Scottish Journal of Political Economy, Vol. 48, No. 4, September 2001

MACROECONOMIC FUNDAMENTALS AND EXCHANGE RATE CREDIBILITY. FURTHER EVIDENCE ON THE ITALIAN EXPERIENCE FROM A REGIME-SWITCHING APPROACH

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ABSTRACT

This paper explores the links between exchange rate credibility and macroeconomic fundamentals with reference to the Italian experience during the first half of the 90's. The analysis relies on a nonlinear framework emphasizing shifts between credible and not credible states, and assuming a significant degree of persistence in the above regimes. We detect a significant influence of a cumulative loss in external competitiveness and of real output dynamics on devaluation expectations. While supporting the cautious monetary policy stance taken by monetary authorities during the transition phase following Italy's re-entry in the EMS, our evidence suggests that structural supply-side policies will become crucial, in the years ahead, to ensure a credible and lasting permanence of Italy inside the EMU.

I INTRODUCTION

The whole decade of the 90's has been marked by extreme turbulence on foreign exchange markets. Along the first half of this decade, massive speculative attacks forced the Italian Lira and the British Pound out of the Exchange Rate Mechanism (ERM) in September 1992, while the 'hard' ERM was temporarily replaced by a much weaker scheme for exchange rate targeting in August 1993. The Mexican Peso crisis in late 1994 and the large cumulative devaluations experienced by South-East Asian countries in 1997–98 are further examples of the inherent fragility of pegged exchange rate systems in an environment of high international capital mobility.

Spurred by these striking and, to most observers, largely unanticipated events, research into the underlying determinants of currency crises has undergone a major revival in recent years.

On the theoretical side, efforts have concentrated on developing an alternative approach with respect to the first generation of speculative attacks models, where currency crises are the outcome of economic policies inconsistent with the

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indefinite defence of a fixed exchange rate parity. This alternative framework (often referred to as 'escape clause' or 'endogenous policy' approach) emphasizes the optimizing behaviour of policy-makers, in contrast to the earlier framework where speculative attacks represent optimal market reactions to inconsistent government policies. According to this more recent strand of theoretical literature, policy-makers continuously compare the costs and the benefits of a fixed exchange rate policy and, under particularly adverse shocks, may decide to break the above commitment. A crucial feature of escape clause models is the existence of multiple equilibria: sudden changes in private sector's expectations, triggered by sunspot-like events, may induce the collapse of a fixed exchange rate peg which would otherwise have survived (Obstfeld, 1994).[1]

Real-world developments on currency markets have exerted an equally appreciable influence on applied research about exchange rate credibility. A standard methodology widely employed in the empirical literature (drift-adjustment approach) computes realignment expectations subtracting the expected rate of depreciation within the band from the nominal interest rate differential (Svensson, 1993). This standard approach, however, has generally produced poor empirical findings. As regards the 1992–93 EMS experience, for instance, Rose-Svensson (1994) find few significant macroeconomic influences on realignment expectations, with the potential exception of inflation differentials. These authors, moreover, are unable to detect significant anticipatory signals of the impending currency turmoil.

A major shortcoming of the drift-adjustment approach is that it cannot account for relevant nonlinearities characterizing foreign exchange markets, which are particularly strong in EMS data (Engel-Hakkio, 1996; Bekaert-Gray, 1996). Building upon this argument, many authors have recently developed alternative frameworks to assess exchange rate credibility, documenting the predictability of most target zone realignments (Mizrach, 1995; Bekaert-Gray, 1996), and how speculative pressures and observed regime changes inside the EMS are often associated with a deterioration in macroeconomic fundamentals (Ötker-Pazarbasioglu, 1997).

This paper contributes to the applied EMS literature dealing with the Italian experience along the first half of the 90's. The consensus view in this literature is that, differently from other countries participating to the ERM, speculative attacks against the Italian Lira were largely driven by growing macroeconomic imbalances.

Two outstanding influences are commonly identified in academic discussions outlining the unfolding of the exchange rate crisis which led to the withdrawal of the Lira from the ERM in September 1992. The former relates to growing

[1] According to the first generation of currency crises models, by contrast, speculative attacks reflect basic macroeconomic imbalances and are largely predictable. Multiple equilibria may however arise also in this set up. As shown in Obsfeld (1986), the exact timing of an exchange rate crisis may be indeterminate if monetary policy is conditional on the occurrence of a speculative attack. In this case, the same level of fundamentals is consistent either with a stable exchange rate or with a run on foreign reserves leading to the ultimate collapse of a fixed exchange rate parity.

imbalances in domestic public finances due to a large budget deficit and a very high debt/GDP ratio. According to most observers, this would have unambiguously signalled to financial markets the lack of credibility of an eventual defence of the parity pursued through sensible and long-lasting increases in domestic interest rates (see, among others, Eichengreen-Wyplosz, 1993; Vaciago, 1993). The latter influence is instead represented by an overt competitiveness problem (Eichengreen-Wyplosz, 1993; De Grauwe, 1997). Many macroeconomic indicators point out a cumulative loss of competitiveness of the Italian economy since 1989: the stability of the nominal exchange rate, coupled with a positive, albeit declining, inflation differential towards Germany, produced an increasing appreciation of the real LIT/DM exchange rate up to the first half of 1992. This, in turn, induced a large decline in the profitability of tradeable sectors and increasing current account deficits, raising serious doubts about the sustainability of the current parity.

Despite identifying relevant sources of speculative pressures, the existing literature suffers from a serious drawback. Actually, although it provides an accurate description of the macroeconomic environment, the influence of potentially destabilizing factors is never submitted to rigorous empirical tests. Lacking a formal investigation about the underlying determinants of devaluation expectations, the ultimate nature of the Italian exchange rate crisis remains basically indeterminate.

In a previous paper relying on a nonlinear econometric framework, we have documented how fiscal and debt management indicators displayed significant effects on devaluation expectations, providing some clear anticipatory signals about the September 1992 Lira crisis (Amato-Tronzano, 2000). The purpose of this paper is to complement this research, drawing on the same nonlinear approach, but focusing on different channels of macroeconomic influence potentially affecting the credibility of the LIT/DM parity along the first half of the 90's.

