INTEREST RATE SETTING AT THE ECB: INDIVIDUAL PREFERENCES AND COLLECTIVE DECISION MAKING

José Ramón Cancelo (jramon@udc.es)
Diego Varela (dvarela@udc.es)
José Manuel Sánchez-Santos (jose.manuel.sanchez@udc.es)
University of A Coruña

Published in
Journal of Policy Modeling, Volume 33, Issue 6, November‐December 2011, Pages 804‐820. Available at http://dx.doi.org/10.1016/j.jpolmod.2011.08.017.

ABSTRACT

We investigate whether the members of the Governing Council of the European Central Bank take into account the specific economic conditions of their states of origin, to set the interest rates for the euro area. Testing the national-based view against the Europeanist perspective is a challenging issue, because voting inside the Governing Council is secret, and the final outcome depends both on the individual preferences and the procedures followed by the Governing Council to arrive at a decision. Accordingly, we model interest rate setting as a two-stage process: first, each member of the Governing Council sets his/her preferred rate, and next the Governing Council meets and decides the actual figure. Our empirical analysis shows that domestic developments play a major role in determining the preferred interest rate of the each member; and that some members exert agenda setting power, that precludes some interest rate policies to be considered at the meeting.

KEYWORDS

European Central Bank, monetary policy, policy reaction function, committees, nationalistic bias, voting models, agenda setting

1. INTRODUCTION

The European Central Bank is responsible for monetary policy in the Euro area, i.e. the countries that have adopted the euro as their common currency. But despite the convergence criteria required to join the Euro area and the ECB's common policy, there are still differences in the economic fundamentals of the participating countries. Therefore, different countries may have divergent monetary policy preferences, which raise the question of whether the ECB's policy is designed with the interests of the Euro area as a whole in mind, or else its decisions are a result of international negotiation between participating member states. This paper aims to shed some light on this issue by investigating interest rate decisions by the ECB, which are the main policy instrument at its disposal.

Interest rate decisions are made by the Governing Council of the ECB, which is composed by the members of the Executive Board (the President, the Vice-President and four other members), and the governors of the National Central Banks of the Euro area. Members of the Governing Council are forbidden to have a national mandate. They must not receive instructions from member states, but act independently in the pursuit of price stability in the Euro area as a whole. Thus, when the ECB's strategy was announced by its Governing Council on 13 October 1998, it was stated that the single monetary policy would have an area-wide objective (price stability, in accordance with article 105 of the EU Treaty), and would be concerned with national developments only to the extent that these were significant for the area altogether.

Yet, each member state retains the power to appoint the governor of its National Central Bank. Member state governments also strive to ensure that appointments to the Executive Board, especially to the position of President, go to nationals of their member state. Therefore, there are some reasons to suspect that members of the Governing

Council of the ECB might act in the interests of their member states of origin, as if they carried out a national mandate.

Testing the national-based view against the Europeanist perspective is far from simple. Unlike in the case of the Federal Open Market Committee of the Federal Reserve, voting inside the Governing Council of the ECB is secret, so it is not possible to know the positions of individual members: it is only the results of the final, aggregate decisions that are public. But such outcomes are not only driven by individual preferences. They are also heavily influenced by the procedures followed by the Governing Council to arrive at a decision. The same set of individual preferences may lead to different observed interest rates depending on whether the decision is made by simple majority, or by looking for a wide consensus. Furthermore, the existence of some form of agenda setting, i.e. the power of some individual or small group of individuals to exert an *ex-ante* veto on some interest rate policies, impede to extracting the actual underlying preferences of the Governing Council as a whole, from the observed decision at the end of the meeting.

As a consequence, even if the primary problem is to determine whether there is a nationalistic bias in the interest rate preferences of the members of the Governing Council, it can not be properly assessed without taking into account the way group decisions are made. For that reason, our methodological approach to deal with this issue consists of two stages. In the first, we make hypotheses on the motivations of each member of the ECB's Governing Council, and predict his/her unobserved ideal interest rate. In the second stage, we model decision-making inside the ECB, given the preferences predicted in the first stage and assuming a number of decision rules. We end with a variety of competing models, which combine alternative assumptions on the

relevant information used to form individual preferences, and different protocols for arriving at a decision within the Governing Council.

It may be argued that the actual decision making heuristics at the Governing Council is far too complex to be captured by the type of models discussed in this paper. Yet, a growing number of central banks all over the world implement monetary policy by committees, and we still lack a comprehensive theory that explains how monetary committees work. While this is a major shortcoming in the case of national central banks, it is critical in a monetary union like the euro area.

The paper is organized as follows. After this introduction, Section two reviews some aspects of interest rate setting by central banks. Section three develops a two stage procedure to model decision making at the ECB's Governing Council, and proposes a number of competing specifications to explain interest rate setting at the euro area. Section four develops the empirical analysis and discusses the results. Section five checks whether the previous findings are robust to changes in the policy rule and to errors in forecasting future inflation. Section six concludes.

2. INTEREST RATE SETTING AT CENTRAL BANKS: A BRIEF SURVEY ON SELECTED ASPECTS

The term "monetary policy" refers to the actions undertaken by a central bank, the ECB in our case, to influence the availability and cost of money and credit, in order to attain a set of objectives oriented towards the growth and stability of the economy. To implement the monetary policy the ECB has at its disposal a set of instruments. It conducts open market operations, offers standing facilities, and requires credit institutions to hold minimum reserves on accounts with the Eurosystem.

