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Efficiency of Decision Making in Central Banks:

Lessons for the European Central Bank

Co-directed dissertation presented in order to obtain
a title of doctor in Economic Science by

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It is impossible to imagine the universe run by a wise, just and omnipotent God, but it is quite easy to imagine it run by a board of gods.

Henry Louis Mencken (1880-1956)
American writer and freethinker

Acknowledgements

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List of Abbreviations

AR – Autoregressive

BC – Bank of Canada

BE - Bank of England

BJ – Bank of Japan

BM – Bank of Malta

CNB - Czech National Bank,

ECB – European Central Bank

EMU – Economic and Monetary Union

EP – Eesti Pank (Bank of Estonia),

ERM – Exchange Rate Mechanism.

ESCB – European System of Central Banks

EU – European Union

Fed – Federal Reserve System of the USA

FOMC – Federal Open Market Committee

GC – Governing Council

GDP – Gross Domestic Product

GV – Göhlman and Vaubel (2007)

IGC – Inter-Governmental Conference

LSE – London School of Economics

MBA – Master of Business Administration

MPC – Monetary Policy Committee

NBP – National Bank of Poland

OECD – Organization for Economic Cooperation and Development

OJ – Official Journal

RBA - Reserve Bank of Australia

RBNZ – Reserve Bank of New Zealand

SNB – Swiss National Bank,

SR - Swedish Riksbank,

TEEC – Treaty Establishing the European Community

General introduction

Central Banks usually come to public consciousness (and press headlines) for one of the following three reasons: they raise, cut or leave unchanged interest rates (most often), a new person is being nominated as the governor or a member of its decision-making body (somewhat less often) or, finally, their legal basis is reshaped (much less frequently). Referring to the first of these reasons, it seems that an important part of the population realizes that interest rates play a significant role in their everyday life influencing the cost of credit and the revenue from their savings. In some countries like Poland, where domestic interest rates (both nominal and real) used to be high, a considerable fraction of the population pays even attention to interest rate movements abroad (having their mortgage loans denominated in foreign currencies). Not to mention financial markets where interdependencies are so deep that a word of a central banker may influence exchange rates and capital flows throughout the world.

Thus, the attitudes of central bankers matter and their nominations are closely tracked by the financial markets and general press as well. In recent years we experienced some important turnovers on central banks' heads. The Greenspan – Bernanke change at the Federal Reserve Board made probably the most headlines[i], even if some other similar events were also largely commented (cf. Stanley Fischer at the head of Bank of the Israel, most recently Athanasios Orphanides, former economist at the Fed with substantial publication record in the field of monetary policy, nominated as the Governor of the Bank of Cyprus, or\ the appointment of Sławomir Skrzypek as the President of the National Bank of Poland in January 2007 closely followed by media). Nominations of central banks' Governors are also followed with diligence by financial markets, which has recently been proved by Kuttner and Posen (2007).

The nomination (and the personality) of the Governor is, obviously, the most exposed one of the decision-making body of a central bank, though, usually, the most important decisions are taken collectively. The trend of moving from monetary policy decisions made by an individual central banker to collective decision making, is easily perceivable and has been

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[i] The nomination of Ben Bernanke as the successor of "Maestro" Greenspan was e.g. analyzed on the first page of *Le Monde* (Nov. 8 2005) by Daniel Cohen. His conclusion accentuated the fact that central banks are more and more often governed by academics. Kuttner and Posen (2007) report that at least 1322 articles on the same subject were published on the day of the nomination (Oct. 25, 2005) and the following one.

even qualified as one of main aspects of the *quiet revolution*, which central banking undergone in recent years (Blinder, 2004). Nonetheless, the vote of the Governor, even if it formally does not differ from the other members de facto may be quite important - Chappel et al. (2005) estimate that the weight of the chairperson of the Federal Open Market Committee (FOMC) vote may even comprised between 0.4 and 0.6. This influence results from the usual tie-breaking power of the Governor as well as from their role of "agenda setter". These rules however do not cross out the role of the other members, because it happens that they outvote the chairperson[ii]. This proves the importance of the whole committee for the interest rate setting.