The outline of the paper is as follows. Section II reviews existing interpretations of the Lira exchange rate crisis put forward in the EMS literature. Section III describes our methodology of empirical investigation. Exchange rate credibility is modelled inside a regime-switching framework with time-varying transition probabilities. These conditional probabilities, in turn, are potentially affected by various macroeconomic variables, selected on the basis of alternative strands of economic theory. Section IV contains our empirical findings. We first present parameter estimates from regime-switching models, and then discuss some relevant features associated to the time profile of conditional probabilities. Section V concludes.

II The 1992 Lira Exchange Rate Crisis: A Review of the Current Literature

The Italian Lira was the first currency exposed to large selling pressures along the 1992–93 ERM crisis. Foreign reserves losses began in February 1992 and hastened in June. In the meantime Lira bond prices declined both in futures and in spot

markets. Towards the end of August, the Italian lira joined sterling at the bottom of the currency band, while a week later the Bank of Italy increased the discount rate to 15%. On September 16, the Bank of England announced the withdrawal of sterling from the ERM while, a few hours later, Italy followed Britain's move.[2]

The dominant view in the literature is that, differently from other EMS currencies, speculative attacks against the Italian lira were triggered by strong imbalances in some macroeconomic fundamentals. As stated in the previous section, however, this view is not properly supported by adequate empirical tests.

Eichengreen-Wyplosz (1993) compare alternative indicators of external competitiveness for various European countries, including EMS and not-EMS participants (Italy, Spain, United Kingdom, Denmark, France, Sweden and Finland). For each country, these authors present three competitiveness measures: bilateral unit labour costs relative to Germany, multilateral relative unit labour costs adjusted for the business cycle and the ratio of traded to nontraded goods prices at home. The main conclusion from this analysis is that Italy is:

> the only EMS country that shows unambiguous evidence of deteriorating international competitiveness (ibid., p. 65).[3]

The unit labour cost index for Italy shows a competitiveness loss of about 20% between the first quarter of 1988 and the first quarter of 1992, while a continuous decline of the traded to nontraded goods price index is observed along the same period. Among other potential sources of speculative pressure, Eichengreen-Wyplosz (1993) quote the imbalance in domestic public finances, as witnessed by Italy's large budget deficit and high public debt.

In line with the above interpretation, informal analyses carried out in Vaciago (1993) and De Grauwe (1997) recognize the role of the cumulative loss of external competitiveness in making ultimately not credible the existing Lira parity. The former author points also to unsustainable imbalances in Italian public finances, conditioning both the effectiveness and the autonomy of domestic monetary policy.

Fratianni-Artis (1996) take a different approach with respect to earlier studies, applying Svensson (1991) simplest test of target zone credibility to the LIT/DM exchange rate over the 1987–92 period. Overall, their results show a rather low credibility for the LIT/DM target zone. Using monthly data, these authors detect frequent deviations of the 1-year forward rate from the constraints implied by a perfectly credible exchange rate band; moreover, using daily observations, they claim that:

> throughout 1992 the financial markets never believed in the sustainability of the exchange rate arrangement (ibid., p. 577).

[2] Italy rejoined the ERM on November 25, 1996, at a central parity of 990 against the D-mark.

[3] As discussed in Eichengreen-Wyplosz (1993), also Spain and the United Kingdom present symptoms of competitive difficulties although, for these countries, the evidence is more difficult to interpret.

Differently from the UK pound, finally, no significant mean-reverting tendency for the Italian lira is detected from January 1987 to June 1992. Although Fratianni-Artis (1996) go one step further with respect to previous research, providing convincing evidence about the low credibility of the Italian target zone, they do not formally investigate eventual links between low exchange rate credibility and the disappointing performance of some macroeconomic fundamentals.

This topic is explicitly addressed in Amato-Tronzano (2000), through a nonlinear econometric framework identical to that employed in the present paper, emphasizing shifts between credible and not credible exchange rate regimes. Amato-Tronzano (2000) focus on a particular set of fiscal and debt indicators, selected with reference to debt management models of currency crises and previous applied work on the EMS. Overall, their evidence strongly supports the informal consensus view outlined above, according to which large imbalances in domestic public finances played an important role in triggering the Lira exchange rate crisis. These authors, however, do not investigate the impact of cumulative losses in external competitiveness nor, more generally, the effects of other real imbalances emphasized in escape clause models or of other channels of macroeconomic influence underlined in the earlier literature on speculative attacks. These topics are instead at the core of the empirical investigation performed in the present paper.

III Exchange Rate Credibility: A Nonlinear Framework

As remarked in the introductory section, a major shortcoming of the drift-adjustment approach is that it cannot account for relevant nonlinearities characterizing EMS data. For this reason, in line with the recent applied EMS literature (Mizrach, 1995; Bekaert-Gray, 1996; Ötker-Pazarbasioglu, 1997), this paper relies on a nonlinear econometric framework to assess exchange rate credibility and investigate its potential links with some macroeconomic fundamentals.

Our nonlinear approach is identical to that employed in Amato-Tronzano (2000): differently from the drift-adjustment methodology, we do not extract realignment expectations from the nominal interest differential and focus on the overall expected rate of depreciation as relevant credibility variable.[4] We assume that the interest differential shifts between 'low' and 'high' values denoting, respectively, 'credible' (low expected depreciation) and 'not credible' (high expected depreciation) exchange rate regimes. Moreover, we assume that the

[4] One reason for this choice is that, along the second half of our sample period (i.e. from September 1992 up to 1995.8), the Lira has been freely floating on foreign exchange markets. Absent an explicit target zone, realignment expectations cannot obviously be computed. The focus on the nominal interest rate differential, however, can also be motivated on more general grounds: see Amato-Tronzano (2000, Section 3), for a more detailed discussion. In line with the drift-adjustment approach, our investigation relies on uncovered interest parity, which in turn requires the absence of capital controls and that government bonds be perfect substitutes or that investors are risk neutral. This simplifying assumption is standard in the applied credibility literature: as pointed out in Svensson (1993), the foreign exchange risk premium is small in a target zone, even in presence of a devaluation risk.

above process exhibits a significant degree of persistence, i.e. that credible and not credible states tend to cluster over time.[5] On this basis, we model the interest differential as a stochastic process whose realizations are drawn by a mixture of two i.i.d. distributions: the former holds whenever the process is in the credible state, while the latter holds when the process is in the not credible state.

