Jesús Manuel García-Iglesias[1]

How the European Central Bank decided its early monetary policy?[2]

1. Introduction.

The basic premise in this work consists of the fact that the European Central Bank's (hereafter referred to as ECB) decisions incorporate a rational behavior with regard to the attainment of certain objective(s). Having omitted the possibility of an erratic management of the monetary policy, we believe it is feasible to understand within reason the decisions actually adopted, which, we can say, have induced a notable control over inflation in the European Monetary Union (EMU). We pose questions regarding the basic reasoning behind the ECB setting the interest rate, that is to say, the justifications that link the chosen targets with the instrumental variable according to specific dynamics inside a certain temporary horizon. Given the inter-temporary and optimizing nature that monetary policy decisions must have, the monetary policy strategy, explicit or implicitly adopted by a central bank for the attainment of its aims, acquires a special transcendence. Hence, the reaction function followed by the central bank constitutes a privileged indicator of such a strategy. Consequently, our principal aim is to detect some reaction function that, by contrastive analysis, adjusts the monetary policy decisions adopted by the ECB throughout our analysis period, which begins in January, 1999. Unlike other works which have also examined previous stages of monetary policy decisions adopted by the national central banks of the future members of the EMU, in this one we center on the behavior of this new institution. Our study is developed under the framework of theoretical principles of interest rate rules.

Another contribution of this analysis lies in a more flexible treatment of the number of periods of advance or delay in the possible explanatory variables within a reasonable range from the point of view of economic logic and from the perspective

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that nowadays is maintained on the dynamics of the monetary transmission mechanism.

Following this brief introduction this paper is organized accordingly: Section 2 establishes a set of considerations on the possible components of the reaction function related to monetary policy strategy. Section 3 presents the analysis model and the estimation method. Section 4 shows the obtained results. Finally, section 5 offers our conclusions.

2. Setting hypotheses on the ECB's policy.

The first aspect to determine regarding the true behavior developed by the ECB consists of finding out if it adjusts systematically to a certain reaction function in the interest rate or, on the contrary, if it is so flexible that we are unable to specify any function which significantly captures the abovementioned behavior. The expected result should be the former. This is due to the fact that the central bank follows an approach close to the orthodoxy of ruled behavior, instead of a discretionary type, and this, in turn, is possible because the ECB has well-defined aims, a knowledge of the possible incompatibilities existing among them, and the sacrifice ratio it is willing to assume, even though these may be implicit. At the same time, if this hypothesis is in fact confirmed, it would suppose a bonus of transparency in the monetary policy strategy actually followed, thus strengthening its efficiency. This hypothesis does not exclude the risk of circumstantial deviations, which would enter inside the realm of what is known as "restricted discretion". In order to find an answer to this first question we are going to think in terms of the theoretical structure of the taylorian interest rate rules, but with an opened and flexible character,

meaning, as we will specify in the following section, a reach which extends beyond the simple rule:

$$i_t^* = \bar{i} + a(\pi_t - \pi^*) + b\left(y_t - y_t^*\right) \qquad [1]$$

where $\bar{i}$ is the equilibrium nominal interest rate, π^* the inflation target, and $\left(y_t - y_t^*\right)$ the output gap.

If it were possible to determine a meaningful reaction function, we might interpret it as a significant indication in favor of a systematic behavior on the part of the ECB.

Alternatively, we might consider the ECB's behavior through a quantitative formulation of the monetary policy, such as for example, controlling some monetary aggregate, or through a direct follow-up of the Fed's policy, or fixing the exchange rate of the euro, or by following a target for the nominal output growth. Nevertheless, for the present time, we reject all these options for diverse reasons. Among others, our justifications include: a) the already well-known difficulties that occur when a central bank has tried to strictly determine the evolution of any wide monetary aggregate in the short term;[1] b) the non-strict convergence of political and economic interests between the EMU and the USA; c) the inability to control foreign exchange markets in a current context of financial liberalization worldwide;[2] or, d) the theoretical discredit of a blind follow-up of nominal production which does not throw any light on the subject with regard to important variables, namely: inflation and real output.[3]

Once this basic theoretical scheme has been adopted, the following question consists of reasoning out those variables the ECB has taken into account on its decisions regarding rates. Such variables well might be fundamental policy targets,

indicators of them, or conditioning variables for the above mentioned targets, or restricting variables for the ECB's decision capacity.

