The propensity to form coalitions in the ECB Governing Council

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Abstract:

Heterogeneity of the European Monetary Union is currently pointed out in many studies. Thereby, one issue among others is the relevance of the decision-making process within the ECB. Moreover, the lack of transparency raises doubts on the way decisions are made by the Governing Council of the ECB and about the relative strength of Executive Board. Our purpose is to scrutinize the possible formation of coalitions in the ECB Governing Council over the selected period 2007-2011. To that end, each country is represented by its desired interest rate time series, which is determined through the estimation of a Taylor-type rule. Three explanatory statistical methods are applied to these time series in order to identify similarities and therefore potential coalition formations. On the basis of classical voting power indices, an assessment is made of the effects of such coalition formations on the voting power of different subgroups within the Governing Council.

Keywords: European Monetary Union, cluster analysis, voting power, decision-making process, Taylor rule, power indices, coalition formation.

JEL classification: D72, D78, E52

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Introduction

Since the launch of the euro, the conduct of the single monetary policy is delegated to the European Central Bank (ECB). Monetary decisions are made by the Governing Council, which consists of six Executive Board members and all of the euro area national central banks governors. Each member of the Governing Council has a voting right according to the "one member one vote" principle, leading to the same voting weight for each country in monetary policy decisions. However with the enlargement of the European Union and the Eurozone, many uncertainties arise concerning the efficiency of the decision-making process. Various reform proposals have been put forward, as in Baldwin *et al.* (2001), Eichengreen and Ghironi (2001), Berger (2002), Fitoussi and Creel (2002) and Heisenberg (2003). In March 2003, the Council of the European Union accepted the ECB reform proposal consisting of the introduction of an asymmetric rotation system once the number of national governors would reach fifteen in the Governing Council. Yet, the latter decided in December 2008 to postpone the implementation of this new voting scheme until the number of member states in the Council exceeds eighteen. Consequently, the "one member, one vote" principle is still in force in the Governing Council with 23 members.

In the ECB Governing Council, the probability that national committee members have different ideas about the optimal path of the common monetary policy is not nil. National governors could be influenced by the current economic situation in their home countries and prone to adopt national behaviour. A number of scholars provide evidence about the fact that economic development may affect the voting behaviours of policy decision-makers in a monetary union federally organized. The experience of the main decision-making body of the Federal Reserve Board in the United States provides evidence about the existence of state biases in the behaviour of policy-makers. Notably, Gildea (1992) and Chappell et al. (2008) emphasize that regional economic developments may influence the voting behaviour of Reserve Bank presidents in the Federal Open Market Committee. Meade and Sheets (2005) show similar behaviour for members of the Board. These results suggest that regional interest can exert influence on the voting patterns. As for the ECB, studies of Berger and De Haan (2002), Heinemann and Huefner (2004), Arnold (2006), or Badinger and Nitsch (2011) have reported that economic developments of individual countries affect the behaviour of their representatives in the Governing Council. Hayo and Meon (2012) explain that the current framework of the ECB Governing Council is not optimal because it doesn't take into account regional concerns. According to the statutes of the ECB, national governors shall not act as

national representatives when they decide on the monetary policy¹. However, this practice cannot be proved because the ECB doesn't reveal the way monetary decisions are made. The minutes of meetings and the voting records are not published unlike other central banks like the Fed or the Bank of England. Such lack of transparency raised some doubts about the decision rules applied in the Council and about the behaviour of national governors.

Against this background, we aim at analysing the decision-making process in the ECB Governing Council. Two main and relevant issues arise. First, we don't know exactly how decisions are made in the Governing Council. According to speeches of the ECB presidents, decisions are made by consensus². However the lack of transparency cannot confirm this evidence. Moreover the necessity to reform the ECB decision-making process heightens doubt on consensus solutions. Second, national governors may be more sensitive to the economic situation in their home countries rather than being turned towards average European economic targets. They could attach their own weights to euro area perspectives. This is why our investigation focuses both on the national governor's behaviour and the possible coalition formation in the Council.

In the European context these are burning issues because the ECB is particularly affected by the heterogeneity problem. Nowadays, there exists a significant diversity among current European member states. For instance the cases of Greece or Spain could trigger off tensions in the Governing Council. Not only the present member states of the euro area show a strong heterogeneity and even disagreements among them, but also the enlargement process could increase discrepancies between European members³. Newcomers are still in economic transition, which is characterized by levels of inflation and growth rates higher than the average⁴. The latter may have different monetary policy preferences compared to former members. Finally it may be very difficult for the Executive Board members to obtain the

¹ ECB (1999), Article 108 of the Maastricht Treaty.

 $^{^{2}}$ Mr. Duisenberg (2000) and Mr. Trichet (2003) mentioned several times in meetings that decisions have been made by consensus. During the ECB press conference on 03/02/2000, Mr. Duisenberg said: "First, there was no formal vote. Again, as I had hoped and as it was, it was a consensus decision". During the ECB press conference on 04/12/2003, Mr. Trichet said: "....I will say only that there is a consensus that the situation is not to be changed..."