Open market operations play an important role in the monetary policy of the Eurosystem for the purposes of steering interest rates, managing the liquidity situation in the market, and signalling the stance of monetary policy. In particular, the main refinancing operations (MROs) are the most important open market operations. They are regular reverse transactions, with a weekly frequency and a maturity of one week, that provide the bulk of liquidity to the banking system, and represent the key monetary policy instrument of the ECB. Monthly, the Governing Council of the ECB sets the interest rate of the main refinancing operations, which is a suitable indicator of its monetary policy stance. Lower interest rates tend to increase the money supply and are an expansionary policy, whereas higher interest rates tend to lower the money supply and represent a contractionary monetary policy.

The two other main policy instruments, i.e. the standing facilities and the minimum reserve requirements, are less informative about the variations in the monetary policy stance of the ECB. Indeed, together with the rate on the main refinancing operations, the ECB fixes the rate on the deposit facility, which banks may use to make overnight deposits with the Eurosystem, and the rate on the marginal lending facility, which offers overnight credit to banks from the Eurosystem. But these rates do not add much information, as its differential with the main refinancing rate has been kept constant between 21 January 1999 and 9 October 2008. As far as the reserve requirement is concerned, it has been kept constant for the whole period.

For all those reasons, we have chosen the rate on the main refinancing operations as the best single indicator of the monetary policy stance of the Governing Council of the ECB.

The literature has focused on two different aspects of interest rate setting. The first is how to process the available information about the relevant state of the economy, in

order to determine the adequate level of the interest rate. The second is to reconcile a variety of individual preferences with collective decision making within a monetary policy committee. Next we sketch some results of previous work on each issue.

Interest rate reaction functions are based on policy rules that are extensions of the so-called Taylor rule (Taylor, 1993). In the original rule the interest rate depends on lagged values of inflation (expressed as deviations from its long run equilibrium) and of some indicator of economic activity. Up to date extensions allow for interest rate smoothing, forward-looking behaviour of central banks, shocks in the policy rules, etc.

Policy reaction functions based on the Taylor rule have been used to explain the monetary policy of a number of central banks all around the world, such as the Federal Reserve, the German Bundesbank, the Bank of Japan or the Bank of England (Clarida et al., 1998). Gerlach and Schnabel (2000) demonstrate that average interest rates in the EMU countries in the period 1990–98, with the exception of the period of exchange market turmoil in 1992–93, moved very closely with average output gaps and inflation, as suggested by the Taylor rule.

Similar policy reaction functions have been applied to explain monetary policy decisions by the European Central Bank. Most of the papers concentrate on estimating the relative weights of inflation and real activity indicators in the determination of interest rate policy by the ECB (Fourçans and Vranceanu, 2004, 2007; Sauer and Sturm, 2007; Gorter et al., 2008). A common characteristic of these models is that they treat the ECB as if the Euro area monetary policy were designed by an individual governor. But this assumption contrasts with the federal-like nature of the main ECB decision-making body, its Governing Council, where the national central banks of EMU states are represented.

In fact, since the 1990s monetary policy setting in most central banks has shifted from the single-governor decisions framework, to group decision making structured in formal monetary policy committees. A committee displays some advantages even if every member behaves strictly as *homo economicus*: the committee merges different information, different models and different forecasts, and such knowledge pooling is expected to produce better decisions than any of its members would do alone (Blinder, 2007).

But monetary committees are never a gathering of genuine *homines economici*. In practice, it is quite likely that there exists a "home bias" in the policies advocated by members appointed by their regional affiliations, as they may be more concerned about local than global economic conditions. Besides, members do not have the same influence and power to control the way meetings evolve. The role of the presidency, voting rules, or agenda setting are just a few examples of different aspects of the bargaining process that bring under control the final decision. Under any of these departures of the strict majority rule, the preferences of the dominant part of the committee will be overrepresented in the observed outcome, either giving too much weight or filtering out the potential home-biased orientation of the committee as a whole.

For the United States, Tootell (1991) presents evidence that district bank presidents in the Federal Open Market Committee (FOMC) do not manipulate monetary policy to help their own regional economies. However, Gildea (1992) analyzes the voting behaviour of Federal Reserve Bank presidents, and concludes that there is a regional bias in their monetary policy preferences. In a similar way, Meade and Sheets (2005) show that both the president of regional banks and the Board members of the FOMC are influenced by the economic conditions prevailing in the region they come from.

Chappell et al. (2008) confirm that regional conditions affect the policy preferences of Reserve Bank presidents, and also appear to influence Governors.

In the case of the ECB, the votes of individual Governing Council members are not made public, so more sophisticated procedures are required to determine whether its members act with national or Euro area interests in mind.

Heinemann and Huefner (2004) challenge the official view on ECB monetary policy that claims that monetary decisions are based solely on average data for the euro zone, and that diverging national developments are disregarded. They develop a generalised monetary policy reaction function that explains desired interest rates as a function of inflation and unemployment data, while allowing for an influence of national heterogeneity. The national-based version of their model uses the median inflation and the median unemployment of the members of the Governing Council, under the assumption that this combination of medians will provide a good approximation to the median desired rate of nationalistic members. They find that although the predictive power of both models is similar, the model based on the member states medians is marginally better, providing some first support for an impact of national divergence on ECB decision making.

