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THE ROLE AND NATURE OF MARKET SENTIMENT IN THE 1992 ERM CRISIS

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September, 2002[♦]

Abstract:

This paper attempts to explain the importance of the role of the speculators in determining the 1992 ERM crisis, and the effects that the policy of maintaining external parity had on internal growth. We focus on a different way through which expectations are formed about the macroeconomic fundamentals independently of the behaviour of the monetary policy. In the present model, agents' *rational beliefs* do not emerge from arbitrary circumstances but only when the value of the exchange rate, kept under control by the central bank, did not correspond to the expected value and to the current wide-spread beliefs in the market.

Keywords: Exchange Rate, Financial Crisis, Market Sentiment, Kalman Filter.

JEL Classification: E58, E65, F31

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[♦] We would like to thank, for useful comments and criticisms, the participants to the International Conference MMF-UEM (Money, Macro and Finance and Understanding the Evolving Macroeconomy Programme Conference), 4-6 September 2002, Warwick, UK.

Introduction

In the last ten years economic literature has produced numerous works to explain Italy's withdraws from the Exchange rate Mechanism (ERM) in the 1992, when fixed parity was abandoned and the exchange rate was left free to fluctuate.

In fact, prevalent models give only a partial explanation of the events, in the sense that, although they identify the variables on the basis of which operators formulate their decisions, they assume the hypothesis that expectations are either adaptive or rational. In any case, it seems that the events of that period can be regarded from another perspective in order to bring out, with greater clarity, the variables which determinate the course of the exchange rate[1].

Following the contribution of De Grauwe (2000) we intend to take a different route. We assume that expectations are not formulated on the basis of analytical evaluations of the behaviour of the economic authorities, but rather they may be understood as *rational beliefs* founded on *market sentiment*. The *rational beliefs* are formed in the market on the basis of the observation of events and intuitions regarding the future course of the market and they might wind up determining the monetary authorities' policies. This intuitions is based on the idea that probability which is assigned by agents to the realization of future events is not strictly quantifiable nor necessarily based on the analytic representation that is given by the authorities, but rather is the result of a rational complex process based on the observation of those variables which, at that time are considered to be relevant.

From the empirical analysis we explain how operators determined the abandonment of the fixed parity. Furthermore the intervention of the Central Bank sets to defend the value of the exchange rate were made useless since the variables observed by agents gave indication contrary to those used by the authorities for the control of the external value of money.

[1] For more information see P. Del Giovane (1994), L. Bini Smaghi O. Tristani (1995) and P. G. Hopper (1997).

The work is organized as follows: in the second section recent contribution to the explanation of the currency crises will be briefly examined to show how our report may be included in the context. In section three the model is presented in its theoretical and econometric form. Conclusions are presented in the final section.

The evolution of currency crises models: an overview.

The framework in which the models of currency crisis are included is the monetary approach to the balance of payment. It has origins that may be traced back to Mundell (1968, 1971), and Johnson (1972)[2], latter evaluated further by the contributions of Dornbush (1976), Frenkel (1976) and Bilson (1978). There are two groups that maybe referred to for the simplicity of their models explaining the currency crisis: the first is the 'Krugman group'[3] –which identifies the cause of abandonment of parity in the exhaustion of currency reserves- and second is the 'Kydland and Prescott group'[4] – according to whom the economic authorities try to maximise a utility function or minimise a loss function. Based on this the Central Bank would regulate whether to keep or to adjust the band of fluctuation of the exchange rate[5].

The models that follow the path outlined by Krugman's contribution identify the main causes of the evaluation in the mismanagement of fiscal and monetary policy. In fact, the excessive budget deficit and the consequent excess of public debt called for a tighter monetary policy (i.e. an increase in the interest rate). This increased the probability for a monetization of the debt, determining higher inflation expectations by the operators. This latter circumstance had induced financial speculators to convert national currency to foreign currency in the *belief* that the latter would be able to hold its internal value constant. The exchange rate regime forced the Central Bank to back up these requests, exhaust its own stock of reserves available and guarantee international lines of credit. The prolonged use of the reserves would, at the end,

[2] These authors linked the conclusions they reached using open market models with the monetary models made by Friedman (1956), and Patinkin (1956).
[3] Krugman (1979 e 1991), Buiter (1987) are good examples of this approach.
[4] See also Kydland e Prescott (1977) and Obstfeld (1986 a e b).

determine the abandonment of fixed exchange rate and the choice of a regime of flexibility. The Bank of Italy in the attempt to oppose inflationary expectations in those years adhered to a tighter monetary policy but this behaviour seems to confirm the idea proposed in these models that the dimensions of fiscal imbalances were unsustainable, and sooner or later the monetary authorities should have printed money.