³Today the enlargement process is stopped because of the financial and economic crisis. However, some countries such as Lithuania and Latvia confirm their entry in the euro zone within 2014.

⁴ This assumption is supported by several studies. See for instance Berger (2002), Eichengreen and Ghironi (2001). For example the annual GDP growth rates in 2011 for newcomers such as Estonia (7,6%), Cyprus (0,5%), Slovakia (3,3%), Malta (2,1%) and Slovenia (-0,2%) were higher than the average of the euro zone (0,5%). In the same way, the annual inflation rates in 2011 for the same countries: Estonia (5,1%), Cyprus (3,5%), Malta (2,5%), Slovenia (2,1%), Slovakia (4,1%) were higher than the average of the euro zone (2,7%). The same conclusions apply for potential members such as Latvia, Lithuania, Hungry, Romania, and Poland. Data come from Eurostat database.

majority of votes and then safeguard European prospects at the very time of the decisionmaking. Recent studies have already scrutinized the possible emergence of coalitions in the ECB. Sousa (2009) discovers possible voting coalitions in the Governing Council during the period 1999-2003. However he notes that coalitions cannot affect the efficiency of monetary policy decision because of the strong position of Executive Board members. Nevertheless, various studies on voting power argue that the Board's power is prone to decrease when coalitions between members are taken into account, as in Kosior *et al.* (2008). In the same way, Mangano (1999) claims that in certain circumstance the Executive Board can have only a low policy impact in spite of its voting power. Eventually, the position of the Executive Board is not obvious⁵. What could be the real power of the Executive Board members if potential alliances between national governors arise?

In this study we inquire into the possible formation of voting coalitions in the current decision-making process of the ECB. Here, the notion of coalition refers to the principle of common shared preferences in terms of monetary policy between committee members. In this way, we analyse the voting behaviour of members through their a priori stance of the monetary policy. More specifically we first compute monthly desired interest rate for each country over the period 2007-2011, according to a contemporaneous Taylor rule. In order to detect similarities between members, and to look at the likelihood of clusters, we apply three explanatory statistical methodologies to the monthly time series of desired interest rates. First, coalition formations are using comparative Box and Whiskers plot to reveal similarities or differences between these time series. Second, metric properties are used in order to cluster countries following the Hierarchical Agglomerative Clustering. Third, groups of countries are formed through Markov switching models emphasizing identical dynamics in these time series. An advantage of this comparative approach is that it offers different ways to clustering countries thus allowing taking in consideration the convergence or divergence of the three obtained kinds of clusters. The investigation reveals the emergence of country groups and frequently several similar groups appear through these three methodologies. From such outcome it seems useful to ask how much powerful can be such coalitions. In order to assess the voting power of each coalition in the decision-making process we apply classical voting power indices to the obtained clustering analysis. Likely it follows that Executive Board members lose weight in their strategic position.

⁵ Other studies like Belke and Styczynska (2006), Fahrholz and Mohl (2004) and Ullrich (2004) assessed the voting power of members in the Governing Council. However these studies applied voting power indices without consideration of possible coalition formations.

The article is organized as follows. Section 1 sets out the heterogeneity level in the ECB Governing Council. Macroeconomic divergences lead to different monetary preferences estimated by an interest rate rule respectively for the ECB and its European members. Section 2 provides an analysis on the possible emergence of voting coalitions based on three statistical methodologies. Section 3 offers an assessment of the voting power of European members when coalitions are formed. In this section we inquire into the voting power of Executive Board members. Finally, some concluding remarks are presented in connection with the issues of heterogeneity, transparency and ambiguity.

1. Applying a monetary rule to the ECB and national governors

With the aim of measuring discrepancies among members of the euro area, in the first place the ECB interest rate rule is determined. According to the ECB statutes, the Governing Council assesses continuously the economic and monetary situation and makes monthly monetary policy decisions⁶. Committee members should set the ECB interest rate while asking if the latter should be changed, in what direction and how much. In this way, the general principles of monetary policymaking may be described by a Taylor rule.

1.1. Estimation of the ECB interest rate rule (2007-2011)

In order to assess the monetary policy of the ECB we estimate a contemporaneous Taylor rule based on the ECB's observed policy over the period 2007.01 to 2011.08. On the one side, this selected period corresponds to the beginning of the financial and economic crisis in the Western world and to the beginning of the euro area enlargement⁷. Indeed, since 2007, Slovenia, Cyprus, Malta, Slovakia and Estonia have joined the euro zone. In this way it may be relevant to analyse the impact of the enlargement on the European monetary policy decisions. On the other side, this period allows us to continue and actualize studies dealing with the ECB monetary policy estimates. Notably, Gorter et al. (2008) provide an estimation of the ECB monetary policy under the period 1997.01 to 2006.12.