Varela and Sanchez-Santos (2003) consider a reaction function that explains interest rate decisions as a linear function of inflation. Thus, assuming equal parameters for different Council members, the country with a median inflation will also be the one with a median desired interest rate. Additionally, an augmented version of their national-based model seeks to account for the special power of the ECB president as an agenda setter by adding to the equation the inflation in the president's country of origin. After applying the model to the first 55 months of ECB interest rate decisions, it is found that the domestic-biased version of their model features greater explanatory power than the

Europeanist one, and that the president has a significant impact. However, the omission of an economic activity variable reduces the explanatory power of the model. Also, modelling the role of the president as a linear effect may not capture entirely the extent of his or her power as an agenda setter.

Riboni and Ruge-Murcia (2010) study the theoretical and empirical implications of monetary policy making by committee under different decision rules. These protocols give pre-eminence to different aspects of the actual decision making process, and capture the observed heterogeneity in formal procedures across central banks. The models are estimated by using interest rate decisions by the committees of the Bank of Canada, the Bank of England, the European Central Bank, the Swedish Riksbank, and the U.S. Federal Reserve. In the case of the ECB, they find that deciding by consensus is the most likely option, followed by the models with a dominant chairman.

3. TWO-STAGE MODELLING OF ECB DECISION MAKING

3.1 Overview

In this Section we develop a formal procedure to join together individual formation preferences, and committee decision making within the ECB's Governing Council. From our perspective, there are two separate, sequential issues that lead to the final decision on the interest rate: accordingly, we model decision making as a two-stage process. In the first stage each member of the Governing Council sets his/her preferred rate, given his/her preferences and perception of the state of the economy. Next, in the second step the Governing Council meets and decides the actual figure. While the first stage is based on a standard policy reaction function following the textbook approach to monetary policy setting, the second step relies on different protocols for collective decision making.

3.2 The first stage: determining desired rates for the individuals

Consider member j of the Governing Council. His/her desired level of the interest rate is determined according to:

$$r^{*}_{t,j} = \bar{r}_j + \beta_j \left\{ E\left(\pi_{t+k,j} \,|\, \Omega_t \right) - \pi^{*}_{t+k,j} \right\} + \gamma_j \left\{ E\left(y_{t+q,j} \,|\, \Omega_t \right) - y^{*}_{t+q,j} \right\} \qquad (3.1)$$

$$r^{d}_{t,j} = \alpha_j \, r_{t-1} + (1-\alpha_j) \, r^{*}_{t,j} \qquad (3.2)$$

where r stands for the nominal interest rate; π is inflation; y is an indicator of real economic activity; $\bar{r}_j$ is the long-run, equilibrium interest rate, which is assumed to be constant over time; $E(.|\Omega_t)$ denotes the expected value given the set of information available at t; the asterisk is used for target values, while the superscript d indicates desired values; α_j, β_j and γ_j are parameters. The model is easily extended to allow for more variables in the determination of the target rate, like money growth or exchange rates.

Equation (3.1) states that there is a target level of the interest rate that depends on its long-run equilibrium, and the deviations of inflation and real activity from their targets. We adopt a forward-looking perspective to take into account the time lag needed for a change in the interest rate to affect the economy, although the reaction lags need not be the same for inflation and the real sector. For simplicity, we assume that the reaction lags and the set of information available at t are the same for all the members of the Governing Council.

It is well known that central bankers are reluctant to change key interest rates to avoid inducing undesirable volatility in the money and credit markets. Therefore, the actual desired rate for time t is computed as a weighted average of the previously observed value and the target rate, see equation (3.2). The desired rate $r^{d}_{t,j}$ is the level of the

interest rate that member j will advocate for in the meeting of the ECB Governing Council.

By combining equations (3.1) and (3.2), the final expression for the policy rule of member j results:

$$r^{d}_{t,j} = \alpha_j r_{t-1} + (1-\alpha_j)\left[\bar{r}_j + \beta_j \left\{ E\left(\pi_{t+k,j} \mid \Omega_t\right) - \pi^{*}_{t+k,j} \right\} + \gamma_j \left\{ E\left(y_{t+q,j} \mid \Omega_t\right) - y^{*}_{t+q,j} \right\}\right] \quad (3.3)$$

Differences in the desired rate values among members may arise because of different responses to the relevant variables, or due to nationalistic biases that give preference to monitoring domestic economic conditions instead of euro area developments. In this paper we focus on the influence of allowing for different relevant variables, under the restriction that the coefficients of (3.3) are the same for all j.

The constancy of the parameters seems to be a strong assumption that conditions the validity of the conclusions, and yet it is a common practice in empirical research (Heinemann and Huefner 2004, Sturm and Wollmershäuser 2008, Riboni and Ruge-Murcia 2010). All EMU members explicitly applied to join the euro area and to leave the implementation of the monetary policy in the hands of the ECB. Hence, it seems natural to think that the way the ECB reacts to inflation developments or to the state of the real economy is quite close to the policy rule that a national central bank would follow. As a consequence, one may expect that the differences in the desired rate among member states, that would certainly exist in the case of separate monetary policies carried out by independent national central banks, will be due to different perceptions of the actual level of the relevant variables that determine the interest rate, and not to the specific values of the parameters of the policy rule.

3.3 Second stage: formal procedures for collective decision making

In the second stage the individual preferences are combined to derive the observed ECB's interest rate. To approximate decision making heuristics at the Governing Council we set up a number of alternative procedures for collective decision making, and assess their *ex-post* performance by comparing the actual interest rate path and the predicted outcomes.