The economic literature that examines the second stream of analysis support the idea that is always possible to preserve an adequate portion of the reserves and that the main cause of the abandonment of the exchange rate is identifiable in a conflict among the objectives of the economic policy. In fact, the authorities have not only the responsibility of managing fixed parity but also that of maximizing a utility function (e.g. the growth of income) or minimizing a loss function. According to this point of view it would have been more important (e.g. in the currency crises in 1992), to avoid a recession with high unemployment rate –caused by mismanagement of fiscal policy than to maintain the regime of fixed exchange rate. Therefore, the Bank of Italy preferred to maintain a single objective function, which was considered of primary importance in its choices. These decisions would be determined by the circumstance that the agents had rational expectation; and that, namely, they were able to predict that the balance between the credibility of monetary policy and the costs in preserving it had become unbearable.

Both groups of models provide an interesting indication regarding an explanation of currency crisis, but it is possible, however, to identify some limits that restrict their ability to explain the events. The first group, in fact, do not consider the effect induced and the social costs generated by the commitment of the authorities to defend the level of exchange rate. Further, focusing only on the role of the official reserves and on the behaviour of the speculators put in second place the choices of the other agents and the effect on growth and employment. The second group assumes that the economic agents are rational in forming their expectations and they have perfect knowledge of the Central Bank economic model. If it had been so in those years, the perseverance of the Bank of Italy to control the quantity of money through

[5] The main theoretical contributions are Jeanne (1995) and Spadafora (1999). Tronzano (2001) made a

movements in interest rate would have excluded real effects and been sufficient to preserve the fixed exchange rate.

Diverging from the previous analysis, our model underlines the importance of the role of the speculators in determining the exchange rate, and the effects that the policy of maintaining external parity has on internal growth. It proposes, however, a different way through which expectations are formed about the macroeconomic fundamentals independently of the behaviour of the monetary policy.

In other words, the usual relationship of causality between monetary policy actions and expectations of the exchange rate would have been inverted at that time. The behaviour of the Bank of Italy was influenced by the beliefs of the market agents.

The Theoretical Model

In the previous paragraph we underline the central role of expectations in determining the abandonment of parity. The first group of models, in fact, indicate the importance of the expected value of currency, while the second one underlines, on the other hand, the importance of the expected future income.

In our model, besides considering both expected values, we intend to show the direction of causality from the formation of expectations of the exchange rate and income towards the conduct of monetary policy; so that the formulation of widespread *beliefs* on *market sentiments* would have end up determining the sequence of events in the currency crisis of 1992.

The analysis of the *market sentiment* model can be developed in two faces: in the first, we try to identify analytically the components that embodied *market sentiments*; in the second we develop a quantitative analysis that allows a study of the influence of rational beliefs on the exchange rate market and points out the direction of causality indicated previously.

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similar approach.

In order to model the market sentiment we need to define how economic agents form their expectations. Let us, therefore, assume that there are N economic agents and J fundamental variables and their expectations can be formally expressed as:

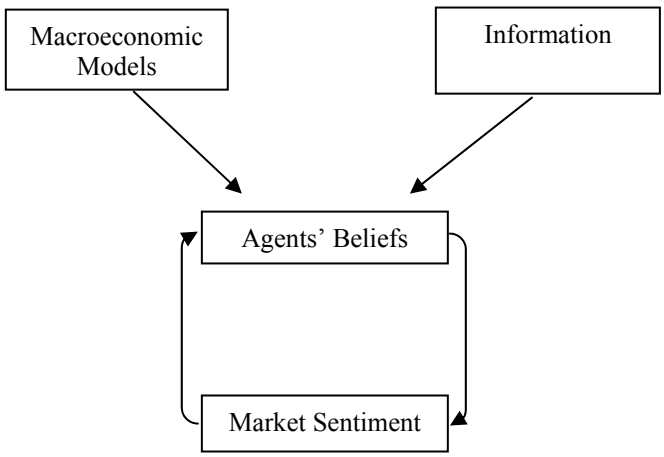
$$\frac{\sum_{i=1}^{N}\sum_{j=1}^{J}\varpi_{i,t+1}z_{j,t+1}}{\sum_{i=1}^{N}\varpi_{i,t+1}} \tag{1}$$