Before turning to a more precise definition of the problems tackled in the present dissertation, three potential vocabulary difficulties should be clarified. First, a committee will denote a collective decision making body in general, thus including juries, firms' boards, parliamentary commissions as well as monetary policy committees and other similar structures. Second, a monetary policy committee (MPC) will denote a committee which is in charge of interest rate setting in a given country or monetary union. Thus, MPC will designate the British Monetary Policy Committee, the Polish Monetary Policy Council, but also the American FOMC as well as the Governing Council of the European Central Bank (ECB). Third, the Governor will stand for the head of the central bank, no matter the exact title (President, Chair etc.).

These precisions are important as the main question of the present dissertation is the collective nature of decision making in monetary policy. This term will more precisely refer to interest rate setting by central banks, because even if important monetary policy decisions concern also such technical issues as conducting open market operations, allotments, eligible collaterals, issuing banknotes etc., the general public as well as the financial markets pay the highest attention to interest rate moves. These interest decisions, taken by central banks in selected countries between 1999 and 2006 are presented on figure I. below.

[ii] Notably the proposal of Marvin King, the Governor of the Bank of England, to keep the interest rates unchanged "lost" with the alternative to lower the interest rates on the August 4, 2005. The situation where the Governor of the central bank was on the losing side of the committee was much more common in Polish Monetary Policy Council in recent years of Balcerowicz's term of office.