All the formal rules we consider share a common structure. There is a veto player, which is always the Governing Council, and there may be an agenda setter too. Regardless of whether there is an agenda setter or not, all the members are expected to be equally skilled, so we ignore strategically motivated behaviour.

If the agenda setter exists, he/she is assumed to have complete information about the Governing Council members' preferences, and presents the Governing Council with a take-it-or-leave-it offer. The members may, by majority, accept the agenda setter's proposal, which becomes the ECB's decision, or reject it, in which case the status quo prevails. In either case, the game ends.

The agenda setter's proposal, and eventually the outcome of the decision given the assumption of complete information, is the one that maximizes the agenda setter's utility from the set of proposals that are preferred to the status quo by a majority in the Governing Council. As a consequence, the agenda setter has the power of preventing the interest rate to change even if there is a majority in the Governing Council that advocates for such change, by simply not presenting the preferred rate to be voted.

In all the models the President has a prominent role, as he/ she has a casting vote in the event of a tie (Varela and Sanchez-Santos, 2003). The President's casting vote is modelled by providing him or her with an extra vote when there is an even number of members in the voting body. This is a suitable, well-known way of accounting for the casting vote, because it changes the balance in the event of a tie, but does not affect the

outcome of the vote when the casting vote is not necessary, as it just increases or reduces the size of the majority (Heinemann and Huefner, 2004).

Within this basic structure, we define three competing decision rules following alternative assumptions on the agenda setter. In the first rule there is no agenda setter, in the sense that no member has the power to bar some values of the interest rate to be voted. In the two other rules there is an active agenda setter, the president of the ECB in one case, and the Executive Board in the other.

3.4 Stylised models for explaining decision making within the Governing Council of the ECB

By combining the possible ways of determining the individuals' desired rates and the procedures for collective decision making, several models for explaining how the Governing Council arrives at a decision can be defined. Some combinations are more realistic than others, so we focus on the six models that are summarized in Table 1.

INSERT TABLE 1 HERE

In the first three models there is no active agenda setter, while in the rest some members exert an *ex-ante* veto on the values that the Governing Council will be presented to vote for. Individual members neglect domestic conditions only in the first model. In the others nationalistic considerations are allowed, at least for some members, and there is a real problem of deciding among different individual preferences.

The Europeanist model corresponds to the official statements of the ECB, that it conducts monetary policy exclusively on the basis of the economic developments of the euro area as a whole. Under this assumption, and given that all the members of the Governing Council have the same reaction function, they share the same desired rate.

This is the ideal gathering of experts with the interests of the euro area in mind that the ECB declares its Governing Council to be.

The nationalist median voter model combines nationalistic preferences for all the members of the Governing Council, and no agent with the power to set the agenda of the meeting. Following a standard result in the bargaining literature, its final outcome is the desired rate of the median voter.

The median voter with mixed preferences model elaborates the previous version, to take into account that the members of the Executive Board are expected to be more sensitive to the interests of the euro area, than national central bank governors (Belke and Styczynska, 2006). They are assumed to form their desired rates on the basis of euro area data, while the governors display nationalistic preferences.

The model with the president as agenda setter and the model with the executive board as agenda setter share almost all their features. All the members of the Governing Council are nationalistic, and there is an active agenda setter that controls the interest rate policies that will be considered at the meeting. The only difference between the models is the specific cluster of members that holds the agenda power, the president alone in the first case, and the Executive Board as an aggregate in the second.

Finally, the Europeanist agenda setter model combines the Europeanist view of the Executive Board, the nationalistic preferences of National Central Bank governors, and the agenda setting power of the Europeanist members.

4. EMPIRICAL ANALYSIS

4.1 Data

We consider monthly data from 1999:1 to 2009:12 for the euro area and its member states. The interest rate is the ECB's rate of main refinancing operations. From 1

January 1999 to 27 June 2000, and from 15 October 2008 onwards, it is a fixed rate for fixed rate tenders; in the period 28 June 2000 to 14 October 2008 it was a minimum bid rate for variable rate tenders.

Inflation is computed as the year-over-year percentage change in the Harmonised Index of Consumer Prices (HCPI), excluding energy and seasonal food prices. By eliminating the components that are more related to pure price-level shocks, this variable is expected to provide a better proxy to core inflation.

To measure real economic activity we use the OECD's composite leading indicator, which was preferred to other candidates for two reasons. First, it is for the most part derived from data that are not revised, and with a very short publication lag. Secondly, by construction it provides an expectation on the future state of the economy, so it is not necessary to implement a procedure to forming such expectations. The leading indicator is not available for Slovenia; instead, the euro area indicator was used to proxy domestic real activity. The lack of indicators for other EMU members, like Cyprus and Malta, has no consequences because of the sample period considered in the empirical analysis.

4.2 Specifying the policy reaction function

Following the discussion in Section 3.2, the members of the Governing Council are assumed to have the same reaction function. To approximate its parameters we adopt the standard textbook approach, with a single decision maker that sets the interest rate by focusing exclusively on aggregate inflation and real activity in the euro area. This is a highly restrictive assumption within the context of this paper, but otherwise it is a common practice in the literature to derive interest rate reaction functions for the ECB (Fourçans and Vranceanu, 2007; Sauer and Sturm, 2007; Gorter et al., 2008; Sturm and Wollmershäuser, 2008; Lee and Crowley, 2009; etc.).