A recent econometric approach developed in Hamilton (1988, 1989) is the natural candidate to carry out our empirical investigation since it emphasizes *persistency effects* in alternative states.[6] Hamilton (1988, 1989) suggests a convenient procedure to estimate the vector of relevant parameters; this procedure entails an iterative nonlinear filter providing an optimal inference about the current state given its past values: the outcome of the filter is then used to generate future forecasts of this variable.

Hamilton's original filter posits constant transition probabilities across alternative states. This assumption is however restrictive in our context, since we are interested in exploring whether some macroeconomic variables significantly affect the probability of remaining in a credible (or not credible) exchange rate regime.

This taken into account, our empirical investigation includes a relevant extension of this filter, allowing transition probabilities to be affected by different exogenous variables (as motivated in the following section, our analysis is carried out assessing, one at a time, the influence of each exogenous variable). Assuming that state transitions evolve as logistic functions of macroeconomic variables, conditional probabilities may be parametrized as:

$$p_t = \frac{\exp(\text{consp} + \beta_1 x_{t-1})}{1 + [\exp(\text{consp} + \beta_1 x_{t-1})]}; \qquad q_t = \frac{\exp(\text{consq} + \beta_2 x_{t-1})}{1 + [\exp(\text{consq} + \beta_2 x_{t-1})]}$$

where p_t, q_t are, respectively, the time-varying conditional probabilities of state one ($s_t = 1$; not credible exchange rate regime) and state zero ($s_t = 0$; credible regime); consp, consq are constant terms; β_1, β_2 are parameters governing transition probabilities; $\{x_{t-1}\}$ is an exogenous macroeconomic variable.[7]

[5] This assumption is highly consistent with the recent EMS experience, where long tranquil periods have suddenly been interrupted by massive speculative attacks generating extreme turbulence on currency markets. As forcefully documented in Engel-Hakkio (1996), volatility clustering is a prominent feature of currencies participating to the ERM. Whereas these authors stress the relevance of volatility clustering, the present paper emphasizes the persistency of periods of high and low credibility.

[6] This approach assumes that regime shifts are not directly observable and that probabilistic inferences about them can be drawn on the basis of the past behaviour of the series. The parameters of the autoregressive process governing the evolution of the series depend, in this context, on an unobserved random variable, defined as the *state* or *regime* that the process was in at date t. This *state*, in turn, is a discrete random variable, whose changes are modelled relying upon the theory of Markov chains.

[7] This extension of the simple Hamilton filter entails an iterative EM algorithm to maximize the conditional likelihood function. The parameter vector is initialized selecting a preliminary set of values. The EM algorithm involves then an expectation step (E), where smoothed state probabilities are derived for every period of the sample; this step is followed by a maximization step (M), producing an updated vector of parameters, until convergence is eventually achieved. See Diebold-Lee-Weinbach (1994) for a more detailed and technical presentation.

In line with the above discussion, the next section applies a Markov-switching approach to the interest rate differential, drawing on various strands of theoretical literature to select a set of macroeconomic variables potentially affecting exchange rate credibility.

IV Macroeconomic Variables and Exchange Rate Credibility: Evidence from Markov-switching Models

Selection of relevant macroeconomic variables

As discussed in Section II, the existing literature maintains that, besides large imbalances in domestic public finances, a cumulative loss in external competitiveness exerted a major role in forcing the Italian Lira out of the ERM in September 1992.

The role of external shocks in ultimately breaking government's commitment to a fixed exchange rate policy has recently been analyzed in some endogenous policy models. In Andersen (1994), the currency crisis is triggered by random terms of trade shocks. In a similar vein, other contributions emphasizing spillover and contagion effects show how a speculative attack on one currency may sensibly reduce a trading partner's competitiveness, inducing a devaluation of its currency (Gerlach-Smets, 1994; Buiter-Corsetti-Pesenti, 1998). In this perspective, and with an eye to the Italian experience along the first half of the 90's, we select the real exchange rate and the current account balance as relevant exogenous variables potentially affecting the credibility of the LIT/DM exchange rate.

Another prominent influence outlined in escape clause models is represented by the performance of the real economy. As emphasized in this literature, negative unemployment or demand shocks increase government's temptation to generate an inflationary surprise, through an unexpected devaluation, in order to boost the real economy (see, among others, Drazen-Masson, 1994; Obstfeld, 1994). In line with these theoretical developments, we include real output dynamics (as proxied by monthly industrial production changes) among the set of real macrovariables.[8]

Reference to the endogenous policy approach exhaust all sources of speculative pressure identified in the current literature discussing the Italian

[8] Output dynamics or the unemployment rate are indifferently employed in the literature to model the performance of the real economy (although there is a clear preference towards the use of the former indicator: see Kaminsky-Lizondo-Reinhart, 1998). The present paper focuses on industrial production since official unemployment rate data are particularly misleading, in the case of Italy, due to the existence of a large share of hidden economy. Following a standard practice in the applied credibility literature, all relevant macroeconomic variables (with the exception of the inflation differential) are expressed in domestic rather than in relative terms. Spaventa (1994) and Thygesen (1994) criticize the use of fiscal and debt variables expressed in relative terms since only strictly national indicators should significantly affect exchange rate credibility. This argument can be easily extended to many other macroeconomic fundamentals and, as a consequence, the bulk of applied research uses variables expressed in domestic terms (see, among others: Mizrach, 1995; Siklos-Tarajos, 1996; Jeanne, 1997; Ötker-Pazarbasioglu, 1997; Kaminsky-Lizondo-Reinhart, 1998).

experience. Nevertheless, in a wider perspective, it may also be interesting to assess the influence of other exogenous macrovariables on conditional state transitions.

Two alternative theoretical paradigms are natural points of reference at this purpose: the earlier literature on speculative attacks and the asset-market approach to exchange rate determination.

As regards the former strand of research, two variables play a leading role in Krugman-style models of currency crises: the growth of domestic credit and the level of foreign exchange reserves. Accordingly, both these variables are inserted among the set of relevant macroeconomic fundamentals.[9]

Turning to the latter framework, the asset-market-approach has clearly looser connections with the topics addressed in this paper, since it deals with exchange rate dynamics in a free floating context. Reference to the asset-market approach is however quite common in the applied EMS literature, in order to sharpen the focus on potential macroeconomic determinants of exchange rate credibility (Chen-Giovannini, 1994; Rose-Svensson, 1994; Thomas, 1994; Mizrach, 1995). Asset-market models emphasize purchasing power parity and money market interactions as main equilibrium conditions driving exchange rate dynamics.[10] This taken into account, in line with current applied research, we add the inflation differential and the rate of domestic monetary expansion to the set of exogenous variables potentially influencing transition probabilities.