Where "ϖ_i" is the probability that each operator assign to the verification of a certain events, or *rational beliefs* on the basis of *market sentiments* and $z_{j,t+1}$ is the fundamental variable to which the probability is attached. The intuition behind the rational beliefs can be found on Keynes' Treatise of Probability (1920, p.3-4), where he wrote:

> "All propositions are true or false, but the knowledge of them depends on our circumstances; and while it is often convenience to speak of propositions as certain or probable, this expresses strictly a relationship in which they stand to a *corpus* of knowledge, actual or hypothetical and not a characteristic of the propositions in themselves. […] The theory of probability is logical, therefore, because it is concerned, with the degree of belief which it is *rational* to entertain in given conditions, and not merely with actual beliefs of particular individuals which may or may not be rational."

One of the straightforward applications of the above statement is that that exchange rates could be determined by how economic agents perceive the information and on the importance attached to this, in relation with the market sentiment and the macroeconomic model used. Then, on the basis of the perceptions of events, each economic agent will formulate his/her own choices. This in turn, will tend to be confirmed in a "*self-fulfilling"* view of expectations. Thus the expected final value represents the interpretation of the future value of the fundamentals on the basis of the *market sentiment* prevalent on that moment. Under this view, the exchange rate can be seen as the result of a self-fulfilling process as shown in graph 1.

Graph 1: Self-fulfilling Economic Process



Given the great availability of information, we start from the assumption that exchange rate market is efficient. Although this might be a strong assumption, in our view the market processes and uses all the information available in the best way. This does not mean that we eliminate the forecasting error, but this is the result of the market sentiment. In other words the error could have a systematic component. In order to examine the exchange rate movement, we can write:

$$e_{t+1} = \mathrm{E}_t\left(e_{t+1} \mid I_t\right) + \beta_{t+1}\left[Z_{t+1} - \mathrm{E}_t\left(Z_{t+1} \mid I_t\right)\right] + \varepsilon_{t+1} \qquad (2)$$

Where e_{t+1} is the exchange rate at period t+1; $E(e_{t+1})$ represents the expected value of the exchange rate given the set of information *I* available at time t. in other words that component anticipated by market agents (I_t); $[Z_{t+1} - E_t(Z_{t+1}|I_t)]$ represent the news or surprises that are tied to variation of fundamental variables (*Z*); finally e_{t+1} is the error term following a white noise process. The set of information at time "t" is composed of the historical series of the fundamental variables prominent in the previous period, $I_t = (Z_{t-n},..Z_{t-i},....Z_t)$.

As just described, the aspect that is important for the purposes of the analysis of the market sentiment is given by the value of the coefficients, in our case "β" of Eq. (2).

To be able to capture the dynamics of the parameters of the model we start writing Eq. (2) in its state space form. The state-space representation can, then, be used to compute the estimates of a state vector for t = k + 1; k + 2; :::; T using the Kalman filter. This recursive algorithm, in fact, computes the linear lest square of the forecasted state vector given data observed at time t. To illustrate the evolution of the coefficients, we estimated a time-varying parameters (TVP) model of the following form in compact matrix notation:

$$e_t = \mathbf{Z}\beta_t + \mu_t \qquad \textit{(transition equation)} \qquad (3)$$

$$\beta_t = F\beta_{t-1} + \eta_t \qquad \textit{(measurement equation)} \qquad (4)$$

$$\mathbf{Z} = \begin{pmatrix} c^1 & z_{t-1}^1 & \cdots & \cdots & z_{t-1}^k \\ \vdots & \vdots & \cdots & \cdots & \vdots \\ \vdots & \vdots & \cdots & \cdots & \vdots \\ \vdots & \vdots & \cdots & \cdots & \vdots \\ c^k & z_{t-n}^1 & \cdots & \cdots & z_{t-n}^k \end{pmatrix} \qquad e_t = \left[e_{t-1}, e_{t-2}, \ldots, e_{t-n} \right]$$

$$\beta_t = \left[\beta_{t-1}, \beta_{t-2}, \ldots, \beta_{t-n} \right] \qquad \mu_t = \left[\mu_{t-1}, \mu_{t-2}, \ldots, \mu_{t-n} \right]$$