The empirical Taylor rule specification for the ECB is derived from a contemporaneous Taylor rule. The latter takes generally the following form:

$$i_{t}^{*} = \bar{r} + \pi^{*} + \beta(E(\pi_{t+n}|\Omega_{t}) - \pi_{t}^{*}) + \gamma(E(y_{t}|\Omega_{t}) - \bar{y})$$
(1)

⁶ The Governing Council usually meets twice a month. During the first meeting monetary policy decisions are made. At its second meeting, the Council deals with issues concerning other responsibilities of the ECB. ⁷ We don't take into account the former enlargement including Greece in 2001.

where i_t^* is the short term nominal desired interest rate, \bar{r} the equilibrium real interest rate, π^* the targeted inflation rate, π_{t+n} inflation expectations, y the current real GDP and \bar{y} the potential output. *E* is the expectation operator and Ω_t the information available to the central bank at the time it sets the interest rate. Coefficients β and γ describe the weights attached respectively to inflation and to the output. In practice, central banks tend to smooth interest rate changes in order to avoid disrupting financial market. Interest rate changes will be achieved within a more or less lengthy period. This inertial behaviour is introduced in the Taylor type rule through a partial adjustment mechanism given by: $i_t = \rho(i_{t-1}) + (1 - \rho)i_t^*$. Thus, the effective desired interest rate is given by Equation (2):

$$i_{t} = \rho i_{t-1} + (1-\rho) [\bar{r} + \pi^{*} + \beta (E(\pi_{t+n} | \Omega_{t}) - \pi_{t}^{*}) + \gamma (E(y_{t} | \Omega_{t}) - \bar{y})]$$
(2)

The parameter $\rho \in [0,1]$ captures the degree of interest rate smoothing. The higher is the value of ρ , the slower the adjustment will be.

Given these specifications, Equation (2) can be written in a form suitable for econometric estimation:

$$i_t^* = \beta_0 + \beta_1 i_{t-1} + \beta_2 \pi_t + \beta_3 y_{t-1} + \varepsilon_t$$
(3)

with ε_t the error term. The regression coefficients are: $\beta_0 = (1 - \rho)(\bar{r} + (1 - \beta)\pi^*), \beta_1 = \rho, \beta_2 = (1 - \rho)\beta, \beta_3 = (1 - \rho)\gamma.$

The dependent variable is the ECB interest rate of the main refinancing operations (MRO), in percentage per annum. The dependent variable i_t is dynamically regressed on i_{t-1} in order to take into account the smoothing behaviour of the central bank. We use monthly data derived from the Eurostat database.

The main independent variables are:

- The inflation rate π included at time t and measured as the annual rate of change of the euro area harmonized consumer price index (HICP). The inflation rate is calculated as the percentage change of the price index from one month to the same month of the previous year.
- The output gap *y* defined as the deviation of the real GDP from its potential. No series is available on a monthly basis for the real GDP, thus we use the industrial production index as a measure of real activity. The potential production being an unobservable

variable, it should be estimated. In line with other studies we hold the monthly industrial production index for the euro area in order to calculate the potential output⁸. We apply a standard Hodrick-Prescott filter on the industrial production index (with the smoothing parameter set at $\lambda = 14400$). Best results are obtained with a one-month lag for the industrial output gap.

We estimate the contemporaneous Taylor rule where the interest rate depends only on inflation and output gap. We use the standard ordinary least squares (OLS) method to estimate the values of coefficients⁹.

From these results we determine the Taylor rule for the ECB. Thus Equation (3) becomes:

$$\hat{\iota}_{t}^{*} = 0,06 + 0,96i_{t-1} + 0,065\pi_{t} + 0,075y_{t-1} + \varepsilon_{t}$$

With $\beta = 1.7$, $\gamma = 1.9$ and $\rho = 0.96$. Results obtained are robust as regards the empirical literature. The Taylor rule is sensitive to the choice of variables and period, thus leading to different policy outcomes. Table 2 summarizes the results from different empirical studies. <u>Table 2</u>: Estimations of Taylor-type rules for the ECB

Studies	Type of rules	Period	β	Ŷ	ρ
Gerdesmeier and Roffia (2003)	Contemporaneous	1999.1-2002.1	0.45	0.30	0.72
Ullrich (2003)	Contemporaneous	1999.1-2002.8	0.25	0.63	0.19
Surico (2003)	Contemporaneous	1997.7-2002.10	0.77	0.47	0.77
Fourçans and Vranceanu (2004)	Contemporaneous Forward looking (+6)	1999.4-2003.10	0.84 2.8	0.32 0.19	0.90 0.84
Hayo and Hoffman (2006)	Forward looking (+12)	1999.1-2003.5	1.48	0.60	0.85
Fourçans and Vranceanu (2007)	Forward looking (+12)	1999.1-2006.3	4,25	1,27	0,96
Belke and Polleit (2007)	Contemporaneous	1999Q1-2005Q2	0.49	1.94	0.75
Sauer and Sturm (2007)	Contemporaneous	1991.1-2003.10	1,08	0,66	0,88
Gorter et al. (2008)	Contemporaneous (consensus data)	1997.1-2006.12	1,67	1,65	0,89
Fendel and Frenkel (2008)	Forward looking (+12)	1999.1-2002.12	1.43	0.29	0.69

⁸ We use the seasonally adjusted monthly volume index of production. Data are obtained from the Eurostat database. In the literature, the use of the industrial production index is widely admitted. See Fourçans and Vranceanu (2004, 2007), Sauer and Sturm (2007), Ullrich (2003).