Evidence from Markov-switching models

(i) Preliminary remarks

As motivated in Section III, our credibility indicator is represented by the raw interest differential. We focus on the 1-month nominal interest rate differential between Italy and Germany, using monthly data spanning from 1990.1 to 1995.8.[11]

The starting point of our empirical investigation involves the estimation of a Markov model with fixed transition probabilities. This task, already accomplished in Amato-Tronzano (2000), leads to a regime-switching model with innovation variance independent of the state, and where a *t*-distribution is used to compute

[9] These variables represent only an important subset of macroeconomic fundamentals associated with the earlier literature on speculative attacks. Hence, the results obtained in this paper should not be viewed as an exhaustive examination of the first generation of speculative attacks models against the second generation of multiple-equilibria escape clause models. As we will discuss later, our evidence does not support Krugman-style models whereas, to quote an example, Calvo-Mendoza (1996) develop a framework in which the variability of the M2/reserves ratio displays significant effects. See Blackburn-Sola (1993) for a comprehensive survey of the speculative attack literature.

[10] See Taylor (1995) for a recent survey of this literature.

[11] Approximately half of the sample is therefore characterized by a target zone for the LIT/DM exchange rate; along the latter half, conversely, the Lira was allowed to float freely on foreign exchange markets.

asymptotic standard errors.[12] Figure 1, reproduced from Amato-Tronzano (2000), plots the interest rate differential ($i - i^*$) together with the estimated probability of a not credible exchange rate regime, based on currently available information. As documented in this figure, this model tracks quite accurately the pattern of the Italian-German interest rate differential along the sample period.

Having identified a suitable regime-switching model, we search for potential underlying determinants of exchange rate credibility removing the assumption of fixed transitions probabilities, and letting state transitions depend on some exogenous macroeconomic variable. Our attention focuses therefore on coefficients β_1, β_2, expressing the links between conditional state transitions (p_t, q_t) and lagged exogenous influences (x_{t-1}).

The influence of each exogenous variable is assessed one at a time. This approach is consistent with most regime-switching research relying on time-varying transition probabilities, since a multivariate estimation entails serious computational difficulties in this context (see, for instance, Diebold-Lee-Weinbach, 1994; Durland-McCurdy, 1994). As pointed out in this literature, the functional

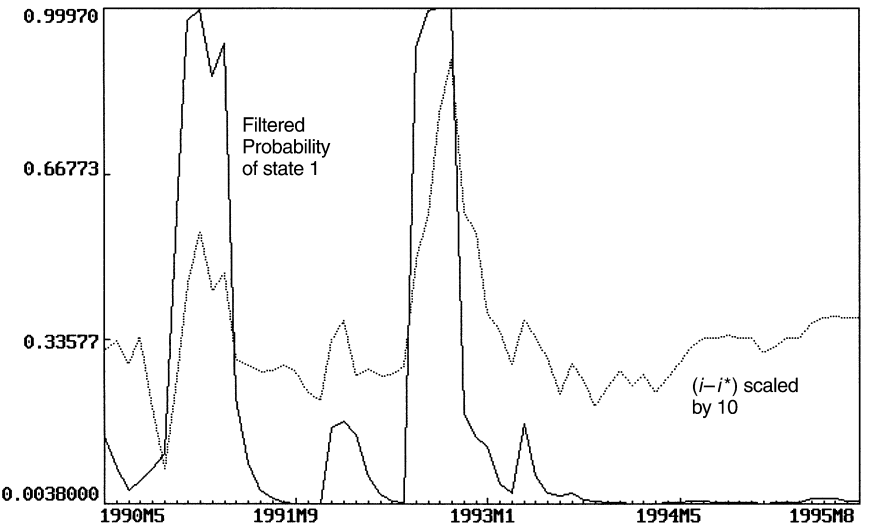

Figure 1. Interest rate differential and filtered probability of state one (not credible exchange rate regime).

[12] As discussed in Amato-Tronzano (2000), a preliminary empirical investigation was carried out allowing for Markov-switching specifications with different variances across alternative states. However, the iterative algorithm for numerical maximization of the conditional log-likelihood did not converge in these cases. In the final fixed transition probability model derived in Amato-Tronzano (2000), all estimated coefficients are highly significant while the model succeeds in separating a low-mean, credible state ($s_t = 0$), from a high-mean, not credible exchange rate regime ($s_t = 1$). Moreover, in line with our previous discussion (Section III, footnote 5), both states turn out to be fairly persistent. The reader is referred to Amato-Tronzano (2000) for a fuller description of preliminary work behind this final specification and more detailed comments about parameters estimates.

form implied by models with time-varying transition probabilities considerably complicates the evaluation in the maximization step: a multivariate analysis would therefore easily preclude convergence in the EM estimation algorithm described in section three.[13]

(ii) Parameters estimates

Table 1 contains empirical estimates from Markov-switching models with time-varying transition probabilities. The first two columns assume, respectively, domestic credit expansion and foreign reserves as forcing macrovariables. As previously discussed, both variables play a crucial role in the earlier generation of speculative attacks models. The next three columns include industrial production changes, the real exchange rate and the current account balance. These macrovariables capture the internal and external performance of the real economy which, according to the escape clause literature, can crucially affect government's commitment to a fixed exchange rate peg. In line with the asset-market approach, finally, the last two columns relate exchange rate credibility to the inflation differential and domestic money expansion.

As shown by α parameters, the estimated models clearly distinguish between a low-mean credible regime, and a high-mean not credible regime. The innovation standard deviation lies in a 0·44–0·50 range, while the first-order autocorrelation coefficient is slightly above 0·7 (third-last row).

Focusing on β parameters, this nonlinear econometric framework yields many interesting insights, usefully complementing the empirical evidence achieved in Amato-Tronzano (2000). These authors point out that fiscal and debt management indicators significantly affect devaluation expectations of the LIT/DM parity along the first half of the 90's. As documented in Table 1, the influence of these indicators is by no means exclusive, since exchange rate credibility reacts likewise to additional channels of macroeconomic influence.

