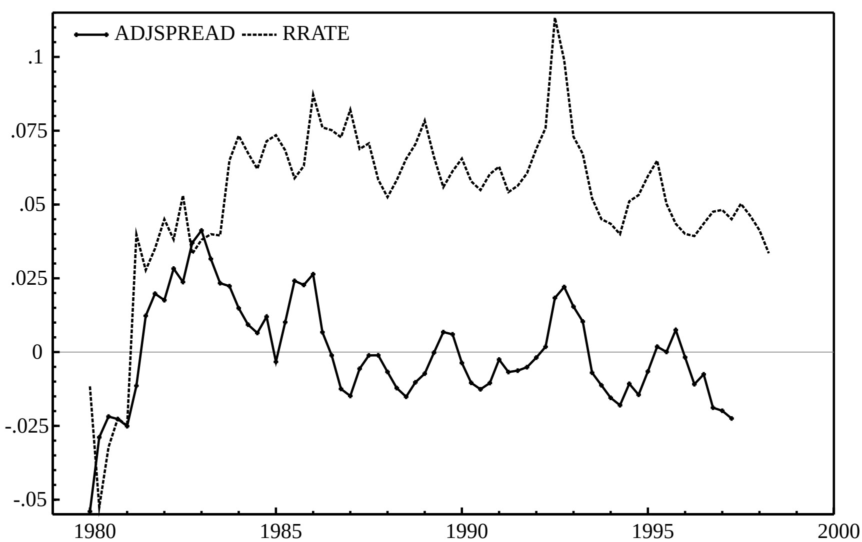


FIGURE 5

France, ex ante short-term real interest rate and adjusted yield spread, 1980Q1-1997Q2 (see main text for details)



Italy, ex ante short-term real interest rate and adjusted yield spread, 1980Q1-1997Q2 (see main text for details)



exit. However, some striking similarities remain, even after the 1992 break-up, between Italy and the other countries. In fact, the coefficient on the domestic output gap is never significant, whereas in all countries the coefficients attached to inflation expectations and to the German interest rate are significant and positive. The coefficient on the long-term spread is also significant and positive. This result deserves more detailed discussion.

As pointed out above, our estimates have been computed inserting the spread component that is orthogonal to inflation expectations into our baseline specification. Figures 5 and 6 show that, along with our calculated measure of ex ante real interest rates, the generated adjspread series is persistently negative, especially over the latter part of the sample. Taking into account that these negative values are obtained in a period of falling inflation expectations, growing fiscal discipline and convergence to German levels, this result implies that some latent factor systematically depressed the spread. This finding is best explained by a combination of a more credible fiscal stance (which lowered the exchange rate risk), and relatively favourable cyclical conditions (which delayed the fall of inflation expectations). To confirm this interpretation, note that in Ireland adjspread becomes systematically negative after the mid-eighties fiscal adjustment, which also triggered a long-term economic upswing. In France and in Belgium one gets negative values from the start of the nineties when, after a prolonged period of fiscal discipline, a number of commentators begun to describe French policy as 'competitive deflation' *vis-à-vis* Germany.

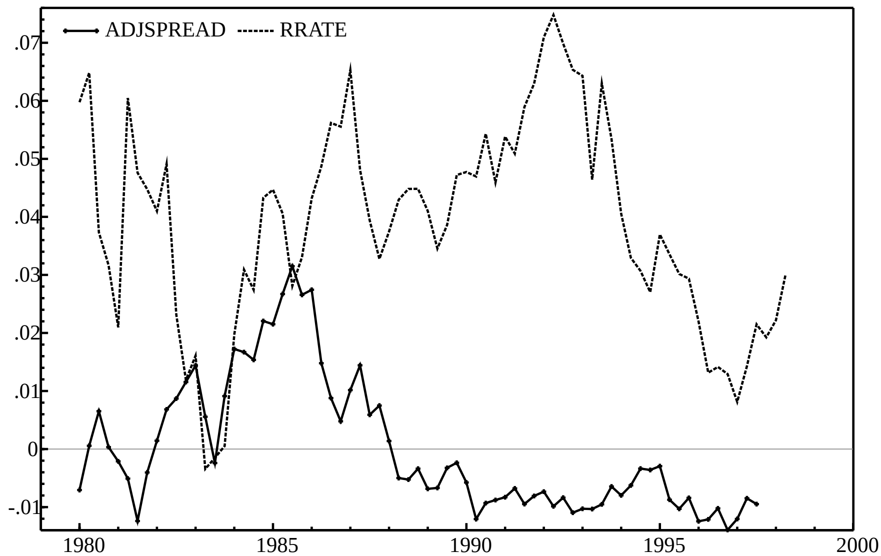
The case of Italy, where the persistence of negative values for adjspread is certainly weaker, indirectly confirms this interpretation. In fact, the cyclical behaviour of the series is clear, with the local peaks centred around the timing of devaluations or periods when narrative accounts signal that speculative pressures mounted. In contrast with the cases of France and Belgium, adjspread returns to positive values in 1992, just before and in coincidence with the ERM crisis, and later in 1996. This is consistent with the recurrent waves of scepticism concerning the ability of policymakers to discipline the fiscal stance after 1992 and to meet the Maastricht convergence criteria.