The decision maker is assumed to know the values of all relevant variables at t-1, and to be concerned about inflation twelve months ahead, so k=12. Target inflation is set to 2% at every time, following explicit declarations of the ECB. By construction the leading indicator is an expectation about the future state of the economy some months ahead, so its value at t-1 is entered directly into the equation; its target is 100, which corresponds to a neutral cyclical position.

Under the previous assumptions, the reaction function is given by:

$$r_t = \alpha\, r_{t-1} + (1-\alpha)\left[\bar{r} + \beta\left\{E\left(\pi_{t+12,ea}\,|\,\Omega_t\right) - 2\right\} + \gamma\left\{y_{t-1,ea} - 100\right\}\right] + \varepsilon_t \qquad (4.1)$$

where ε_t is a random shock and the subscript ea stands for euro area data.

To estimate the parameters of (4.1), we replace expectations by observed variables and use the generalized method of moments (GMM). The list of instruments includes a constant, the lagged interest rate, and two lags of the following variables: inflation, the leading indicator, the unemployment rate, the euro's nominal effective exchange rate, and the EONIA interest rate (Euro OverNight Index Average, which is computed as a weighted mean of overnight transactions at the interbank market). The selection of instruments is standard in the literature, and all the relevant data are known at the time the ECB meets to make a decision on the value of the interest rate. The final estimates are as follows (with standard errors in parentheses):

$$r_t = \underset{(0.014)}{0.959}\, r_{t-1} + (1-\underset{(0.014)}{0.959})\left[\underset{(0.30)}{3.37} + \underset{(0.66)}{2.36}\left(\pi_{t+12,ea} - 2\right) + \underset{(0.89)}{2.09}\left(y_{t-1,ea} - 100\right)\right] + \varepsilon_t$$

$$\text{nobs} = 119\ ,\ R^2 = 0.974\ ,\ s = 0.148\ ,\ Q(4) = 1.96\ ,\ J = 0.049 \qquad (4.2)$$

where nobs is the number of effective observations; R^2 the coefficient of determination; s the residual standard error; Q(4) the Ljung-Box Q statistic computed with the four first

autocorrelation coefficients, to test for residual autocorrelation; and J is the J-statistic to test the validity of overidentifying restrictions.

The estimates are in line with previous results reported in the literature. The responses to inflation and activity are 2.36 and 2.09, respectively. Both indicate that the ECB has performed a stabilizing interest rate policy, and confirm that the central bank is concerned about future developments of the real economy. The smoothing parameter, with an estimated value of 0.959, is high, which suggests considerable inertia and a strong tendency to maintain the status quo. The long-run nominal rate is 3.37%.

The estimated equation does not show any evidence of misspecification. Hansen's test of over-identifying restrictions computed from the J statistic does not reject the null (p-value=0.679), so the extra instruments are only relevant to determine the interest rate as long as they help to forecast future inflation. The lack of residual autocorrelation as measured by the Q statistic (p-value=0.744) can be interpreted in the sense that if there was shocks to the policy rule within the sample period, as suggested by Rudebusch (2002), their effect has been fully captured by the partial adjustment mechanism that accounts for policy inertia.

4.3 How does the Governing Council set the interest rate? Some empirical evidence

If all the members follow the policy rule displayed in equation (4.2), differences in the desired rates will arise only because of some members considering domestic developments in forming their preferences. For each member we computed the time path of desired rates under two scenarios. In the first scenario member j centres on the euro area conditions:

$$r^{d}_{t,j} = 0.959\, r_{t-1} + (1-0.959)\left[3.37 + 2.36\left(\pi_{t+12,ea} - 2\right) + 2.09\left(y_{t-1,ea} - 100\right)\right] \quad (4.3)$$

while in the second scenario a purely nationalistic preference is derived by focusing solely on his/her domestic conditions:

$$r^{d}_{t,j} = 0.959\, r_{t-1} + (1-0.959)\left[3.37 + 2.36\left(\pi_{t+12,j} - 2\right) + 2.09\left(y_{t-1,j} - 100\right)\right] \quad (4.4)$$

Next we simulated the final rates that would be observed according to the models reported in Table 1. For each month within the period 1999:2 to 2008:12 the predicted interest rate, conditional on the assumptions of the individuals' preferences and the group decision rule, was computed. The fact that the ECB sets interest rates at quarter point intervals facilitates both the search of the policies to be presented at the meeting, and the result of the simulated voting. All the computations were programmed in Matlab.

Table 2 displays the sum of squared errors (SSE) and the determination coefficient for each model. R-squared coefficients are high because of the strong persistence of the observed series, a feature that distorts assessing the relative contribution of the models discussed in this paper to explaining the behaviour of the observed rate. For this reason, a random walk baseline was included in Table 2. This baseline merely assumes that the ECB maintains the interest rate of the previous month:

$$r_t = \alpha\, r_{t-1} + \varepsilon_t \quad (4.5)$$

To measure to what extent the models in Table 1 improve the fit of the random walk, Table 2 reports modified R-squared coefficients, where the reference is not the total sum of squares of the observed series, as in the standard R-squared, but the SSE of the random walk.

INSERT TABLE 2 HERE

The results in Table 2 reveal two major characteristics of the decision process within the Governing Council: domestic developments play a major role in determining the

preferred interest rate of the each member; and some members exert agenda setting power, that precludes some interest rate policies to be considered at the meeting.