⁹ Table 1 displays OLS estimation results in appendix 1.

All empirical studies emphasize that the ECB attached importance to the stabilization of the real activity. If the output gap is negative (positive), *i.e.* when the level of actual production is less (higher) than the potential, the ECB will react by reducing (increasing) interest rate. This sensitivity is shown through the value of the coefficient γ .

Among empirical results, there is no consensus about the importance of the inflation coefficient β . For some studies the Taylor principle is respected, whereas in other it is not. This principle states that the coefficient β should be higher than 1 in order to indicate a stabilizing policy¹⁰. Table 2 shows that β is generally higher than 1 in forward looking specification as mentioned by Fourçans and Vranceanu (2007).

Finally, most empirical studies point out that the ECB adopts a smoothing behaviour. The coefficient ρ is positive and large, excepted in Ullrich (2003), implying that the ECB adjusts changes in interest rates slowly.

From our results, which are in line with others studies, we compute the desired interest rate for the ECB over the period 2007-2011. Figure 1 shows the actual ECB interest rate (ECBRA) and the interest rate derived from the Taylor rule.



Figure 1: Actual ECB rate and Taylor rule rate

Source: Authors' own calculations, and ECB web site.

¹⁰ See Taylor (1999).

Over the selected period the change in monetary policy is obviously due to the crisis. The desired interest rate is higher than the actual ECB rate. It means that the ECB monetary policy is less tightened than the Taylor rule. Strikingly we can observe from January 2009 to July 2011 a widening gap between the actual policy rate and the "Taylor rate". One possible explanation would be that the ECB Governing Council is concerned by the situation of some countries. The voting structure of the ECB grants one vote to each member. In this way, large countries, such as Germany or France are underrepresented whereas small countries are overrepresented. Several contributions have already emphasized that the ECB monetary policy favours situations of some countries. Von Hagen and Brückner (2001) and Kool (2006) assume that the ECB interest rates moves were dominated by considerations focusing on economic situation of large countries such as Germany or France rather than the euro area as a whole. In contrast, Sturm and Wollmershäuser (2008) suggest that actual ECB monetary policy decisions grant more than proportional weights to small member countries.

An alternative explanation of this discrepancy between the ECB rate and the Taylor rate would lie in the strong heterogeneity among European members. Indeed, as noted above, over this period five newcomers joined the euro zone, likely increasing differences in economic structures.

1.2. Different a priori stances of monetary policy

In this section we assume that national governors adopt national behaviour and have a priori stances about the path of monetary policy. According to such assumption, we compute the desired interest rate for each national governor by using estimates of the contemporaneous Taylor rules. As we know that decisions on the policy interest rate are made monthly, we compute the position of each national governor for each month.

In this way the desired interest rate for each country is given by:

$$i_{i,t} = \rho(i_{i,t-1}) + (1-\rho)i_{i,t}^*$$
(4)

where

$$i_{i,t}^{*} = \bar{r} + \pi^{*} + \beta \left(\pi_{i,t} - \pi^{*} \right) + \gamma \bar{y}_{i,t}$$
(5)

where $i_{i,t}^*$ represents the short term nominal desired interest rate for country *i* at time *t* derived from the Taylor rule, \bar{r} the equilibrium real interest rate, π^* the targeted inflation rate, $\pi_{i,t}$ the current inflation rate, $\bar{y}_{i,t}$ the output gap. The inflation target of the ECB is fixed at 2%, as it was announced at a press conference on 8 May 2003¹¹. Values of parameters β , γ , and ρ are calculated directly from the estimation in the previous section¹².

We obtain $\beta = 1.7$, $\gamma = 1.9$ and $\rho = 0.96$. The equilibrium real interest rate \bar{r} is calculated from the regression through the constant term¹³. We obtain $\bar{r} = 1,4$. It is assumed that these values are equal for all countries, which mean identical preferences about the stabilization of inflation and output¹⁴.

The inflation rate is measured by the annual rate of change of the harmonized index of consumer prices (HICP) for each European country¹⁵. The output gap is measured by the difference between actual and potential production. We hold the industrial production index for each country in order to calculate the potential output¹⁶. We apply a standard Hodrick-Prescott filter (with the smoothing parameter set at $\lambda = 14400$) and calculate our measure of the output gap as the deviation of actual industrial production from its potential. We now use these outcomes in order to look at possible formation of coalitions.