Turning back to our estimates, the ERM continuers are characterised by a steadily growing weight of the coefficient related to the German interest rate. By contrast, in these countries we observe a decrease in the coefficients attached to expected domestic inflation and to the spread. This is broadly consistent with a scenario where macroeconomic indicators signal increasing convergence with Germany and the central parity gains credibility.

Our estimates for Italy present a substantially different picture. First of all, we detect signs of instability already in the early eighties. Second, the recursive estimates signal a marked policy shift post 1992. The coefficient on the German interest rate falls, whereas that on inflation expectations increases. Third, in contrast with the ERM continuers, the strength of the coefficient attached to the spread steadily increases throughout the period. Fourth, a money supply aggregate enters the reaction function. Recursive graphs suggest that interest rates reacted to monetary aggregates during the final part of the eighties and after 1992. This finding is broadly consistent with narrative accounts of monetary policy in Italy (FRATIANNI and SPINELLI [1997]). In fact, the Bank of Italy relied on credit ceilings and other administrative controls until 1984. Subsequently, the targeting of monetary aggregates was

FIGURE 6

Belgium, ex ante short-term real interest rate and adjusted yield spread, 1980Q1-1997Q2 (see main text for details)



Ireland, ex ante short-term real interest rate and adjusted yield spread, 1980Q1-1997Q2 (see main text for details)

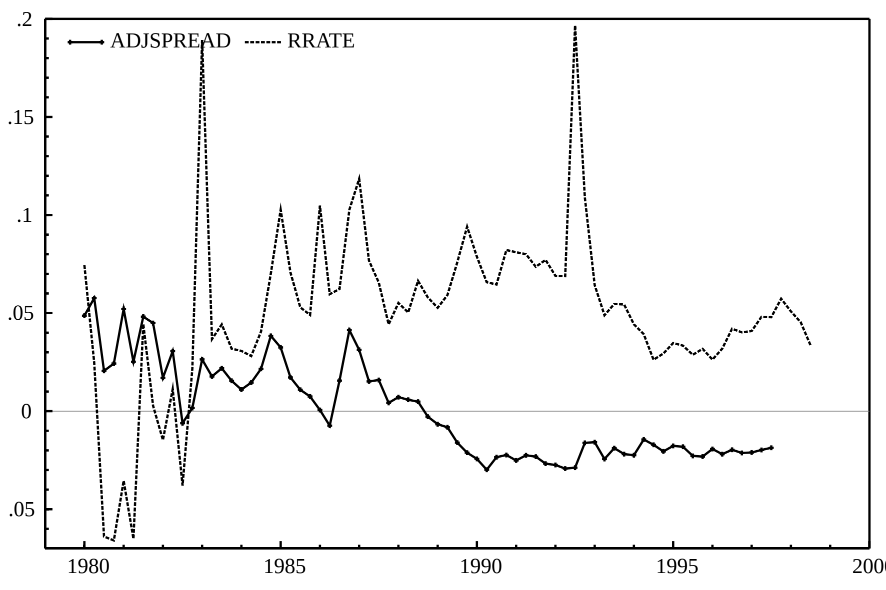
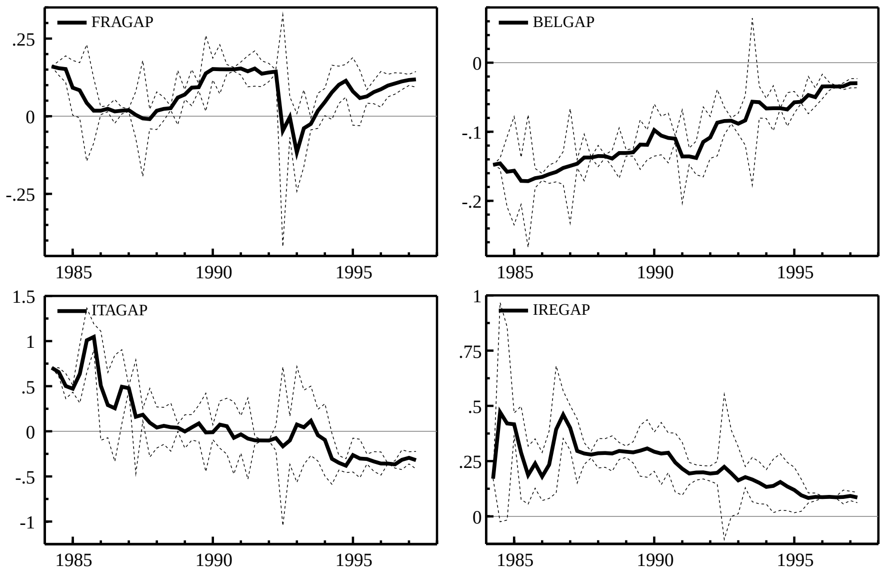


FIGURE 7

Estimated long-run recursive coefficients on output gaps. France (top left), Italy (top right), Belgium (bottom left), Ireland (bottom right).



made possible by the survival of restrictions to capital movements. The latter were lifted at the beginning of the 1990, precisely at the time when our estimates show that the coefficient on the monetary aggregate loses significance. After 1992, the Bank of Italy was freed from the constraints imposed by ERM membership, and the money supply indicator becomes significant once more.