Agenda setting models attain the best fits, as long as all Governing Council members are assumed to have nationalistic preferences. When the president is the agenda setter the model features a SSE of 3.125, and a modified R-squared equal to 0.1935. The last figure indicates that this model captures 19.35% of the error variance that was left unexplained by the random walk model, which represents a major improvement with respect to the no-change baseline.

If the agenda setter is assumed to be the Executive Board, the fit deteriorates slightly, but it is still better than any other model that assumes either no agenda setting or Europeanist preferences.

In relative terms, the formation of interest preferences based on domestic data seems to be more relevant in the decision process than agenda setting. When we consider models with at least one of these components missing, the best fit is attained with the nationalist median voter model, where all members form their preferences based on national conditions, and there is no *ex-ante* control of the agenda.

The models that include some type of Europeanist preferences remain at the bottom of the ranking. The standard Europeanist model and the model with mixed preferences and Europeanist agenda setting display the same fit, which is still better than the random walk baseline. Finally, the model with mixed preferences and no agenda setting is worse than the no-change reference.

4.4 Stylised models and actual heuristics: a comprehensive look

Not so many years ago it would be challenging to assert that the ECB's interest rate policy is not driven by the economic situation of the euro area as a whole. Nowadays,

however, the applied literature on monetary stress in the euro area provides empirical evidence that some national developments are considered in making interest rate decisions. To mention two recent examples, Sturm and Wollmershäuser (2008) derive the implicit weights for member states in the ECB's decision making process, and claim that they lie between the weight on the euro area GDP, and the equal weight embedded in the "one member – one vote" principle. Lee and Crowley (2009) show that euro area policy rates have been particularly close to the 'counterfactual' interest rates of the largest euro members and countries with similar economic conditions, namely Germany, Austria, Belgium and France.

Our finding that allowing for nationalistic preferences improves the pure Europeanist view is in accordance with their results. Yet we go one step further, as we reconcile domestic preferences and the "one member – one vote" rule, on one side, and the prevalent dominance of a group of countries that directs the final decision on the interest rate, on the other. Agenda setting, by either the president of the ECB or its Executive Board, explains why some countries are capable of influencing the final decision and driving the observed interest rate closer to their preferences.

Besides, our results match some well known characteristics of the decision process within the ECB. Monetary policy committees favour making decisions by consensus, or at least super-majority, and normally deter any change if there is only a strict 50-percent-plus-one majority that promotes it. This tendency seems to be particularly relevant in the case of the ECB, as suggested, for instance, by Riboni and Ruge-Murcia (2010) or Belke and Styczynska (2006). Agenda setting can be seen as a means of implementing such super-majority, as it requires both the agenda setter and the majority of the Governing Council to opt for the new interest rate against the status quo. Should

any of them fail, then there is no change in the interest rate policy, even if either a strict majority or an influential, but small, group of members supports it.

Blinder (2007) claimed that the ECB's Governing Council appeared to function as a genuinely-collegial committee, where "members may argue strenuously for their own points of view behind closed doors. But they ultimately compromise on a group decision, and then each member takes ownership of that decision" (p. 114). Our results suggest what may happen behind closed doors. The apparent, public consensus is the combination of individual members with diverse preferences that strive for adopting different interest rate policies, and the requirement that any decision that changes the current level must be backed by a number of votes large enough. Under these circumstances public disagreements are of no use, and even members that actively advocated for neglected options give preference to maintain the appearance of unity.

5. CHECKING ROBUSTNESS

The empirical results in Section 4 displayed a stylised, yet consistent view of the interest rate decision process within the Governing Council of the ECB. It could be argued, however, that this view arose from comparing descriptive goodness of fit statistics, and that it remains an open question to assess whether the differences are large enough to support our interpretation.

To check the robustness of the ranking of models that follows from Table 2, we centred on two specific aspects of the modelling process. First, we analysed the sensitiveness to the reaction function used to derive the preferred rates for each member. Second, we introduced uncertainty in the information set available for the decision makers, by replacing actual values of future inflation by forecasts. Now we concentrate on the first issue.

As discussed in Section 4.2, the reaction function estimated in equation (4.2) is standard enough to be a valid approximation to the actual policy rule used by any policy maker to forming his/her preferences on the interest rate. Nevertheless, it may happen that minor changes in its parameters lead to changes in the individual preferred rates in such a manner that, when the new preferences are compared, the final group decision becomes different. Should nationalistic components and active agenda setting be major characteristics of the decision process, random changes in individual preferences would not lead to sizeable changes in the ranking of the models in terms of goodness of fit. Otherwise, if the ranking varied, it would be an indication that the classification observed in Table 2 might not reflect a primary trait of the interest rate setting process.

Let $\kappa = (\alpha \ \bar{r} \ \beta \ \gamma)'$ be the vector of parameters of the unknown reaction function and $\hat{\kappa}$ the vector of estimators by the GMM method, so $\hat{\kappa}$ is asymptotically distributed normal (κ , Σ). We generated 10,000 random samples of $\hat{\kappa}$ by approximating the unknown expectation κ by the estimated $\hat{\kappa}$, and the unknown covariance matrix Σ by the estimated matrix $\hat{\Sigma}$. Next, we generated 10,000 histories, one for each random observation of $\hat{\kappa}$. Each history consists of the preferred interest rates for all the members of the Governing Council for the period 1999:2 to 2008:12, computed by using actual data of the relevant economic conditions, and the random extraction of $\hat{\kappa}$. In short, each history relies on a different set of values of the parameters of the reaction function. The fit of the six models displayed in Table 1 was derived for each history, and 10,000 tables like Table 2 were obtained.