A relevant distinction must however be drawn in this regard. Overall, neither speculative attacks models nor the asset-market approach receive much support by our estimates; conversely, all real macrovariables related to the escape clause framework display a strong influence on devaluation expectations. Most real macrovariables appearing in Table 1 capture the degree of external competitiveness of the Italian economy. On the whole, therefore, our evidence provides robust empirical support to the existing EMS literature which underlines, albeit in purely descriptive terms, the crucial role of a cumulative loss in external competitiveness during the 1992 Lira crisis.

Taking a closer look at β coefficients, Krugman-style models of currency crises are at odds with our evidence. Domestic credit expansion does not exert any appreciable effect: neither β_1 nor β_2 are statistically significant (Table 1, first

[13] Note, at this purpose, that simulation experiments performed in Diebold-Lee-Weinbach (1994), where conditional probabilities are driven by a *single* forcing variable, show that convergence in the EM algorithm is achieved *only* after 462 iterations. In order to simplify computational issues, Durland-McCurdy (1994) estimate a Markov model of US GNP growth where the only variable affecting state transitions is 'duration' (defined as the number of periods that the system has been in a particular inferred state).

TABLE 1
Markov-switching models with time-varying transition probabilities

	ΔCRED	RES	ΔPROD	REX	CUR.BAL.	INFL.DIF.	ΔMON.
α_0	3.031	2.940	3.015	2.953	2.957	3.051	2.998
	(12.17)	(13.36)	(12.65)	(11.29)	(13.40)	(11.09)	(13.23)
α_1	1.846	1.608	1.956	1.677	1.615	1.868	1.674
	(6.41)	(5.29)	(9.64)	(3.72)	(5.47)	(9.50)	(4.54)
σ	0.487	0.438	0.453	0.441	0.438	0.501	0.450
	(4.00)	(7.46)	(10.45)	(4.47)	(7.35)	(2.10)	(6.19)
consp	1.541	1.287	2.731	19.24	1.703	2.566	0.942
	(1.02)	(0.71)	(1.78)	(0.86)	(1.88)	(1.14)	(0.85)
β_1	3.205	−0.073	−1.165	−2.407	0.207	−0.404	1.606
	(0.06)	(−0.21)	(−2.40)	(−0.86)	(0.84)	(−0.64)	(1.44)
consq	2.979	7.318	3.831	−14.43	3.172	3.268	2.823
	(5.07)	(2.60)	(3.73)	(−3.31)	(4.74)	(4.56)	(4.78)
β_2	−2.691	−1.041	0.425	2.180	0.532	−0.166	−0.144
	(−0.03)	(−1.96)	(2.29)	(3.87)	(2.81)	(−0.45)	(−0.40)
AR(1)	0.743	0.738	0.753	0.741	0.748	0.742	0.734
DF	4.172	6.443	5.869	5.753	5.007	3.606	5.031
	(0.78)	(1.05)	(0.78)	(0.77)	(1.35)	(0.65)	(1.04)
LOG-LIK	−59.60	−59.41	−55.97	−58.04	−59.88	−58.88	−58.71

Notes:
t-statistics in parentheses below parameter estimates.
State Zero ($s_t = 0$): credible state; State One ($s_t = 1$): not credible state.
α_0, α_1 are the coefficients related to the means of the two states. These means are parametrized as follows:

$\mu_0 = \alpha_0$ (mean in state zero);
$\mu_1 = \alpha_0 + \alpha_1$ (mean in state one).

σ is the innovation standard deviation (assumed to be equal across alternative states).
Coefficients consp, β_1, consq, β_2, refer to the parametrizations of the (time-varying) transition probabilities (see Section III).
AR(1) is the autoregressive parameter of the stochastic AR(1) process driving the interest rate differential.
DF is the degrees of freedom parameter since, due to the existence of not normally distributed errors, asymptotic standard errors are computed through a *t*-distribution.

Macrovariables appearing in this table are defined as follows:

ΔCRED: Change in Total Domestic Credit (Italy);
RES: Foreign Exchange Reserves (Italy);
ΔPROD: Change in Total Industrial Production (Italy);
REX: LIT/DM Real Exchange Rate (based on relative consumer prices);
CUR.BAL.: Current Balance (Italy);
INFL.DIF.: Inflation Differential between Italy and Germany;
ΔMON.: Change in Domestic Money Supply (Italy).

column); turning to foreign reserves, β_1 is not significant whereas β_2 is incorrectly signed (Table 1, second column).[14] These findings are only partially

[14] Note, however, as pointed out by one referee, that this lack of support for the first generation of speculative attacks models could partly depend on the simple lag structure associated to our nonlinear econometric framework. As regards domestic credit growth, Kaminsky-Lizondo-Reinhart (1998) found that two-year lagged domestic credit formation was among the key determinants of a currency crisis. In a similar vein, the negative value of β_2 for foreign reserves should not be too surprising given the frequency of the data and the lag structure used. If the probability of being in a low-credible state moves with the interest rate, reserves are likely to climb at time $(t-1)$ (in response to an increase in the domestic interest rate), producing a decrease (rather than an increase) in the conditional probability of remaining in a credible state at time (t). The reversal of the expected causal relationship between foreign reserves and exchange rate credibility could therefore reflect a typical endogeneity problem.

consistent with previous applied research, where foreign reserves have generally been found to exert some impact on devaluation expectations.[15]

Macrovariables related to the asset-market approach denote a relatively modest influence. Considering the inflation differential, both coefficients are not statistically significant. On the other hand, in line with theoretical implications, a positive change in domestic money supply negatively affects devaluation expectations (β_1 positive and significant in Table 1, last column). On the whole, the modest influence of these variables is not surprising, in view of the traditionally poor empirical performance of asset-market models of exchange rate determination; our findings, moreover, are broadly consistent with the existing evidence.[16]

In sharp contrast with the above results, macroeconomic fundamentals related to the escape clause literature display much stronger credibility effects. This finding holds both for indicators of domestic real activity (changes in industrial production) and for external equilibrium indicators (real exchange rate, current account balance).