2. Comparative Clustering methods

According to the successive ECB Presidents, until today no formal vote has been carried out. The practical rule is to find a solution by mutual consent among committee members. However, because member states' heterogeneity in the European Monetary Union suggests that such solution is nothing else than a compromise, the lack of procedural transparency leads us to question the real decision-making process. The non-publication of voting records and minutes of meetings can induce national governors to adopt strategic behaviours. For these reasons one cannot rid the ECB Governing Council of the possible formation of coalitions during a meeting. The conjunction of heterogeneity and lack of procedural transparency may pave the way to some ambiguity surrounding their membership motivation, which awakens the hope to national governors that the implemented ECB policy will not be too distant from their own a priori stance. Let alone the idea that the existence of some

¹¹ During this conference the ECB clarifies its inflation objective. Its intention is to maintain inflation close to but below 2% over the medium term. This target is in accordance with the Maastricht Treaty.

¹² Results are relegated graphically in Appendix 1.

¹³ Alternatively, the equilibrium real interest rate could be calculated as the difference between the average interest rate and the average inflation rate. This approach is found in Kozicki (1999), Clarida *et al.* (1999), Judd and Rudebusch (1998).

¹⁴ This assumption doesn't mean that countries are homogeneous. European countries are characterized by different economic conditions that may lead to different stances of monetary policy.

¹⁵ We use data from the Eurostat database.

¹⁶ We use the seasonally adjusted monthly volume index of production. Data are obtained from the Eurostat database.

ambiguity may comply with rational motivation, here we are mainly interested in the likely consequences of ambiguity. Committee members may decide on the path of interest rate in the euro area but the heterogeneity between members and the lack of transparency can urge them on adopting strategic behaviour. Notably, national governors could be prone to swing the ECB Governing Council decision according to the situation in their respective countries (Berger and De Haan, 2002).

Therefore we contemplate the alliance that national governors wish to form between similar members. Given that monetary decisions are held monthly and that they should decide on the policy interest rate, we assume that the composition of some group depends only on the desired interest rate variable derived from the smoothing Taylor rule. In order to identify groups of countries our analysis is conducted on the basis of three different explanatory statistical methodologies.

2.1. Box and Whiskers Plot Clustering (method 1)

A boxplot (J. Tukey, 1977) is a graphical tool displaying a five data distribution summary. This graph looks like a box extending from the first quartile (Q1) to the third quartile (Q3). The line inside the box represents the median. The whiskers represent the highest and lowest values that are not outliers. Outliers are represented by circles beyond the whiskers. Boxplots are frequently used to visually compare univariate distributions¹⁷.

The clustering analysis is based on the following elements: the length of the Inter Quartile Range (IQR) boxplots, the position of the median inside the boxplots, and the size of the whiskers¹⁸. For instance Germany France and Netherlands show similar patterns. The distributions of these countries have approximately the same spread and are skewed right. In contrast, Ireland and Estonia have the highest spread and skewed left. Using this methodology we obtain the grouping analysis presented in Table 3.

¹⁷ Box plots are presented in appendix 2.

¹⁸ Outliers are not taken into account in this clustering. They only concern two countries Slovakia and Malta.

Ireland Slovakia Germany Finland Portugal Cyprus Estonia Luxemburg France Austria Italy Greece	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Netherlands Malta Belgium Spain Slovenia	Ireland Estonia	Slovakia Luxemburg	Germany France Netherlands	Finland Austria Malta	Portugal Italy Belgium	Cyprus Greece Spain Slovenia	

Table 3: Box plot clustering (January 2007 – August 2011)

Source: Authors' own calculations

Groups are formed according to desired interest rates, resulting in a clustering connected with their economic situation. These results confirm the presence of strong heterogeneity in the euro zone as countries are clustered through six groups. Interestingly, large countries such as Germany, France and Netherlands are in the same group whereas countries in difficulties like Greece, Spain and Slovenia are gathered together. In such a framework, the consensus solution may be difficult to obtain given the number of country groups. This first grouping analysis allows evaluating the heterogeneity among European members and lets conjecture the possible formation of coalitions.

2.2. Hierarchical Agglomerative Clustering (method 2)

We use here the Hierarchical Agglomerative Clustering (HAC) methodology in order to identify groups of countries. Given a distance measure between objects, and a criterion to define intergroup similarity, HAC is a bottom-up clustering method which starts with every single object as if it was a single cluster. Then an iterative process merges the closest pair of clusters satisfying some similarity criteria, until all of the objects are in one cluster. Here, we use Ward Method to define intergroup similarity. This method produces a tree decision called a "dendrogram" which shows the hierarchical structure of the clusters. We use this dendrogram to determine the number of country groups. Results are displayed in Table 4.