We believe that the first factor to analyze in this aspect should be the EMU inflation rate, since it is the variable that must make the Government Council (GC) react if it evolves in a different way from what the GC understands as price stability.[4] Provided that this is the fundamental target assumed by the ECB, we question if this one should be the only variable to bear in mind.[5] We believe it should not, but will later enter into this aspect in depth. Having considered the pre-alluded dynamic aspects, our next point of contention arises in reference to the period which addresses this variable in the reaction function: current, lagged, or future. Once the way in which the monetary policy influences this variable with certain delay is known, the logical conclusion will be to consider it forward-looking, with an advance between12 and 24 months, given the conception that nowadays is maintained about the monetary transmission mechanism. This, evidently, forces operation in the practice with inflation predictions.

On the other hand, the ECB refers exclusively to the harmonized consumer price index (HCPI) in its official statements, and therefore, the inflation measurement should be handled with this index. Nevertheless, it is necessary to recognize that this option, having the advantages of being very transparent, regularly published, and most widely known by the public, also entails a series of disadvantages, including that from time to time, it turns away from the EMU's economy inflationary intrinsic trend and develops a relatively volatile behavior, or also, its partial nature, for example, regarding the assets prices. For these reasons, it is necessary to examine other options, such as some measure of the core inflation, or the deflator, or some price index where assets prices are considered.

The intensity of the ECB's reactions to deviations with regard to the price stability reference should adjust to the so called Taylor's principle: the value of the coefficient *a* in [1] must be greater than one, otherwise, monetary policy would not apply the suitable intensity, and deviations would increase. Nevertheless, if *a* were too high, the consequence would be the instability of economic activity.

The second variable to consider in the reaction function is the output gap. Is it important enough for the ECB? Should the ECB keep it in mind? Though legal, as well as arguments of a socio-political nature could be adduced to answer affirmatively,[6] in light of the direct implications that the consideration of latter variable would have for unemployment or the social well-being, the fact is that, repeatedly, the ECB has categorically expressed its priority for price stability, while rejecting the admission of external influences or interferences. It seems the ECB refuses to allow any type of detriment against the above mentioned priority. Nevertheless, there are repeated opinions of very diverse authors in opposition to the strict and exclusive pursuit of carrying out price stability without bearing in mind the stabilization of economic activity.[7] For example, the output fluctuations around the trend anticipate information with regard to the evolution of inflation. In our estimation, the ECB should keep them in mind and try to act on them. In addition, consideration of the economic situation would imply a greater social comprehension of the monetary policy decisions. Notwithstanding, in this regard we come upon a major problem: the determination of the output trend,[8] which constitutes one of the weak points of the interest rate rules.

Parameter *b* value in [1] will have to be a positive one. However, an excessively high value might carry an imbalance in the output and inflation variability trade off (between variability of the output and variability of the inflation),

increasing the latter. Therefore, if the ECB statements are correct in the sense of granting priority to the price stability, we contend that the value of this coefficient must be small.

Returning once again to the possible use of current, lagged or future values of a variable, the option is not so clear as it was in the case of the inflation rate. If the ECB is really trying to stabilize the economic activity, it would have to develop a forward-looking monetary policy with regard to the output gap, because, again, the effects of this appear later in time with regard to economic activity. On the contrary, if the intention of the ECB consideration of this variable is that of a mere inflation indicator, on making rate decisions, the entity might also bear in mind lagged or current values of the output gap, depending on the dynamic links that could be established between both variables. On the other hand, a contradictory situation of the above mentioned variables may incur from the point of view of stability. That is to say, in order to stabilize the inflation, it may be necessary to adopt the exact opposite decision to the one needed for the stabilization of economic activity; and, on being so, we believe that, except in special circumstances, the most probable alternative would be for the ECB to decide in favor of price stability. Furthermore regarding this question, we might also add that, though the ECB has demonstrated that it does not hold direct responsibility for the EMU's economic reactivation, if a recessive (too expansive) trend were to consolidate, this would force the ECB to loosen (to tighten) monetary conditions. In this case, we think that the ECB would operate backward-looking with regard to the output gap. However, we should state that due to our focus, we are leaving aside the questions related to the possible asymmetric behavior of the ECB, which are dealt with in depth by Altavilla and

Landolfo (2005), reiterating that we focus on the inter-temporary dimension of the ECB's monetary policy.[9]

Regarding other possible variables to bear in mind, such as monetary growth, the Fed rate, or the euro exchange rate, we believe that at the moment, for the reasons previously pointed out, that there is a lack of verisimilitude to assigning a significant protagonism to them in the decision-making process of the ECB.