Figure I: Interest rate decisions in selected countries

European Central Bank

Bank of Sweden

Reserve Bank of Australia

Swiss National Bank

Bank of Canada

Bank of England

Bank of Japan

Federal Reserve

Reserve Bank of New Zealand

National Bank of Poland
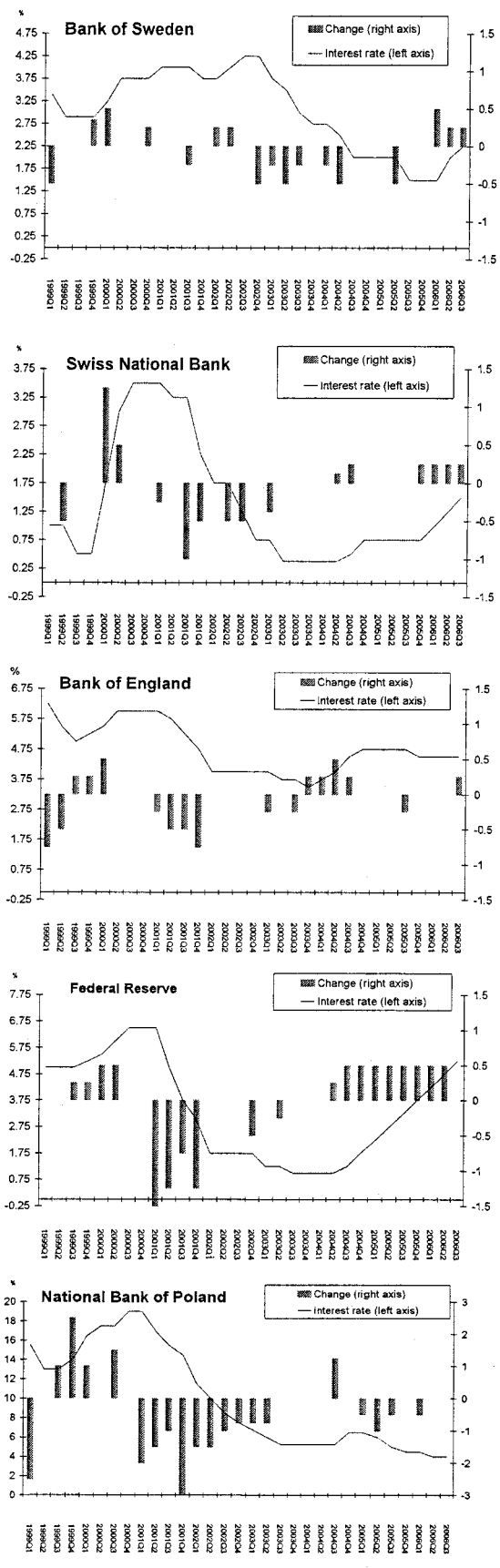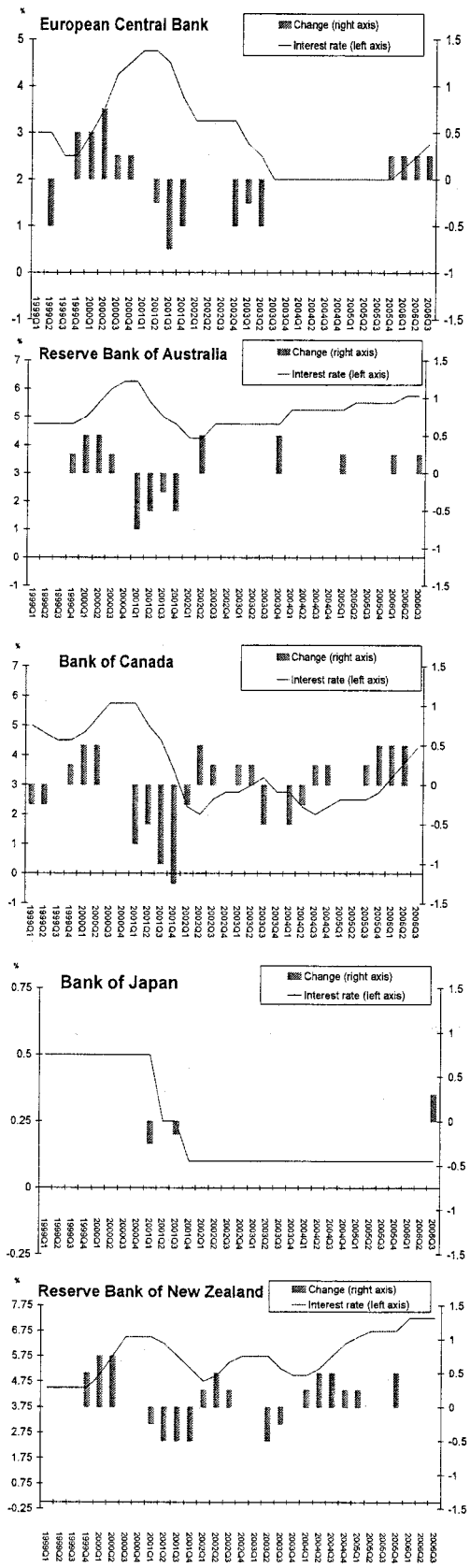
Figure I. above presents the monetary policy decisions – the interest rates variation in ten selected countries on the quarterly basis from the first quarter 1999 to the third quarter 2006. The analysis period starts with the very first days of the European Central Bank (ECB) to finish with the latest data available from the IMF (2007, February). Some more arguments in favor of the choice of this time span are provided in the empirical part of the thesis. There is an easily observable co-movement of interest rates in the selected countries which makes possible a division of the 31 observed quarters into several subperiods.

In the first one, lasting approximately from 1999Q2 to 2000Q4, a general upward trend is visible (with, however, a few exceptions in the beginning of the period). The year 2001 with its general turmoil in financial markets and not only (Internet bubble crash, 9/11 attacks) is the most marked period of interest rates' cuts. The following period, lasting approximately ten quarters does not reveal any common trend (in some countries some additional interest rate cuts were observed, in other the contrary movements were already present). Finally, since about the third quarter of 2004, a tendency to rise interest rates can be observed in a majority of countries.