Ward Method					
Group 1	Group 2	Group 3			
Germany	Belgium	Ireland			
Austria	Spain	Estonia			
Finland	Italy				
France	Portugal				
Luxemburg	Greece				
Netherlands	Slovenia				
Malta	Cyprus				
Slovakia	* *				

Table 4: Cluster HAC analysis (January 2007 – August 2011)

Source: Authors' own calculations

Results from the cluster analysis show interesting results. Over the period only three possible groups appeared, as in the ECB reform proposal. However, the composition of groups in Table 4 differs from the reform because the latter suggests the distinction of three groups of countries only when the Governing Council will consist of more than 21 members¹⁹.

Group 1 resulting from the Ward method is made up by large European countries like Germany, France and the Netherlands, an outcome similar to group 3 obtained through boxplot clustering (Table3). Surprisingly, new members, such as Malta (entrance in 2008) and Slovakia (entrance in 2009) belong to this cluster while they are both in separate groups in Table 3. On the other hand, group 1 in Table 4 gathers all of the members belonging to groups 2, 3 and 4 displayed in Table 3. The second coalition group according to HAC consists partly of countries facing various financial and economic difficulties such as Greece, Spain, or Italy. Surprisingly, Ireland (whose entrance is from 1999) and Estonia (whose entrance in the European Union dates from 2004 and in the EMU from 2011) belong to a distinct group and yet both of them, in the same way as Spain, experienced a huge indebtedness of the private sector,²⁰ while Greece and Portugal, belonging to group 2 in Table 4 but respectively to group 6 and group 5 in Table 3, have in common to have borne a heavy public indebtedness well before the financial and economic crisis. In other words, both clustering show that there are in some way overlapping groups, so that if we proceed by "grouping the clusters" we may find two groups for the 17 current members of the euro area – group 1 and group "2+3" in Table 4

¹⁹ Indeed, the ECB reform proposal suggests for a euro zone consisting of 17 countries, only two country groups. The first group includes five countries while the second gathers 12 members. However, as mentioned above in the introductive part, the ECB reform has been postponed until the number of members reaches 19.

²⁰ By the way, Estonia had to face a serious and deep recession in 2008 and 2009, with an unemployment rate of about 20% and a public debt of 6% of GDP.

- but in no way these two country groups correspond with the two groups that are suggested in the reform proposal. Before scrutinizing what could be the consequences of such difference with regard to the voting power of each group in the decision-making process, still another method of cluster deserves attention, which is applied below.

2.3. Markov Regime Switching Clustering (method 3)

Markov switching models in economics were initiated by Hamilton (1989). He applied them to American GDP with two levels: high (expansion) and low (recession). Here we use MS-DR (Markov Switching Dynamic Regression) models, which rely on the following equation:

$$y_t = \mu_{S_t} + \sum_{i=1}^p \alpha_i y_{t-i} + \varepsilon_t$$

where y_t is the observed time series, (ε_t) a sequence of independent 0 mean normally distributed variates and σ_{S_t} the standard deviation of ε_t in the state S_t .. Furthermore S_t is a Markov chain with *N* states. The transition probabilities of moving from state *i* to state *j* satisfy the two conditions:

$$P(S_t = j | S_{t-1} = i) = P(S_1 = j | S_0 = i) \text{ for all } t, i, j \text{ (homogeneity of the chain) (1)}$$
$$\sum_{i=0}^{N-1} P(S_t = j | S_{t-1} = i) = 1 \text{ (stochastic property of the chain)}$$
(2)

The model used here is: $y_t = \mu_{S_t} + \varepsilon_t$, where μ_{S_t} represents a constant associated to each regime.

Parameters are estimated using maximum likelihood estimation method. The likelihood is a function of the transition probabilities, subject to the two constraints (1) and (2).

The following principles allow to clustering of countries²¹. First of all, we look at the graphs where the regime periods appear sequentially and the graphs where this is not the case. Secondly, for the latter we are able to observe the sequence high-low regime or low-high regime taking into account the amplitude level. With this methodology we obtain five country groups.

²¹ Results are relegated in Appendix 4.

Group 1	Group 2	Group 3	Group 4	Group 5
Estonia Ireland	Malta Slovakia	Netherlands Germany France	Austria Finland Luxemburg	Belgium Greece Cyprus Italy Portugal Slovenia Spain

Table 5: Markov regime switching (January 2007 – August 2011)

Source: Authors' own calculations

For group 1, countries show similar regime patterns. The regime periods of these countries do not take place sequentially (consecutively). The other groups have consecutive regime periods. Groups 2, 3 and 4 display a pattern of sequence high-low under the entire period. They are differentiated by the regime levels. Finally, group 5 is the only group which presents a sequence of regime periods low-high. Through this way of clustering member countries, we observe that group 1 resulting from the HAC method (Table 4) is split into groups 2, 3 and 4 obtained owing to the Markov switching regime clustering, while the two other distinct groups in Table 5 – groups 1 and 5 – gather the same countries as groups 3 and 2 respectively in Table 4. Notwithstanding a few differences,²² groups of country displayed in Tables 3 and 5 don't show strong dissimilarities, so that observations made in the end of section 2.2 may again apply to the comparison of this third cluster analysis with clustering 1 and 2 above. Therefore, when we look at these outcomes, the main tentative conclusion is that a propensity for the national governors to form coalitions does exist in the ECB Governing Council.