Another aspect worthy of analysis is the probable smoothing in the monetary policy execution by the ECB. This aspect is related to the need to avoid a high interest rate volatility, which, in turn, might provoke dysfunctions on the financial markets. By smoothing, the ECB would send clear signals about its future policy, with a greater impact on the expectations, and it would prevent the interpretation of its behavior as contradictory or erratic, thus attenuating the consequences of the uncertainty that concerns the monetary policy.[10] Though economically the convenience of a smoothed behavior is evident, from an econometric point of view, we come up against difficulties for making calculated adjustments.

In our analysis period we encounter that throughout several months the interest rate has remained unchanged. This, in our view, is the result of a compensating attitude on the part of the ECB with regard to the behavior of the variables, which, in turn, is linked to the medium-term vision that it incorporates into its policy. Nonetheless, numerically speaking, it implies that the current monthly rate is defined exclusively by its value in the previous period, illogically annulling any explanatory capacity of the rest of variables. For this reason, we think that it is suitable to also estimate the behavior of the ECB, doing so without the partial adjustment in the interest rate.

A final aspect in the analysis of the strategy actually followed by the ECB is to question up to what extent it has developed something equivalent to what is known as *inflation targeting*. As M. King (2003) indicates, it is difficult to provide a direct answer to this question, since inflation targeting is rather a way of thinking through the monetary policy, instead of an automatic response to all the complex matters of the same. We would also add that inflation targeting is a way of transmitting, or reporting the monetary policy. Nevertheless, we emphasize there is a whole set of features in the ECB policy-making that brings its actions close to the inflation targeting framework, in spite of the repeated and categorical rejection towards assuming it explicitly in the ECB official statements.[11] Among these features we stress: a) the priority assigned to the aim of price stability, though it should not necessarily imply the exclusive protagonism of this variable; b) the "approximate definition" of an explicit, numerical inflation target; c) the forward-looking nature of decisions on rates, as can be shown in the final results of this work, and on having kept in mind the inflation behavior in the medium-term; d) the high degree of independence the ECB enjoys with regard to the political power in instrumental, operative and target terms; e) the flexibility granted to the euro exchange rate; f) the importance that it assigns to the attainment of a high level of anti-inflationary credibility; g) the understanding of the important role played by the transparency and the suitable communication of its decisions to the public; h) the mechanisms established for ECB accountability.

Actually, it seems that the only absent feature is an explicit commitment with the inflation targeting strategy, but, such an explicit adscription constitutes a fundamental aspect. Hence, some authors, like Svensson (2003) among others, urge the ECB to take the definitive step towards the design of its monetary policy

according to the inflation targeting approach, as well as link itself in an explicit way to it. Other relevant authors, like Bernanke (2003), Goodfriend (2003) or Mishkin (2002), for example, are in favor of the Federal Reserve also assuming this approach. As for the reason for the apparent contradiction in the statements by the ECB, first, we might indicate that the current leaders are possibly not quite sure about the advantages of inflation targeting, as a consequence of the fact that they have certain dreads or doubts regarding the calculation of inflation predictions. This may be due to the scanty experience or the existing problems with the information set, or because inflation targeting carries design problems like that referring to the temporary horizon, or because the ECB is not adequately interpreting the nature of inflation targeting as a result of having done it in too mechanical a way. It is also possible that the ECB wants to enjoy a margin of flexibility, even larger than the one that is provided by inflation targeting. Finally, it may have partly assumed the traditional vision of the Bundesbank by figuratively assigning a special role to the monetary growth in its communication with economic agents, but, as Cabos and Siegfried (2004) conclude, the overall control problems involved in targeting money are larger than those for direct inflation targets.