Table 3 reports the pairwise comparisons of the sum of squared residuals. The president as agenda setter model displays the best performance: when compared to all the other

models but the Executive Board as agenda setter, its SSE is lower at least at 3 out of each 4 histories. When the two best models in Table 2 are compared, the president version is better in 4,868 histories, the Executive Board variant is preferred in 2,765 cases, and they display the same fit in the remaining 2,567 situations.

INSERT TABLE 3 HERE

Although the two preferred models confirm their status, there are some changes in the classification from position three on. The nationalist median voter model seems to be very sensitive to the parameters of the reaction function. From the third place in Table 2 now it ranks fifth, performing worse than the standard Europeanist model, and the model with mixed preferences and Europeanist agenda setting.

Consider now introducing uncertainty about future developments of inflation. In all the experiments carried out for the moment, it was assumed that the members of the Governing Council had perfect information about the relevant variables to form their desired interest rates. This restriction entails perfect core inflation forecasting, and it would be interesting to check whether the results in Section 4 remain the same when such restriction is relaxed.

To approximate the predictions that the individual members of the Governing Council actually had along the sample period, we build forecasting models for the domestic inflation of every member state and the euro area as a whole. The model for the inflation of country j is given by:

$$\pi_{t+12,j} = \lambda_0 + \sum_{i=1}^{2} \lambda_{1,i}\, \pi_{t-i,j} + \sum_{i=1}^{2} \lambda_{2,i}\, y_{t-i,j} + \sum_{i=1}^{2} \lambda_{3,i}\, u_{t-i,j} + \sum_{i=1}^{2} \lambda_{4,i}\, \pi_{t-i,ea} +$$
$$+ \sum_{i=1}^{2} \lambda_{5,i}\, y_{t-i,ea} + \sum_{i=1}^{2} \lambda_{6,i}\, u_{t-i,ea} + \sum_{i=1}^{2} \lambda_{7,i}\, CPS_{t-i,ea} + \sum_{i=1}^{2} \lambda_{8,i}\, NEER_{t-i,ea} +$$
$$+ \frac{1}{1-\phi_1 L-\phi_2 L^2}\, \varepsilon_t \qquad (5.1)$$

It forecasts the domestic year-over-year inflation in the Harmonised Index of Consumer Prices (HCPI), excluding energy and seasonal food prices. The forecast is made at month t for month t+12, and it is assumed that the available history of the relevant variables goes from t-1 backwards. Domestic explanatory variables include past values of inflation, the OECD's composite leading indicator, and the unemployment rate (u). Some euro area conditions are considered as well: inflation, the leading indicator, annual growth of the credit to the private sector (CPS, defined as loans to other residents), and the nominal effective exchange rate of the euro (NEER). Furthermore, lagged errors are allowed to capture potential transitory dynamics not explained by the previous variables.

The model for the euro area inflation takes the same form, but only consists of explanatory variables for the euro area:

$$\pi_{t+12,ea} = \lambda_0 + \sum_{i=1}^{2} \lambda_{4,i}\, \pi_{t-i,ea} + \sum_{i=1}^{2} \lambda_{5,i}\, y_{t-i,ea} + \sum_{i=1}^{2} \lambda_{6,i}\, u_{t-i,ea} + \\ + \sum_{i=1}^{2} \lambda_{7,i}\, CPS_{t-i,ea} + \sum_{i=1}^{2} \lambda_{8,i}\, NEER_{t-i,ea} + \frac{1}{1-\phi_1 L-\phi_2 L^2}\, \varepsilon_t \qquad (5.2)$$

The models were estimated for the sample period 2000:5 to 2009:12, with some adjustments in a few countries due to the lack of data, and the forecasting errors were recorded.

Then we generated 10,000 histories of inflation for the period 1999:1 to 2009:12 by bootstrapping the forecasting errors. For each inflation series, random samples with replacement of the errors were obtained, and "predicted" values of inflation were computed by subtracting the sampled errors from the actual data. After deriving the 10,000 histories of inflation for the euro area and the member states, 10,000 histories of individual preferred interest rates were obtained following the procedure sketched in Sections 3-4, and the reaction function reported in equation (4.2). Finally, the fit of the

six models in Table 1 was estimated for each history, and 10,000 tables like Table 2 were obtained.

Table 4 displays the pairwise comparisons. The dominance of the model where the president is the agenda setter is manifest, even when compared to the model with the Executive Board as agenda setter. The positions in the ranking of models are the same as in Table 2, so the conclusions in Section 4 are not affected by introducing uncertainty in the major variable driving the interest preferences formation.

INSERT TABLE 4 HERE

6. CONCLUSIONS

Interest rate setting is the main instrument of the ECB for conducting the monetary policy in the euro area. Decisions are made by the Governing Council, composed by the members of the ECB's Executive Board, and the governors of the National Central Banks of the Euro area. Even though the members of the Governing Council are forbidden to have a national mandate, in practice there are some reasons to suspect that they may give some attention to the specific economic conditions in their state of origin, when forming their interest rate preferences.