As shown in Table 1, our estimates reveal that the influence of industrial production changes is twofold. A positive variation in real domestic activity lowers the conditional probability of a not credible regime (β_1 negative and significant, third column), while increasing that of a credible state (β_2 positive and significant, third column). These strong credibility effects confirm one basic conclusion of escape clause models, according to which adverse economic conditions can make it costly for the government to defend a fixed parity (and thus more likely the occurrence of a speculative run leading to an adjustment in the exchange rate). These findings, moreover, deserve particular attention since previous research has usually failed to detect significant links between output dynamics and devaluation expectations.[17]

Turning to other real macrovariables, an improvement in external competitiveness (as captured by an increase in the real exchange rate) increases the conditional probability of a credible exchange rate regime (β_2 positive and

[15] Relying upon the drift-adjustment approach, both Thomas (1994) and Siklos-Tarajos (1996) report some significant influence of foreign exchange reserves. A similar finding is achieved in Ötker-Pazarbasioglu (1997), using a Probit approach to estimate the one-step-ahead probability of devaluation as a function of a set of speculative pressure indicators. Note, however, that the temporal range selected in all the above papers (1979–1992) is quite different from that considered in the present work. As far as domestic credit growth is concerned, our results are instead consistent with those of Ötker-Pazarbasioglu (1997), where an expansionary credit policy does not significantly affect the one-step-ahead probability of devaluation of the Italian Lira.

[16] Applied research on the LIT/DM exchange rate based on the drift-adjustment approach reveals that the effects of the inflation differential are either incorrectly signed (Chen-Giovannini, 1994, Table 7.1B), or ambiguous (Thomas, 1994, Tables 4–6). Using a nonlinear econometric framework nesting alternative target zone models, Mizrach (1995) does not detect a relevant influence of domestic money supply on the probability of realignment.

[17] Chen-Giovannini (1994) and Siklos-Tarajos (1996) find that relative industrial production between Italy and Germany is either not significant or incorrectly signed. Mizrach (1995) reports only very weak effects of domestic output on the probability of realignment. Ötker-Pazarbasioglu (1997), using the unemployment rate as a proxy for real domestic activity, document instead a more significant influence on the one-step-ahead probability of devaluation of the Italian Lira.

significant, fourth column). An analogous favourable effect is associated to an improvement in the current account balance (β_2 positive and significant, fifth column). The joint significance of parameters associated to alternative external equilibrium indicators is consistent with the current consensus view about the recent Italian experience, stressing the negative influence of large cumulative external imbalances (see Section II).[18] In a wider perspective, moreover, this result supports another crucial point made in the theoretical literature, namely that, for a small open economy, a worsening of external constraints can negatively affect government's commitment to a fixed exchange rate peg.

(iii) Time patterns of transition probabilities

Parameters estimates analyzed in the previous sub-section highlight strong credibility influences stemming from different real macrovariables. This empirical evidence can be profitably supplemented by examining in some detail the time pattern of conditional probabilities related to the escape clause literature. Consider, first, credibility effects associated to external equilibrium indicators.

Figure 2 plots the conditional probability of a credible exchange rate regime, assuming the real exchange rate as forcing macrovariable. As shown in this

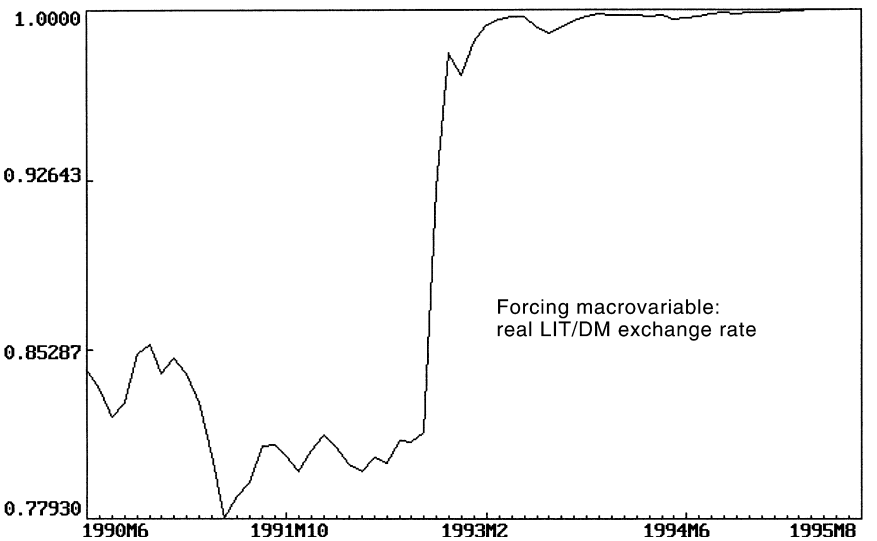

Figure 2. LIT/DM exchange rate: conditional probability of a credible state.

[18] Although external imbalances unambiguously played a crucial role during the latest Lira experience, applied work dealing with earlier EMS periods has generally reached opposite conclusions. With the exception of Mizrach (1995), all previous papers do not find an appreciable influence of the real exchange rate (Chen-Giovannini, 1994; Thomas, 1994; Siklos-Tarajos, 1996; Ötker-Pazarbasioglu, 1997). According to Chen-Giovannini (1994), moreover, the relative trade balance between Italy and Germany did not significantly affect devaluation expectations (sample periods: 3.79–1.92; 9.87–1.92).

figure, along the initial part of the sample this conditional probability swings around relatively low values, reaching an all-time low in 1991.5. Since September 1992, in connection with the Lira devaluation and its temporary exit from the ERM, a dramatic credibility increase is apparent, with the above indicator jumping towards near unitary values until the very end of the sample. This sudden large turnabout corroborates our previous evidence, documenting how a cumulative deterioration in external competitiveness was among the main factors behind the 1992 Lira crisis.

Credibility effects associated to the current account balance are qualitatively similar (Figure 3). The conditional probability of a credible exchange rate regime is now extremely unstable along the first half of the sample, reaching an all-time low in February 1991 as a consequence of a large current account deficit in the previous month (Figure 4). A notably different pattern characterizes instead the latter half of the sample. The September 1992 devaluation gradually removed the external constraint, as witnessed by consistent current account improvements since early 1993. This, in turn, prompted a major structural change. As shown in Figure 3, since January 1993 this conditional probability swings permanently inside a high-value range, pointing out a remarkable credibility increase with respect to previous months.

Consider, finally, credibility effects induced by variations in real domestic activity.