3. Model and estimation method.

To carry out the empirical analysis of the decisions adopted by the ECB on the interest rate we need, apart from the data, a theoretical model and an estimation method. There have already been repeated attempts to estimate a reaction function for the monetary policy decisions of the ECB.[12] We reject the possibility of adopting a calibrated approach, or even a contemporary one. We assume an inter-temporary

theoretical model, inserted in the interest rate rules stream, in line with the Clarida, Galí and Gertler (1998) (CGG) contribution, which has been repeatedly used in recent years.[13] CGG's specification relies on Taylor's simple rule of the expression [1], but incorporates a more opened and forward-looking character:

$$i_t^* = \bar{\imath} + a\left[E_t\left(\pi_{t+k}|I_t\right) - \pi^*\right] + b\left[E_t\left(y_{t+j}|I_t\right) - y_{t+j}^*\right] + cE_t\left[z_t|I_t\right]$$ [2]

where E is the expectations operator and I_t is a vector including the available information for the central bank in the period t, and z is a vector that would contain other possible explanatory variables for the monetary policy followed, since they might be foreign interest rates, real exchange rates, money supply, or, in case of these last two, deviations with regard to pre-announced targets. It might also be the case that the variables included in z, be referred to in period $t \pm m$, instead of in period t. And, in an even wider approach, the model might be backward-looking, since in our case we open the possibility to k, j, m as having negative values.

Likewise, we consider an extended model which incorporates the hypothesis of smoothing in modifications of interest rates by the central bank, in which case we would find that:

$$i_t = (1-\rho)i_t^* + \rho \cdot i_{t-h} + v_t$$ [3]

where v_t is a random disturbance. Substituting [2] in [3] we obtain:

$$i_t = (1-\rho)\bar{\imath} + (1-\rho)a\left[E_t\left(\pi_{t+k}|I_t\right) - \pi^*\right] + (1-\rho)b\left[E_t\left(y_{t+j}|I_t\right) - y_{t+j}^*\right] +$$

$$+ (1-\rho)cE_t\left[z_t|I_t\right] + \rho i_{t-h} + v_t$$ [4]

in which we suppress the non observed variables so that:

$$i_t = (1-\rho)\bar{\imath} + (1-\rho)a\left[\pi_{t+k} - \pi^*\right] + (1-\rho)b\left[y_{t+j} - y_{t+j}^*\right] + (1-\rho)cz_t + \rho i_{t-h} + \varepsilon_t$$ [5]

where

$$\varepsilon_t = v_t - (1-\rho)a\left[\pi_{t+k} - E_t\left(\pi_{t+k}|I_t\right)\right] + (1-\rho)b\left[y_{t+j} - E_t\left(y_{t+j}|I_t\right)\right] + (1-\rho)c\left[z_t - E_t\left(z_t|I_t\right)\right]$$

Alternatively, the second from the last expression [5] might be:

$$i_t = (1-\rho)(\bar{i} - a\pi^*) + (1-\rho)a\pi_{t+k} + (1-\rho)b\left[y_{t+j} - y_{t+j}^*\right] + (1-\rho)cz_t + \rho i_{t-h} + \varepsilon_t \qquad [7]$$

with which, assuming that we can approximate the equilibrium of the nominal interest rate from the observed average nominal interest rate in the euro zone throughout the period, we might obtain an estimation of the implicit inflation target pursued by the ECB using the first addend, a_0, in the last equation, since:

$$a_0 = (1-\rho)(\bar{i} - a\pi^*) \qquad [8]$$

then:

$$\pi^* = \frac{\bar{i} - \dfrac{a_0}{1-\rho}}{a} \qquad [9]$$

We will center on the generalized method of moments (GMM), in which a rational and optimizing approach underlies its inter-temporary character with regard to some target(s), as is the case of the behavior that we suppose the central bank carries out when fixing the interest rate, period after period, with a view, preferably, aimed at price and general economic stability. In addition, as noted by CGG (2000), this method is well suited for the econometric analysis of interest rate rules when the regressions are made on variables that are not known by the central bank at the decision-making moment. Through the generalized method of moments it is possible to estimate the *deep parameters* that describe the central bank's preferences[14] in the monetary policy rules or reaction functions. This is so because a set of orthogonality conditions are imposed. In our case, according to [7], the orthogonality conditions are:

$$E_t(i_t - (1-\rho)(\bar{i} - a\pi^*) - (1-\rho)a\pi_{t+k} - (1-\rho)b[y_{t+j} - y^*_{t+j}] - (1-\rho)cz_t - \rho i_{t-h}|u_t) = 0$$

[10]

where u_t is a vector of variables included in the available information in the central bank on determining the interest rate in period t, and they are orthogonal with regard to ε_t. Among them would be any retarded variable that helps to predict the inflation and the output growth rates, together with other contemporary variables that should not be correlated with the current disturbance, v_t, in the interest rate.