Determining whether there exists such home-bias is not simple. Voting inside the Governing Council is secret, and only the result of the final decision is known. But this result depends both on the individual preferences, and the procedures followed by the Governing Council to arrive at a decision. In accordance, we see interest rate setting as a two-stage process. First, each member of the Governing Council sets his/her preferred rate, given his/her preferences and perception of the state of the economy. In the second step the Governing Council meets and decides the actual figure. The first stage is based

on a standard policy reaction function, while the second considers different protocols for collective decision making.

Some restrictions must be introduced in order to set up feasible empirical models. As individual preferences are kept in secrecy, it is not possible to estimate individual reaction functions. To circumvent this shortcoming we assume that the parameters of the reaction function are the same for all the members, so in fact we are imposing that the differences in the desired values of the interest rate, if they exist, arise only because of nationalistic biases that give preference to domestic economic conditions. The conclusions are conditional on the validity of this assumption, but this is not a particular feature of this paper; on the contrary, it is a general reminder that is valid for the huge majority of empirical research on interest rate determinants within monetary policy committees.

The empirical analysis unveils what appear to be two key characteristics of how the ECB sets the interest rate. First, national developments are relevant to determining the preferred interest rate of the each member. Second, some members have the power to set the agenda, and use it to turn down some interest rate policies to be voted at the meeting.

The first finding goes along the lines of some previous results reported in the applied literature on monetary stress in the euro area, and hence it is not as unconventional as it would have been not so many years ago. But, when combined, the two characteristics allow us to go one step further, as they reconcile domestic preferences and the "one member – one vote" rule, on one side, and the prevalent dominance of a group of countries to bring the interest rate closer to their preferences, on the other.

Besides, the models with nationalistic preferences and agenda setting, by either the President alone or the Executive Board, match some well known characteristics of the

decision process within the ECB. Agenda setting can be seen as a means of making decisions by super-majority, because of its requirement that both the agenda setter and the majority of the Governing Council opt for the new interest rate against the status quo. In accordance, the apparent consensus behind the ECB's decisions may be due to the combination of individual members with diverse preferences advocating for different interest rate policies, and the practical constraint that any decision to change the current level must be backed by a qualified majority. This view would also explain why members that supported neglected options at the meeting, maintain the appearance of unity when the ECB communicates its decision.

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Table 1.- Models of interest rate setting: formation of individual preferences and location of agenda-setting power

Model	Composition of the Governing Council	Agenda setter
Europeanist	Europeanist members	No
Nationalist median voter	Nationalistic members	No
Median voter with mixed preferences	Europeanist Executive Board and nationalistic governors of member state central banks	No
President as agenda setter	Nationalistic members	Nationalist President
Executive Board as agenda setter	Nationalistic members	Median voter of an Executive Board composed of nationalist members
Europeanist agenda setter	Europeanist Executive Board and nationalistic governors of member state central banks	Europeanist

Table 2.- Goodness of fit measures for the competing interest rate setting models: February 1999 to December 2008

Model	SSE	R^2	modified R^2	Position
Random walk baseline	3.8750	0.9599	--	6
Europeanist	3.7500	0.9612	0.0323	4
Nationalist median voter	3.5625	0.9631	0.0806	3
Median voter with mixed preferences	3.9375	0.9592	-0.0161	7
President as agenda setter	3.1250	0.9676	0.1935	1
Executive Board as agenda setter	3.3125	0.9657	0.1452	2
Europeanist agenda setter	3.7500	0.9612	0.0323	4

Notes: SSE: sum of squared errors; R^2: standard coefficient of determination; modified R^2: coefficient of determination taking the random walk model as the reference; position: ranking of the models according to their fit (1, best; 7 worst).

Table 3.- Checking robustness against changes in the parameters of the reaction function: pairwise comparison between models based on the sum of squared errors for 10,000 replications

	Europeanist	Nationalist median voter	Median voter with mixed preferences	President as agenda setter	Executive Board as agenda setter	Europeanist agenda setter
Europeanist	--	4653	5345	1333	1429	1
Nationalist median voter	3599	--	5058	532	444	3586
Median voter with mixed preferences	716	3381	--	1273	1190	595
President as agenda setter	7702	8060	7790	--	4868	7691
Executive Board as agenda setter	7379	8151	7750	2765	--	7369
Europeanist agenda setter	181	4666	5374	1352	1442	--

Notes: Each cell displays the number of cases the SSE of the model in rows is smaller than the SSE of the model in columns; the difference between 10,000 and the sum of cells (i,j) and (j,i) is the number of ties.

Table 4.- Checking robustness against errors in forecasting 12-months-ahead core inflation: pairwise comparison between models based on the sum of squared errors for 10,000 replications

	Europeanist	Nationalist median voter	Median voter with mixed preferences	President as agenda setter	Executive Board as agenda setter	Europeanist agenda setter
Europeanist	--	5240	7073	423	1262	483
Nationalist median voter	3785	--	5150	3	145	3584
Median voter with mixed preferences	1541	3857	--	152	588	1005
President as agenda setter	9288	9984	9713	--	7952	9248
Executive Board as agenda setter	8192	9692	9059	1015	--	8106
Europeanist agenda setter	1569	5456	7637	444	1320	--

Notes: Each cell displays the number of cases the SSE of the model in rows is smaller than the SSE of the model in columns; the difference between 10,000 and the sum of cells (i,j) and (j,i) is the number of ties.