Figure 5 plots the conditional probability of a credible exchange rate regime, assuming industrial production changes as forcing macrovariable. In this case, the time pattern displays a high variability along the full sample, closely mimicking the evolution of the underlying forcing variable (see Figure 6). Actually, a careful comparison between Figures 5 and 6 reveals that every

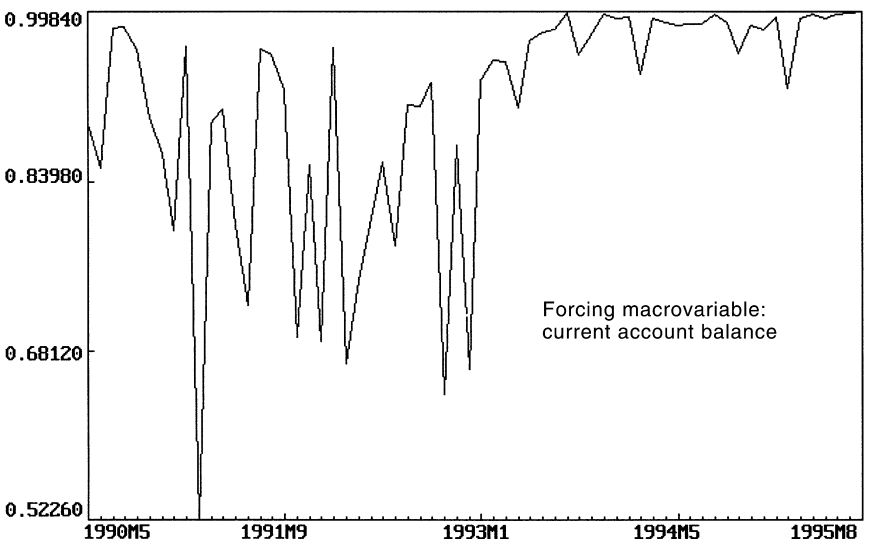

Figure 3. LIT/DM exchange rate: conditional probability of a credible state.

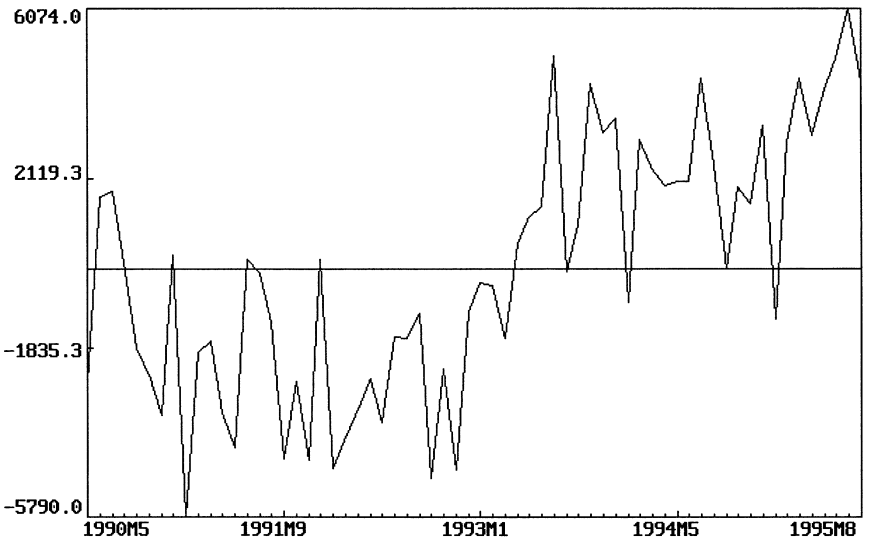

Figure 4. Italy: current account balance.

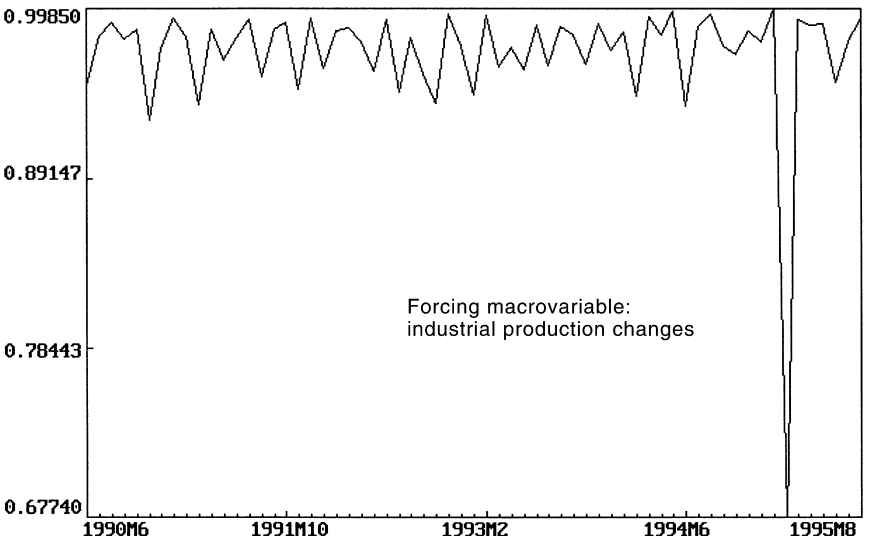

Figure 5. LIT/DM exchange rate: conditional probability of a credible state.

increase (decrease) in exchange rate credibility is systematically related to increases (decreases) in real domestic activity occurring in the previous month. As documented in Figures 5–6, this robust influence is particularly evident towards the end of the sample: in January 1995, a major drop in industrial production induces a very large credibility decrease in the subsequent month. This visual evidence lends further support to our previous empirical estimates,

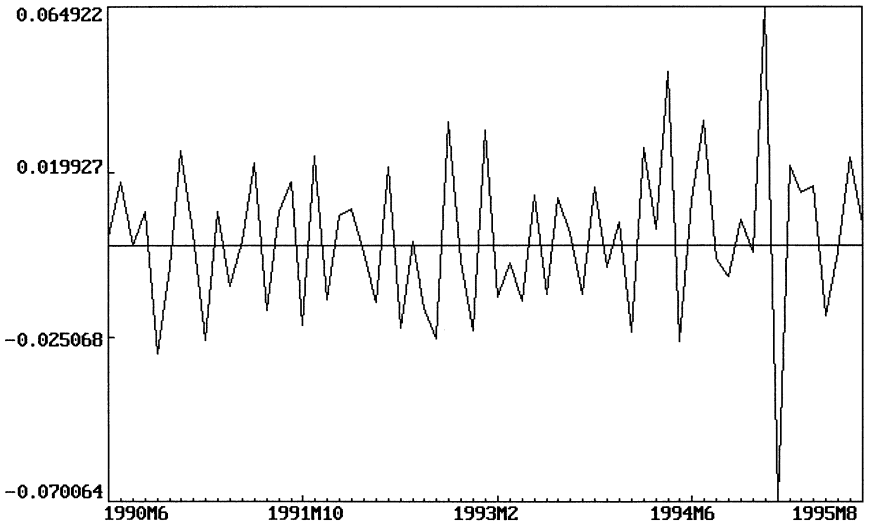

Figure 6. Italy: changes in industrial production.