Following the suggestion by Favero (2001), on working with monthly frequency data, the set of instruments included in u_t will be integrated by a constant and the retarded values corresponding to eleven previous periods to t of a set of variables, as the nominal interest rate itself, the inflation rate, the economic growth rate, and others. Hereby the model is over-identified, and we confirm the validity of the above mentioned over-identifying restrictions with the J-test proposed by Sargan. With such a contrast we will be able to evaluate if the estimated simple specification of the monetary policy rule [4] omits important variables that are taken into account by the ECB in its reaction function. If this happens, the orthogonality conditions would be violated, and the test to contrast the instrument validity would reject the null hypothesis. Under the null hypothesis, the central bank determines the interest rate every period so that, in case of partial adjustment, [4] is fulfilled by setting the value of the expected variables of the right side of the equation from all the relevant available information by the central bank at this moment. The i_t itself would be one of them when it determines the future behavior of inflation and production. This hypothesis implies that some values exist in order to estimate the parameters so that the residue is orthogonal with regard to the variables included in the set of available information, I_t. That is to say, the central bank develops a rational

inter-temporary behavior, since we suppose that such a residue has an unpredictable behavior given the available information and the theory. Under the alternative hypothesis, on the contrary, the central bank adjusts the interest rate in response to changes in some current, forwarded or lagged variables, but not necessarily in connection with the information that these changes contain with regard to the future behavior of inflation and output. In the latter case, certain explanatory relevant variables are being omitted in the equation [5]. Then, as CGG affirms, up to the point of which some of these variables should be correlated with u_t, the set of orthogonality conditions [10] do not comply, which would carry the statistical rejection of the model.

Another important question related to the application of the generalized method of moments is that it is supposed that all the variables included in the equation to estimate [7] are stationary. The problem that several authors[15] have indicated is that for short samples, as is our own case, the stationarity test, such as the habitual Dickey-Fuller's ones in which the null hypothesis is that the analyzed series is I(1), have low power against the alternative stationarity. For this reason we suppose that the stationarity conditions are fulfilled in order to carry out the estimations through the use of this method.

On the other hand, the estimations that we will obtain of the parameters applying the generalized method of moments with Eviews are corrected, being robust against heteroskedasticity and serial autocorrelation of an unknown form, unlike the maximum likelihood estimations.

One major aspect characterizing this work with regard to others about the ECB monetary policy, consists of the fact that we center exclusively on the period starting at the beginning of 1999, when the ECB formally assumes its

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responsibilities. It might be adduced that in the two previous years, 1997 and 1998, there had probably already been a high degree of coordination in the monetary policy developed by the national central banks of the EMU integrating countries. Nevertheless, it is not until 1999 when this new institution, the ECB, independent and autonomous, makes its own decisions. Precisely, the basic aim of this study is to detect the fundamental reasoning behind adopting decisions in this new institution. For this reason, we consider it appropriate to do so without considering the years previous to 1999. We acknowledge the disadvantage of shortening the analysis period, nevertheless, we think that this is sufficiently significant of ECB monetary policymaking, since, through data observation along this period a series of decisions happen on the key interest rate that include a wide scale of contexts, and that materialize in diverse phases, namely: a decrease of the interest rate - maintenance - increase - maintenance - decrease - stability - decrease - stability.

The origin of the data is derived from the ECB and Eurostat. In some cases we will generate a new series from the observed ones in order to obtain the trend-cycle component, which will be done using the Tramo-Seats program available in Eviews 4.1.

As the interest rate variable we select the eonia and the key ECB interest rate: the minimum bid rate at the main refinancing operations. The EMU's global inflation rate will be obtained from the HCPI, and the underlying inflation rate will be taken from the same index excluding food, energy, alcohol and tobacco prices. As a consequence from the monthly frequency data, the EMU's real output growth rate behavior will be deduced by using the industrial production growth rate as an indicator.

4. Results

We will now present some of the most significant adjustments obtained for the inter-temporary reaction function [5]. In such an expression we have the option of not considering the interest rate partial adjustment, that is to say, $\rho=0$. This extended expression can be reduced by taking the inflation rate as the only explanatory variable, or this one together with the output growth.