Despite some apparent differences outlined above, there is one common theme underlying the interest rate policies of these four countries: the dominance of external constraints over domestic objectives. Central banks did not exploit the exchange rate target zone to implement counter-cyclical policies: Figure 7 shows that after 1992 the coefficients on output gap are all very small, insignificant and in two cases have the wrong sign. By contrast, the observed targeting of domestic inflation expectations may be seen as a means to force convergence to German levels. The emphasis on the long spread suggests that reputational factors posed a decisive constraint on the ability to pursue domestic objectives: *Krugman*'s 'honeymoon' effect never materialised for these countries. This conclusion is even more striking if we bear in mind that after the 1993 target-zone widening both the ERM continuers and the Bank of Italy were de facto freed from the obligation to defend the exchange rate parity. Nevertheless, the continuers insisted in mimicking a narrow-band regime. A further confirmation of this is that for all countries foreign reserves significantly enter our estimated reactions functions throughout the sample period. This closely resembles central bank behaviour in a textbook fixed-exchange-rate regime, whereas under credible target zones monetary policy action is called for only when the exchange rate hits the margin of the band.

5 Conclusions

Both the theoretical model and the econometric methodology presented in this paper are based on the assumption that asymmetric information and gradual learning characterise the relationship between the central bank and the private sector. Moreover, we have assumed that the risk of a fiscal regime shift puts an additional constraint on the monetary policies of former ERM countries. Our empirical results seem consistent with both assumptions.

Target zones model based on full credibility show that the central bank might exploit the bandwidth to pursue domestic objectives. However, the same models show that, when realignments are possible, reputational factors impose a tighter discipline on the Central Bank. Our results confirm earlier empirical analyses of the ERM, where it is shown that such reputational factors where indeed important (GERLACH and SCHNABEL [2000]; FAVERO, GIAVAZZI and SPAVENTA [1997]).

Our contribution to this literature is twofold. First, we present evidence that the risk of a shift to a regime of fiscal dominance was at the root of the central banks' credibility problems. Second, our results suggest that inflation convergence was the other main objective driving central bank policies. As a result, very little room was left for countercyclical policies: the honeymoon effect never really materialised for these ERM countries. Not surprisingly, all these countries were affected by the contractionary monetary policies in Germany in 1990-91.

These results may help to understand why these countries turned out to be enthusiastic supporters of EMU and of the Stability and Growth Pact that came with it, whereas other EU members, such as the UK, manifested stiff opposition. In fact, empirical evidence shows that in the UK external constraints and the danger of fiscal imbalances were never overwhelming, and the domestic stabilisation objective remained important throughout 1980s and 1990s (see, for instance, MUSCATELLI TRECROCI and TIRELLI [2002], or CLARIDA, GALÍ and GERTLER [1998]). It is therefore understandable why EMU membership implies an effective loss of national sovereignty for UK policy-makers. By contrast, our results suggest that EMU should unambiguously benefit the group of countries whose monetary policies have been analysed in this paper. On the one hand, the risk of going back to a FD regime seems definitely staved off. On the other, compared to what happened under Bundesbank's leadership during the ERM years, the ECB's policies are more likely to take into account their preferences in managing Euroland's business cycle. The symmetry of EMU is much more preferable for these countries than an asymmetric ERM. ▼

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APPENDIX

Data Appendix

Variables were taken from OECD Main Economic Indicators and IMF International Financial Statistics. In most cases, we were able to employ seasonally adjusted data. For each country we measured real output using the GDP at constant price series. The inflation series were defined as simple 4-quarter log-differences in the all-items CPI. Below we briefly list the short-term interest rates we chose as policy indicators, and the definition of variables in the graphs. Rates are generally converted from monthly series.

Country	Modelled Interest Rate Variable
France	Call Money Rate
Italy	3-Month Interbank Deposit (overnight)
Belgium	Call Money Rate
Ireland	Call Money Rate

Variable	Definition
EXPINF	Expected inflation, as described in the main text
ADJSPREAD	Adjusted spread, as described in the main text
OUTPUTGAP	Actual – Potential Output, computed via STS approach
GERFIBOR	3-month German Fibor
Δ Reserves	4-quarter log-difference in official reserves excluding gold
M1(3)GROWTH	4-quarter log-difference in M1(M3) Growth