reiterating the strong influence of domestic output on the credibility of the LIT/DM exchange rate.[19]

V Concluding Remarks

Analyzing the Italian experience in the 'New EMS' and focusing in detail on 1992 events, Fratianni-Artis (1996) conclude that:

> There is little doubt that the Italian fundamentals were weak: the forward price of the lira had been consistently outside the upper limit of the band. Our formal tests show that there was no tendency for the lira to revert to the mean of the ERM band. In sum, the participation of the lira in the ERM was not credible (Fratianni-Artis, 1996, p. 587).

[19] The pace of economic expansion slackened in early 1995, mainly as a consequence of a decrease in inventories, following rapid accumulation in the previous six months (OECD Economic Surveys, Italy, 1995–1996, p. 8). Since we use log differences of the raw industrial production series, our data emphasize this temporary slowdown in real domestic activity. As regards our empirical findings, one referee pointed out that industrial production does not seem to be a particularly good indicator of when credibility is low or high, because the conditional probability of a credible state associated to this variable swings almost permanently around high values (including the period in which Italy actually devalued, see Figure 5). I take this point: the time pattern of transition probabilities clearly suggests a major influence of external macrovariables along the September 1992 currency crisis (see Figures 2–3 as opposed to Figure 5). However, this by no means implies that, overall, domestic output exerted negligible effects on exchange rate credibility. As discussed in the main text, looking at the sample period as a whole, credibility turns out to be systematically related to real domestic activity. Moreover, as remarked in the previous sub-section, domestic output is the only macrovariable displaying a twofold effect on credibility (since both β_1 and β_2 are significant and correctly signed in this case).

Visual evidence provided by these authors, based on cumulative differences towards Germany, shows that Italy and the United Kingdom were the EMS countries with the worst fundamentals in terms of inflation, output growth and real exchange rate appreciation. The role of cumulative external imbalances in forcing the Italian Lira out of the ERM in September 1992 is commonly recognized in the current EMS literature. The consensus view is that, beside strong imbalances in domestic public finances, a sensible deterioration in international competitiveness made ultimately not credible the existing Lira parity.

A major flaw of current applied research, however, is that potential sources of pressure on the Lira exchange rate have not been submitted to rigorous empirical investigation.

This paper fills this gap in the literature through a nonlinear econometric framework emphasizing shifts between credible (low expected devaluation) and not credible (high expected devaluation) exchange rate regimes. Although this framework incorporates important nonlinearities and persistency effects, allowing to test alternative theoretical models of currency crises, it cannot establish which set of macroeconomic variables are more important in driving exchange rate credibility. In this perspective, while Amato-Tronzano (2000) document relevant credibility influences associated to various fiscal and debt management indicators, this paper usefully complements this evidence pointing out that the LIT/DM exchange rate reacted to additional channels of macroeconomic influence.

On the whole, neither speculative attacks models nor the asset-market approach receive support by the empirical evidence; on the other hand, all real macrovariables related to the escape clause framework display a strong influence on devaluation expectations.

Empirical estimates of Markov-switching models with time-varying transition probabilities reveal that both indicators of domestic real activity (industrial production changes) and external equilibrium indicators (real exchange rate, current account balance) significantly affected exchange rate credibility during the first half of the 90's. Focusing on the September 1992 crisis, the time pattern of conditional probabilities provides robust empirical support to descriptive interpretations of this event, reiterating the major influence of external macrovariables in triggering the speculative attack against the Lira. Overall, moreover, our evidence draws attention on the influence of domestic activity on the ultimate sustainability of a fixed exchange rate commitment, an issue virtually neglected in the previous literature.

These findings have relevant policy implications both in retrospect and concerning Italy's future prospects inside the EMU. As regards the former aspect, the strong influence of the external constraint on devaluation expectations supports the cautious monetary policy stance taken by monetary authorities during the second half of the 90's. After the Lira re-entry in the ERM in November 1996, and along the final transition phase towards EMU, this disinflationary policy significantly enhanced exchange rate credibility, avoiding further cumulative external imbalances and ultimately allowing Italy to join the monetary union from the very beginning. The stabilizing effects of this policy are

witnessed by the substantial stability of the Lira in more recent years, and by the gradual decrease in the spread between Italian and German financial assets.

Turning to future prospects, another result achieved in this paper, namely the strong influence of real output on devaluation expectations, has far-reaching policy implications. Related to the present context of irrevocably fixed exchange rates, this finding reiterates one basic point raised in the theoretical literature on optimal currency areas, which emphasizes the disruptive effects of asymmetric real shocks in the presence of nominal rigidities and low labour mobility. Recent empirical research using structural VAR methods suggests that, differently from other European countries, in France and Italy monetary and financial shocks typically account for between 45 and 68% of output variability over a 1 to 10 quarter horizon (Nikolakaki, 1996). This evidence apparently reinforces Italy's relative position inside the EMU, since LM-type shocks are actually best dealt with a fixed exchange rate regime. Nevertheless, as shown in the present paper, negative real shocks induce a highly destabilizing influence on the Italian economy, which should anyway be seriously taken into account in the design of future economic policies.

In this perspective, our empirical investigation implies that structural supply-side policies will indeed become crucial, in the years ahead, to ensure a credible permanence of Italy inside the EMU. Among them, an increase in labour mobility and labour market flexibility, and sound infrastructural policies to promote satisfactory long-run growth in Southern Italy are, in our opinion, on the top of the policy agenda for the next decade.

ACKNOWLEDGEMENTS

This paper was presented at the 14th Annual Congress of the European Economic Association (University of Santiago de Compostela, Spain, 1–4 September, 1999). The author is grateful to Eric Girardin, Olivier Jeanne and two anonymous referees for useful comments and suggestions. The usual disclaimer applies.

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Date of receipt of final manuscript: 12 October 2000.