Faced with the formation of coalition groups and opportunistic behaviours, the Executive Board may have some difficulties to impose European perspectives. As mentioned by Baldwin *et al.* (2001) the Executive Board should convince more national governors to obtain the majority of votes with the enlargement process.

3. Strategic Behaviours and Voting powers in the ECB Council

This section aims at gauging the voting power of Executive Board members taking into account the formation of coalitions. In order to assess the voting power of committee members we use voting power indices. The latter allow quantification of the *a priori* influence of each member on the monetary policy decisions. The voting power of a member is

²² It concerns for instance the cluster of Malta and Luxemburg respectively in Tables 3 and 5.

measured by the probability to break a tie in favour of his preferred decision. A player *i* is decisive when he makes the coalition winning. This means that the player *i* is decisive if v(S) = 1 and $v(S - \{i\}) = 0$. We will note d(S) the number of decisive players in coalition *S*, and $D_i(v)$ the set of coalition in which the player *i* is decisive. The concept of power index allows us to assess the probability of a player *i* to play a key role in the decision made.

Among various power indices, two of them are particularly used in the literature. One is the Shapley-Shubik index (henceforth S-S index) and the other is the Banzhaf index (henceforth BZ index)²³. The main distinction between them relies on what the qualifier crucial or decisive means.

The S-S index considers all possible permutations of voters in a voting game and takes into account permutations in which the player *i* is decisive. That is where the player *i* turns a coalition into a winning one while joining it. This index is based on the notion of "pivot". The player *i* is a pivot because the coalition wins thanks to his vote²⁴. This player is decisive in coalition *S* formed by itself and all prior players. Thus, in order to calculate the S-S index of player *i*, we have to divide the sum of players permutations for which the player *i* is decisive by all the possible permutations. The S-S index of a player *i* is given by:

$$SS_i = \sum_{S \subseteq N, i \in S} \frac{(s-1)! (n-s)!}{n!} [v(S) - v(S - \{i\})]$$

Assuming that all permutations consist in one and only one decisive player, we have: $\sum_i SS_i(v) = 1$. Consequently the S-S index measure the number of times where a given player *i* is decisive.

The BZ index is slightly different. Banzhaf also considers that the measure of player i voting power depends on the number of times where the player i is decisive. However, in the Banzhaf voting process coalitions vote in bloc. Therefore, this index is based on the notion of "swing". A player i has a swing insofar as when he leaves a winning coalition, he turns it into a losing one. In this way, player i is decisive for the coalition S. Therefore, the BZ index counts the swings of the player i in all possible coalitions.

²³ Historically, the Shapley-Shubik index (1954) was first elaborated. For twenty years, debates focused essentially on the analysis and the comparison of this index with its rival, the Banzhaf index (1965), which appeared a few years later. Over the following years, the literature on indices grew considerably with extensions. Other indices have been proposed by Deegan and Packel and Johnston both in 1978. Extensions of the theory have been developed by Felsenthal and Machover (1998) and by Holler and Owen (2001).

²⁴ Player *i* is considered as the pivot when he makes the coalition a winning one.

The normalized Banzhaf index is given by:

$$\widetilde{B}_i(v) = \frac{d_i(v)}{\sum_{j=1}^n d_j(v)}$$

With $d_i(v) = \sum_{S \subseteq N, i \in S} [v(S) - v(S - \{i\})]$. In other words, $d_i(v)$ represents the number of decisive coalitions containing *i*. The normalized index has the property that the indices of all players always add up to 1. This formulation is generally used in order to compare it with the SS index²⁵.

In order to apply voting power indices to the ECB Governing Council we consider each coalition as one separate player. We presume that Executive Board members act as one player. Given that there is a lack of transparency, we don't know exactly the way in which decisions related to interest rates are made. Thus, we assume as in Baldwin *et al.* (2001) that the ECB president proposes a value for the interest rate (that is rising, decreasing, or maintaining the value). If no consensus is obtained, a simple majority is required. In the case of a tie, the President has a double vote. In the present decision-making process, the majority requires 12 votes. Table 6 displays voting power indices for committee members.

$$B_{i}(v) = \frac{d_{i}(v)}{2^{n-1}} = \frac{1}{2^{n-1}} \sum_{S \subseteq N, i \in S} [v(S) - v(S - \{i\})]$$

²⁵ There are two calculations of this index. Dubey and Shapley (1979) suggested another weighting of the BZ index. The non-normalized index is the most used in the literature. The latter is often associated with Coleman and the normalized index originated in the studies of Penrose (1946). The formulation of the non-normalized BZ index (or the absolute BZ index) takes the following form:

In other words, this formulation counts the sum of swings of player *i* divided by the number of all coalitions including player *i*, that is (2^{n-1}) .