As can be observed in table 1, it is possible to find a set of significant econometric adjustments with a methodology that entails the suppositions of rationality and inter-temporality in the ECB's behavior. In all cases the J-test for the validity of the used instruments set[16] leads us to non-rejection of the null hypothesis, with P-values to commit type-I error in an interval from 0.95 to 0.99, so that it does not seem that the orthogonal conditions are violated.

[Insert Table 1 AND its notes, near here]

The adjustments in table 1 show the fundamental role played by the future underlying inflation rate on explaining the ECB's monetary policy, especially the trend-cycle series $\pi_{sub\ trd}$. If we suppose that the ECB takes price stability as its only aim (adjustments 1 to 8), we get a clear explanation of its monetary policy, given the case that we do not introduce a partial adjustment term (adjustments 1 to 4), or in the case that we do (adjustments 4 to 8). Therefore, the four initial adjustments

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emphasize that it is not necessary to use the delayed interest rate to explain the ECB decisions, wherein the second group of adjustments emphasizes that the BCE follows a smoothed policy. Another clearly shown aspect is the forward-looking nature of the ECB monetary policy with regard to the inflation rate, with an advance placed interval from sixteen to eighteen months. The value for the coefficient *a* is established in the range prescribed by Taylor's principle, with a value very near to the proposed 1.5.

Incorporating the output growth rate as an explanatory variable increases the capacity of the reaction function, though it is so with a relatively small coefficient *b*, which may be due to the volatility of the industrial activity growth rate series used as indicator. The most outstanding is the backward-looking nature of the role played by this variable, delayed six months with regard to the one in which the interest rate is set. From all this we deduce that, according to the value of *b*, the BCE sets its monetary policy to some extent on the behavior of the economic activity in the EMU. However, according to the value of *j*, the ECB does so with such a delay that it leads us to believe that the said economic activity is recognized when the trend is consolidated in such a way that the ECB considers itself "obliged" to take it into account. In other words, the ECB grants a secondary role to the EMU economic activity.

As can be seen, the adjustments are robust enough to establish the key interest rate or the eonia as the explaining variable.

Finally, from the adjustments herein presented, we might calculate the implicit ECB's inflation target. To arrive at it we must formulate a hypothesis with regard to the equilibrium nominal interest rate and the industrial production growth rate trend. From the data we might establish a value of 3.5 % for the first one, and 2

% for the second one, and, with these suppositions, the implicit ECB's inflation target would be around 1.7 %.

[Insert near here:figures1, 2, 3 , 4]

5. Conclusions

The empirical analysis undertaken provides enough evidence to conclude that the ECB, on setting the interest rate in the analyzed period, basically takes into account the underlying future inflation rate deviations with regard to an implicit inflation target of 1.7 %, doing so in a smoothed way, likewise, the ECB does it in an orthodox manner with regard to the so called Taylor's principle. As for the role that could be played by the output growth rate, the results indicate to us that this variable significantly contributes a certain explanatory power, which, in our case, seems to have a backward-looking character and be rather small. However, the latter condition could be a by-product from the industrial production series volatility used as indicator for general economic activity.

We finalize these conclusions about the monetary policy strategy developed by the ECB, in attempting to answer to the question of the entity being an inflation targeting regime. In spite of the fact that the ECB has declared its rejection towards inflation targeting in a public and official way, if we revise a whole series of aspects we come to, at least partly, an affirmative answer regarding our query. Notwithstanding, we need to clarify this conclusion does not carry a binding character. First, we find that the ECB has made its inflation "target" explicit: a range from 0 % to 2 %, but placing its central point asymmetrically near 2 %. Furthermore, it grants an absolute priority to the attainment of the above mentioned target over any

other. As we have seen, though the output stabilization contributes something to the empirical explanation of the ECB decisions, its influence is actually slight, and with a delay that makes its postponement evident in the approach adopted by this central bank. The strategy is forward-looking with regard to inflation behavior, though it does not react directly to the evolution of the global observed inflation rate, according to the HCPI, which is what the ECB declares, but rather, fundamentally, what it bears in mind is the underlying inflation rate trend. All the aforementioned is perfectly consistent with the ECB's medium-term approach for the attainment of price stability.