This common pattern is followed more or less precisely by the different countries, depending on their particular situation (less e.g. by Japan with its zero bound on nominal interest rates or Poland under significant disinflation), but possibly also on some other factors. Remarkably, the number of interest rates' changes, as well as their amplitude, significantly differs among countries. Again, these differences may be explained by the economic conditions, however, it would be interesting to test the hypothesis, that they are, at least to certain extent, driven by the diversity of the decision-making bodies in these countries.

Thus, some important research questions arise. These are:
- Which are the factors influencing the outcomes of decision-making in monetary policy?
- More precisely: Are there any links between the composition of MPCs and their performances and behavior with regard to interest rate setting?
- How the design of the main decision-making body of the ECB – the Governing Council (GC) may be assessed with respect to its actual and potential efficiency?

In order to avoid any potential misunderstandings, let us define the idea of efficiency which will be adopted in the present dissertation. First, remark that in economics efficiency means achieving the maximal output given scarce resources. In his seminal paper, Leibenstein (1966) introduced this concept of "X-efficiency" indicating that its major (but not the only one) element is motivation (or incentives).

However, the adaptation of the efficiency concept to decision making or more precisely decision making in monetary policy requires some important modifications. It seems that two main resources of (any) decision-making are the available information (and the tools of its analysis, which will be ignored here), and the decision-makers themselves. The efficiency of their use will be certainly affected by the procedures. Thus, the decision-making efficiency in the EU was e.g. measured as the time between the proposition of the Commission and the decision of the Council (Schulz and König, 2000).

Such an approach seems impossible in case of the "real" monetary policy making. Though Lombardelli at al. (2006) compared individual and collective ability to detect a shock in economy, nevertheless it was a "laboratory experiment" – students faced a simple stochastic model and were asked to react by interest rate changes. In the real life the detection (and even precise definition) of economic shocks may by somewhat tricky and any empirical study of the time of reaction of the MPC to economic shocks seem even impossible. Instead two measures allowing this will be proposed. The first one concerns the attainment of the main goal of monetary policy – price stability, and the second the reactivity of monetary policy. The latter will be measured in three ways, the number of interest rate moves, its variance and finally as a square of interest rate changes.

The final goal of the present dissertation is to analyze the efficiency of monetary policy decision-making systems in major OECD countries in order to provide some lessons for an optimal shape of the ECB decision-making from a euro-wide point of view. This contains also an assessment of the previous and reformed (current) legal basis for the ECB decision-making in monetary policy as well as some alternative scenarios.

Attaining this goal requires four stages, which will reflect the composition of the dissertation. The first stage is a review of the existing literature on the collective decision making (with a special concern on monetary policy making) to apprehend the main directions and the current state of research in this domain. This will allow to proceed with new theoretical and empirical research focused on decision making in monetary policy. Thus, the first chapter proposes a conceptual framework for the classification of the factors influencing the collective decision-making, which allows for a well-structured review of the existing literature. Under this structure, it presents the analysis of the impact of these factors on groups' decisions in general (section one) and focuses especially on characteristic aspects of collective decision-making in monetary policy (section two).

The second stage relies on designing a new theoretical model of decision making with respect to interest rate changes where decision by an individual member relies on his private information. Thus, in the second chapter of this dissertation an attempt to deepen the theoretical approach towards modeling the incentives of committee members to search for precise information within a stylized monetary environment will be presented. Consequently, an important weight will be given to the information – the crucial input for the good monetary policy decisions and to the effort of members in making it more exploitable. Thus, such an important aspect of monetary decision making as the precision of information about the state of the economy will be made endogenous. A novelty will be also treating the skills of decision-makers as related to the effort they have to expend in order to analyze the available information. This will offer some important insights into collective monetary policy making.