Without coalition	Voting power	Clustering 1	Voting power	Clustering 2	Voting power	Clustering 3	Voting power
Executive Board	43,051	Executive Board	29,032	Executive Board	33,33	Executive Board	21,429
National Governors (Individual countries)	3,35	Group 1 IRL, EST	6,452	Group 1 GER, AUT, FIN, FRA, LUX, NTH, MAL, SLQ	33,33	Group 1 IRL, EST	7,143
		Group 2 LUX, SLQ	6,452	Group 2 BEL, SPA, ITA, PORT, GRE, SLV, CYP	33,33	Group 2 MAL, SLQ	7,143
		Group 3 GER, FRA, NTH	12,903	Group 3 IRL, EST	0	Group 3 GER, FRA, NTH	14,286
		Group 4 FIN, AUT, MAL	12,903			Group 4 AUT, LUX, FIN	14,286
		Group 5 PORT, ITA, BEL	12,903			Group 5 BEL, CYP, PORT, ITA, GRE, SLV, SPA	35,714
		Group 6 CYP, GRE, SPA, SLV	19,35 %				

Table 6: Voting power distributions under the actual voting system (%)

Source: Authors' own calculations.

A first observation of Table 6 highlights the loss of Executive Board voting power when coalition formations are taken into account. Without considering coalition, the Executive Board holds 43 per cent of voting power and each country has 3,35 per cent of voting power. In such case, board members need to convince few members in order to obtain the majority of the voting power. However, the possible coalition formation will affect the power of the Board. The latter could vary between 33 per cent to about 21. These distributions imply that the Executive Board position is not strengthened. Board members should make more efforts in order to impose European perspectives.

Furthermore, the present voting system grants the same political weight to committee members. According to the "one member, one vote" principle, the Executive Board has the same political weight as European members. In the same way, large countries as Germany or France have the same political weight as small countries or countries strongly affected by the economic collapse such as Greece or Spain. Such situation could encourage countries to form alliances in order to draw the European interest rate path nearer to their own stance of monetary policy.

Conclusion

This study provides an assessment of the current decision-making process of the ECB Governing Council by emphasizing the propensity to form coalitions. First of all, we find that the Governing Council of the ECB faces with the possible formation of coalitions over the period 2007-2011. Coalitions are analysed through common monetary preferences. For this purpose, desired interest rates by each country are calculated on the basis of a contemporaneous Taylor rule. Then, three explanatory statistical methods are applied to the desired interest rates in order to cluster countries. Several countries present similarities on their a priori stance for the monetary policy. The cluster analyses show that there is a risk of regional bias in the common monetary policy. The potential formation of coalitions could lead national governors to adopt strategic behaviour in order to bend the European monetary policy to their own will. In this way, our analysis is in line with other studies proving the risk of some "nationalization" of the European monetary policy. Finally we have enlightened that because of strategic behaviour of coalitions it could be very uneasy for the Executive Board members to impose European-wide perspectives. Once coalition formations are taken into account, Executive Board members will be less influential on the decision-making process outcome as their voting power decreases.

The future introduction of the rotation system, expected with the nineteenth member joining the euro zone, would not avoid potential alliances between countries. The clustering of countries proposed by the reform doesn't seem reflecting the economic preferences of countries apart from Germany, France and the Netherlands. As a further extent of our analysis it could be interesting to cluster countries with other variables such as public debt, inflation rate or unemployment rate.

Finally as some recommendations, two alternative solutions can be derived from our results in order to avoid coalition formations. On the one side decreasing the heterogeneity level may be an attempt to shun such propensity to form coalitions. In the actual context some countries could be tempted to leave the euro zone. Indeed, by reducing the number of countries, the euro area could move near to an optimal currency area. However, such scenario does not seem easily and politically feasible. Neither erasing the strong heterogeneity between European

members is economically and socially feasible in the short run. Another way to avoid coalition formations would be to increase the transparency of the ECB in order to induce national governors to adopt European perspectives. The disclosure of minutes and voting records could contain strategic behaviours. Nevertheless, more transparency shall be understood with cautiousness. Higher transparency could be harmful when there is strong heterogeneity and some ambiguity can be desired by any member.

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Annex:

Appendix 1: OLS Estimation results

Coefficient	Estimated coefficient	Standard Error	t-statistic	P-value	
β _o	0,0600786	0,0475344	1,2639	0,21190	
β_1	0,961426	0,0181364	53,0110	<0,00001	***
β_2	0,0650981	0,021703	2,9995	0,00414	***
β_3	0,0751117	0,0149839	5,0128	<0,00001	***

Table 1: Taylor rule estimation from January 2007 to August 2011

Notes: Dependent variable: the ECB interest rate of the main refinancing operations. $R^2 = 0.989109$ *** denotes significance at 1% level, ** denotes significance at 5%, * denotes significant at 10% level.



Appendix 2: Boxplot graphs of countries' desired interest rates

Appendix 3: Desired interest rates by country





Appendix 4: Markov Regime Switching Clustering