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Table 1: Main equations

	Interest rate[a]	Inflation rate[b]	Econ. activ.[c]	k	j	a[d]	b[d]	ρ[d]	$\overline{R^2}$[e]	J-stat
1	id	$\pi_{sub\ observ}$	-	16	-	1.66 (78.16)	-	-	0.77	0.26
2	id	$\pi_{sub\ trd}$	-	16	-	1.65 (88.3)	-	-	0.81	0.25
3	io	$\pi_{sub\ trd}$	-	15	-	1.63 (43.09)	-	-	0.8	0.24
4	io	$\pi_{sub\ trd}$	-	16	-	1.5 (54.71)	-	-	0.8	0.24
5	id	$\pi_{sub\ observ}$	-	18	-	1.62 (26.63)	-	0.475 (34.05)	0.914	0.25
6	id	$\pi_{sub\ trd}$	-	18	-	1.897 (23.36)	-	0.66 (40.85)	0.956	0.24
7	io	$\pi_{sub\ trd}$	-	18	-	2 (15.49)	-	0.73 (40.11)	0.95	0.25
8	io	$\pi_{sub\ trd}$	-	17	-	1.74 (18.62)	-	0.62 (36.29)	0.95	0.23
9	id	$\pi_{sub\ trd}$	t. ind. trd	15	-6	1.25 (87.25)	0.07 (34.21)	-	0.9	0.27
10	io	$\pi_{sub\ trd}$	t. ind. trd	16	-6	1.51 (226.5)	0.04 (34.18)	-	0.86	0.27
11	id	$\pi_{sub\ trd}$	t. ind. trd	18	-6	1.46 (47.67)	0.08 (16.63)	0.71 (141.7)	0.97	0.28
12	io	$\pi_{sub\ trd}$	t. ind. trd	18	-6	1.52 (20.59)	0.104 (30.04)	0.71 (71.14)	0.95	0.27

[a] id: eonia; io: key ECB interest rate.
[b] $\pi_{sub\ observ}$: observed underlying inflation rate; $\pi_{sub\ trd}$: underlying inflation rate trend-cycle.
[c] t. ind. trd: industrial production rate of change, trend-cycle.
[d] t statistic in parenthesis.
[e] Adjusted.