The Z_t matrix, of dimension (Txk), contains the fundamental variable. We now have the state vector β_t, a (kx1) vector that contains all the slope coefficients, which are now varying through time. The F matrix, of dimension (kxk), contains the autoregressive coefficients of β_t. We allow the coefficient β_t to follow a random walk process. The error terms are assumed to be independent white noise $Var(\mu_t) = Q; \quad Var(\eta_s) = R; \quad Var(\mu_t \eta_s) = 0$ for all t and s.

For each endogenous variables of the model it is therefore possible to observe how the respective coefficients are changing over time by the effect of changing in the market judgment. If we calculate for every coefficient the first difference, we can quantify how the market sentiments are modified by each independent variable.

$$\underset{t-2,t-1}{\Delta} \beta_i = \beta_i^{t-1} - \beta_i^{t-2} \qquad (6)$$

Eq. (6) expresses how the weight has changed in successive times, attributed and deduced by the market, relative on the expectations of the *i-inth* variable. This represents another component of the market sentient.

Empirical Analysis

The choice of the model was based underneath to include among the main variables considered those that where able to determine variations in the expectations of the Italian Lira/ Deutschland Mark exchange rate for the time period under investigation. In fact, it is on these variables that economic agents form their expectations representing the core of the analysis.

The model is composed of two parts. In the first we precede to the estimation of the Kalman Filter how presented in the previous paragraph. In the second, on the basis of the indication given by the estimates of Eq. (1), we make a forecast of the exchange rate for the period 1990:01-1992:09. This allows us to support the main idea that market fundamentals followed by the economic agents where different from those considered by the Central Bank.

Following De Grawe (2000) and Corsetti (2000) we decide to include in our set of fundamentals the differentials between Italy and Germany of the expected value of the output growth and of inflation, the differential of the interest rate and the money supply[6].

The model can be represented in its state space form by the following equations:

$$S_t = b_{0,t} + b_{1,t} EDIFIP_t + b_{2,t} EDIFINF_t + b_{3,t} DIFINT_t + b_{4,t} DIFM2_t + \xi_t \qquad (6)$$

[6] We tested for the inclusion of other macroeconomic variables, but none of them appeared to be significant, therefore they where dropped from the analysis.

$$b_{0,1..4,t+1} = b_{0,1..,4,t} + \vartheta_{0,1..,4,t} \quad (7)$$

In Eq. (6) the variables for the period 1987:4-1996:12 are constructed as the follow[7]. St is the log of the exchange rate Italian Lira- Deutschland Mark; EDIFIP is the differential of the expected value of the annual rate of growth between the Italy and Germany; EDIFINF is the differential of the expected value of the annual inflation rate. These two variables have been constructed following and AR(n) process regressing output growth/inflation on a constant and on its own values in the previous periods. DIFINT is the difference of the monthly Eurolira and Euromark interest rate; DIFM2 represents the difference of the rate of growth of the money supply measured as M2[8].

Figs. A-D in Figure 2 represents the evolution of the coefficients estimated in Tab. 1 for the period under investigation. On the other hand, the graphic analysis indicates how the weights (i.e. the pattern of the coefficients) of the differential of expected rate of growth of income and inflation are diverging from their trend at the end of the 1991. On the other hand, the coefficients of the variables in Fig. 2C and Fig. 2B show a persistent stability for the entire period of time except in proximity of the September 1992 crisis. This leads us to consider that the market operators used fundamental variables like EDIFIP and EDIFINF as a base to carry out their expectations of the exchange rate. Contrarily, the behaviour of the coefficients of DIFINT and DIFM2 seems to be more consistent with the fundamentals followed by the Central Bank. From the results of the estimated model, it appears that operators used a more restricted series of variables, such as EDIFIP and EDIFINF, to carry out their forecast. On these two, agents seem to have almost totally omitted other fundamental variables that, according to economic theory, should have been taken into account. On the basis of the indications provided by the estimation of the Eq. (6) and from the analysis of the coefficients in Figure 1, we precede to the estimation of the followings equations[9]:

[7] All data are from the IMF-Financial Statistics collected by DATASTREAM. Plots of the variables are presented in appendix, figure 1.
[8] The plot of the explanatory variable is presented in the Appendix, Figure 1.
[9] S:E: in parenthesis.

$$S_t = 6.821561 + 9.101297 EDIFIP_t - 17.18452 \text{EDIFINF} + \varepsilon_t \quad (8)$$
$$(0.0243) \quad (1.6781) \quad (3.6411)$$

$$S_t = 6.689 + 0.092 DIFINT_t + e_t \quad (9)$$
$$(0.032) \quad (0.047)$$

The first equation tells us that only on these variables previously identified as fundamental variables in determining the market sentiment have been considered as variable explicative of the exchange rate. The results are presented in Table 2. On the basis of the Eq. (8) we then proceed to make a prediction of the dependent variable for the period 1990:1-1992:09. The shaded area in Figure 3 shows the course of the nominal exchange rate and that predicted by the rational beliefs of market agents. The "S" curve describes the course of the exchange rate for the period examined. It is worth to note, the bifurcation of the expected rate and the actual value is seen around the end of 1991, about a year before the crisis. The model tells us that, despite the fact that monetary authorities considered more important to maintain a policy of strong exchange rate (that is, to avoid a realignment in the system as established by the 1979 agreement), agents carried on forming their expectations in an even more *self-fulfilling* way. As the time went on agents become convinced that the Italian Lira was suffering from an appreciation in real term and that the differential of income would keep increasing, an even ever greater divergence was determined.

In Eq. (9) we include the different in interest rate as explanatory variable of the nominal interest rate. We, consider this as the main indicator that the Central Bank followed during that period. Figure 4 present the in sample forecast for the period 1990:1-1992:09. From the analysis of the two forecasts we can assert, as mentioned earlier, that the line of causality of the exchange rate during early nineties goes from the agents' *beliefs* to Bank of Italy behaviour and not *vice versa*.

Conclusions

In this paper we have reached the following conclusions. Firstly, not all the variables included in the structural model contribute to the determination of the pattern of the exchange rate. In fact, from the econometric estimates it is clear that only the differential in income growth and inflation has a decisive role in the abandonment of the parity. Money supply and interest rate had no significant role in determining the upward pressure on the exchange rate, and this explain why the policy followed the Central Bank did not have any effect. Secondly, expectations on the differential of the output growth and inflation between Italy and Germany were the real determinants of the expected value of the exchange rate. Thirdly, the expected value of the exchange rate made on the basis of the wide-spread *beliefs* of the income growth and inflation ended up determining the value of exchange rate.

It can also be confirmed that, in the present model, the agents' *rational beliefs* do not emerge from arbitrary circumstances but only when the value of the exchange rate, kept under control by the central bank (this was the case of Italy for the period 1990:01-1992:09), did not correspond to the expected value and to the current wide-spread beliefs in the market. Moreover, on one hand, the Italian economy at that time lost its attraction for foreign investors and this certainly helped to reinforce a prevalent negative opinion about future value of the exchange rate. On the other hand, the depreciation of the fundamentals paved the way for speculation for which the exact moment was determined by the *market sentiment*.

Appendix

Table 1: Estimate Eq.(6)

	Periodo: 1987:04 1996:12
Variables	**Coefficients**
COSTANT	6.728930***
EDIFIP	9.747656***
EDIFINF	-25.81251***
DIFINT	0.217487***
DFM2	-6.890151***
Adjusted R-squared	0.422872
S.E. of regression	0.127380

Note: *, **, *** rappresent the significance level at 10, 5 and 1 percent.