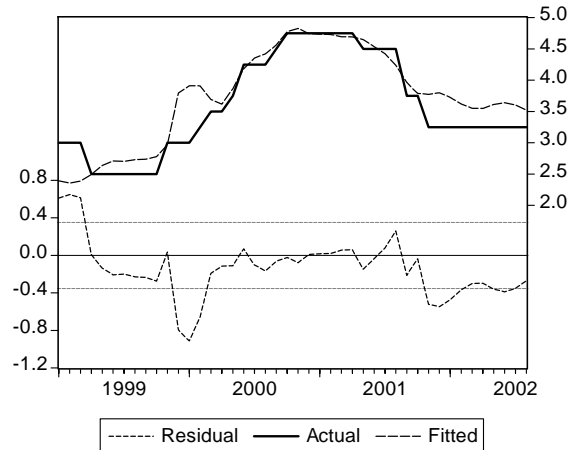Figure 1: Adjustment 4

------- Residual ——— Actual ----- Fitted

23

Figure 2: Adjustment 6

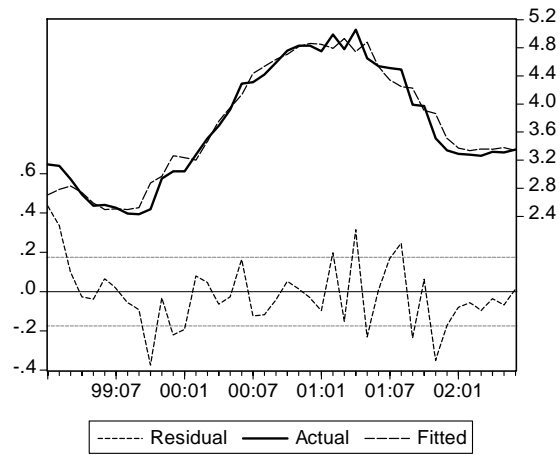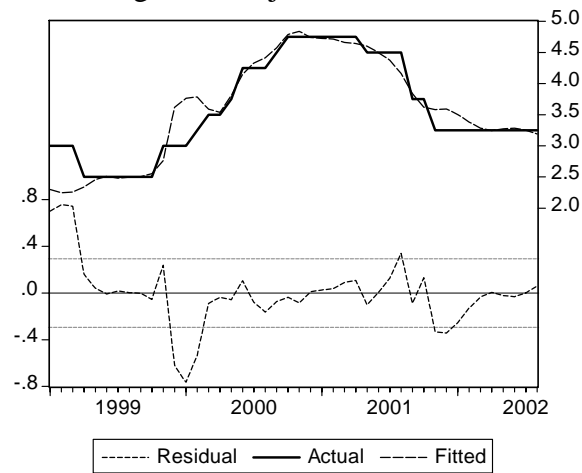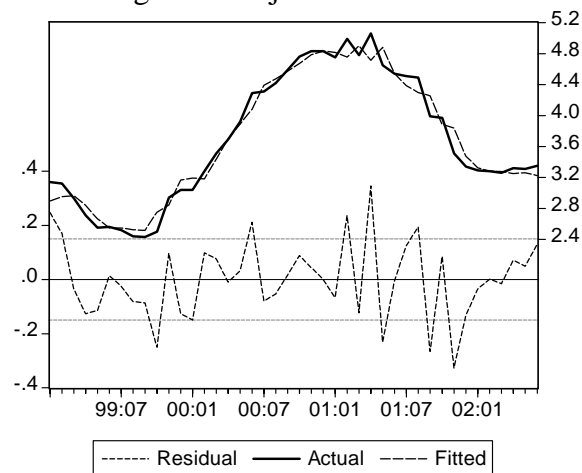
Figure 3: Adjustment 10

Figure 4: Adjustment 11

[1] Cabos and Siegfried (2004) point out this aspect for the euro zone during the period 1980-1997.

[2] As can be seen in Cotter (2005) the behavior of the euro in its first years is similar to that of other main currencies.

[3] Little can be said about practical discredit since, as Mishkin (1999) indicates, no country has ever adopted it.

[4] Another option would be to try to stabilize the level of prices directly. See, for example, Svensson (1996 and 1997), or Berg and Jonun (1999) for the pioneering case of Sweden. Interestingly, Kobayashi (2005) suggests the use of hybrid inflation-price-level targets as a solution to the stabilization bias problem.

[5] Like, for example, Galí (2002) points out.

[6] For example, according to the specification in paragraph 1 of article 105 of the European Union Treaty, the ECB also will have to contribute to the aims of article 2, in which, in turn, an express reference is made to a high level of employment and a sustainable and non-inflationary growth, among others.

[7] See, for example, Mishkin (2002) or M. King (1996).

[8] This has provoked a considerable amount of debate concerning the validity of the usual statistical methods like Hodrick and Prescott's, or the use of other alternative methods such as those of Clarida, Galí and Gertler (1999), or McCallum and Nelson (2000) and McCallum (2001). Whereas Atkenson and Ohanian (2001) and Estrella and Mishkin (1999) question the usefulness of the output gap to predict inflation.

[9] About asymmetries in the effects of monetary policy can be seen Florio (2005). As for the inter-temporary dimension, Kim and McMillin (2003) analyse the implications of lag structure for estimating the effects of monetary policy shocks in a VAR.

[10] There is a theoretical debate about if interest rate volatility has adverse effects for the financial markets. So whereas for Clarida, Galí and Gertler (1999) this is not clear, other authors, such as Rotemberg and Woodford (1999), Goodfriend (1987 and 1991), Loewe and Ellis (1997), or Cukierman (1996), think a smoothed monetary policy is more suitable.

[11] See Issing (2003).

[12] See, for example, Gerlach and Schnabel (2000), Gerlach-Kristen (2003), Gerdesmeier and Roffia (2003), Fourçans and Vranceanu (2004) or Altavilla and Landolfo (2005) among the most recent.

[13] See, for example, Batini and Haldane (1999), Favero (2001), Aron and Muellbauer (2002), or Gerdesmeier and Roffia (2003), among others.

[14] Supposedly they do not change throughout the period under study, in the same way as it is supposed that the measurement of the variables is error free.

[15] Clarida, Galí and Gertler (1998), Aron and Muellbauer (2002), or Rogoff (2003), among others. Also can be seen Charemza et al. (2005).

[16] The first eleven delays of the variables in every adjustment. As an exception: in the adjustments 3, 4, 7, 8, 10 and 12, due to matricial calculation problems, the first eleven lags of *id* are used, instead of that of *io*. In these cases we cannot reject the validity of the instruments.