Figure 1. Plot of the variables

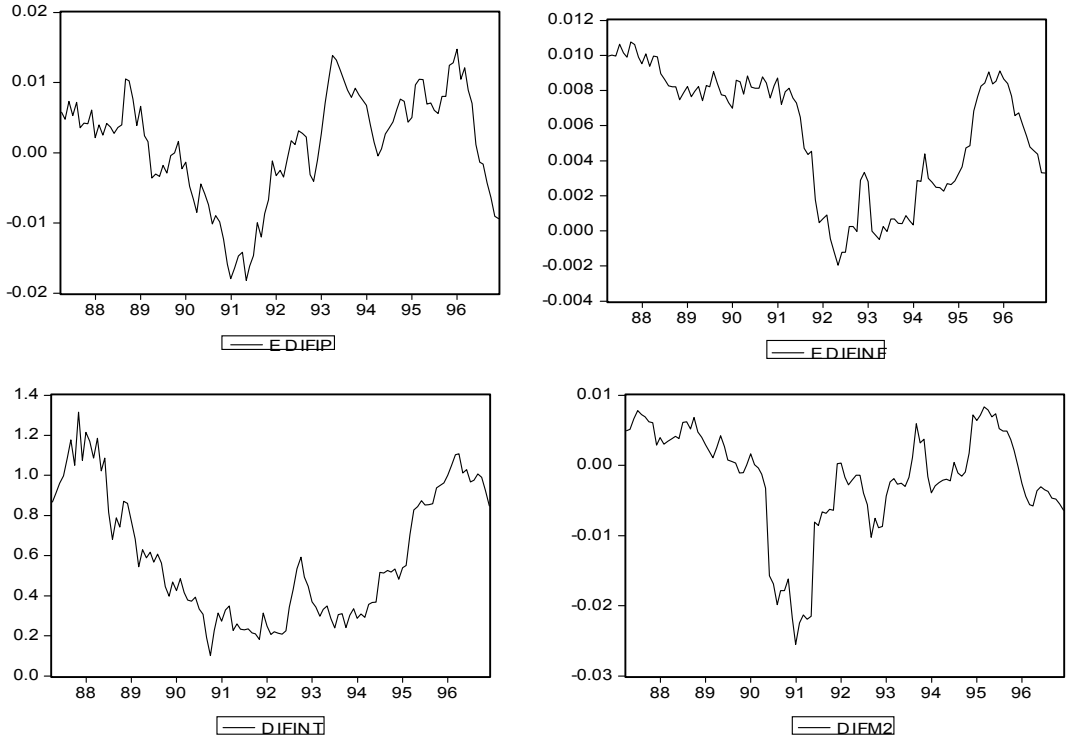


Figure 2: Behaviour of the coefficients in (7)

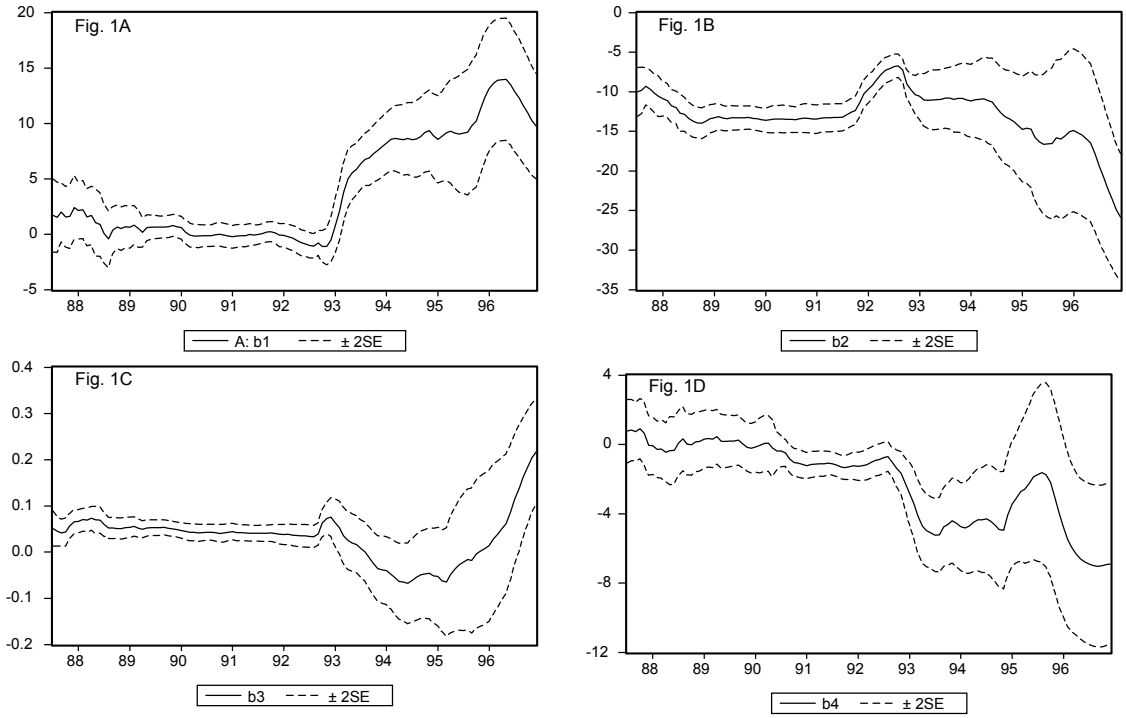


Figure 3: Agents' Forecast

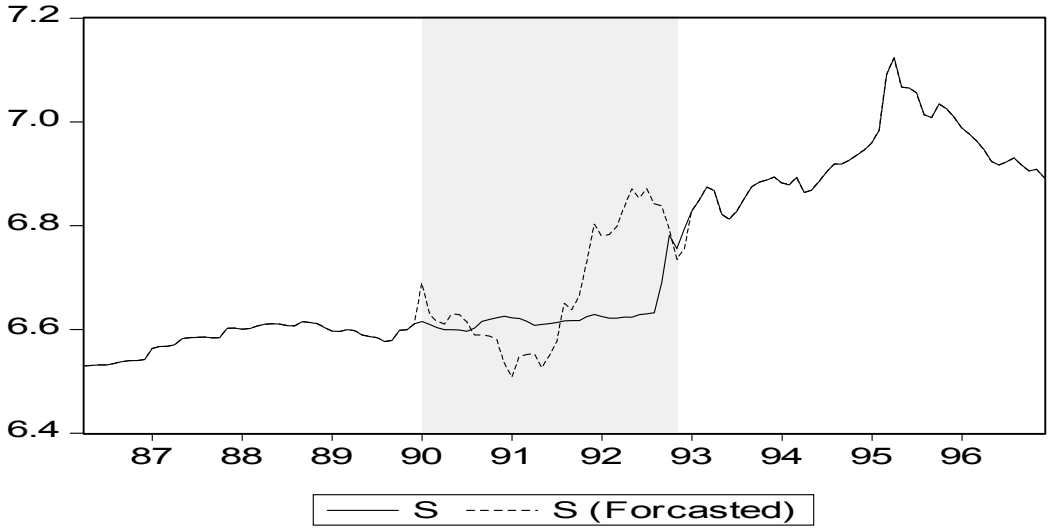
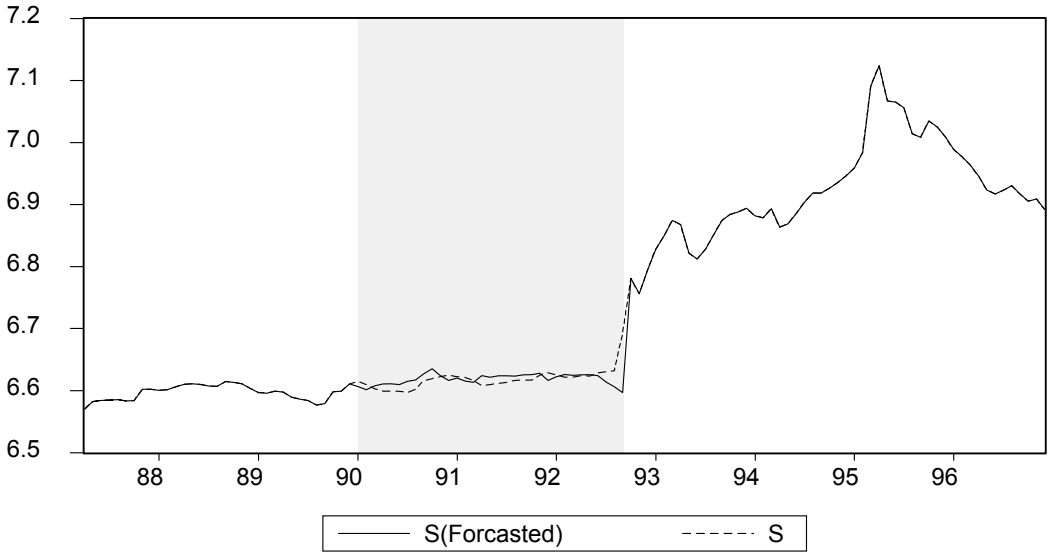


Figure 4: Central Bank's Forecast



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