The third step consists in an empirical research studying the relationships implied by the theoretical model and linking the characteristics of the MPCs (and their members') with their performances and reactivity. Then, a comparative empirical research of some important MPCs will be presented in Chapter 3. To test for the impact of personal preferences implied by demographic characteristics as well as educational background or career experience, a research on their impact on policy efficiency will be presented. More precisely, chapter 3 attempts to assess the impact of characteristics of monetary policy committees (and their members) on inflation and their responsiveness.

Finally, the results of the three research steps will be contrasted with the political economy of the (related to EU enlargement) reform of the Governing Council of the European Central Bank. Thus, the recent reform of the decision-making system of the ECB will be scrutinized in the light of the previously presented research in chapter 4. The recent enlargement of the European Union and consequently, within a few years, of the euro area, requires a reformulation of the decision-making framework of the European System of Central Banks. Chapter 4 serves thus as a reminder of the reasons for the necessity of this reform, evaluates the adopted solution and surveys other reform possibilities. More generally, it provides theoretical background for the analysis of decision making in the specific environment of a monetary union (or federal-type central bank). Subsequently, it proposes a coherent and exhaustive set of criteria to judge the European Central Bank enlargement reform. Finally, it indicates another solution, which closely fits the proposed set of criteria.

Thus, internal and external factors influencing the decision-making system in monetary policy will be applied to a comprehensive set of studies, both theoretical and empirical, throughout this dissertation.

Concluding remarks, summarizing the whole analysis and underlining its importance for political economy of central banks as well as giving prospects for the further research close the thesis.

Chapter 1

Theoretical aspects of monetary policy making in committees

> *"[O]ne of the hallmarks of the quiet revolution in central banking practice has apparently been a movement toward making decisions by committee, whereas previously the dictatorial central bank governor was more the norm."*
>
> Blinder, 2004, p. 35.

Introduction

Since the decline of autocratic monarchies, more important decisions are less often entrusted to individuals. This development is in line with the common knowledge that two heads are better than one, which has been mathematically proved by Condorcet (1785) on the grounds of the then emerging probability theory. Even if his analysis concerned juridical decision-making, one may think that any important dilemma of the human society could be delegated to a *committee*.

Indeed, it is easily remarkable that laws are usually (at least in peacetime) made by parliaments, juridical cases are settled by courts and authorities on virtually all governance levels are collective bodies, even sport competitions are usually evaluated by several referees[1]. More economic examples include supervisory boards of enterprises, boards of directors, editorial boards of scientific journals as well as diverse economic councils or think tanks, which may play significant role, even if they are only of consultative character. Nevertheless, the most powerful, or at least enjoying the highest reputation, among economic committees are probably monetary policy councils (MPCs).[2]

To conceptualise the analysis of decision making in an MPC and its determinants, a simple scheme is proposed: a committee obtains some information[3] (possibly divergent or

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[1] This particularly concerns qualitative judgments.

[2] Hereafter, MPC will designate any committee whose competence is interest rate setting. Thus, this term covers the British Monetary Policy Committee, the American Federal Open Market Committee, the Board of Governors of the European Central Bank and other similar decision making bodies.

[3] Information may be considered as an input to the decision-making process.

differently interpreted by different members) and reaches a decision through a decision-making process. However, two groups of factors may influence its work and outcomes.

First, external determinants influence the committee and the process of reaching the decision. They represent structural and institutional characteristics shaped by laws regulating the framework of monetary policy making and include such elements as the organisational setup (number of committee members, decision-making rule, etc.), appointment process and also possibly encompass external pressure (political pressure or "central bank bashing"[4] being the most common examples). Second, internal features, including preferences of the committee members and diverse interactions among members clearly exert effect on quality and character of the decision-making activity. It seems logical, that preferences of committee members are shaped by their personal experience and thus can be proxied by their demographic and social characteristics. At the same time, members' features (somehow aggregated) may be used to describe the committees themselves. This broad idea is visualised by figure 1.1
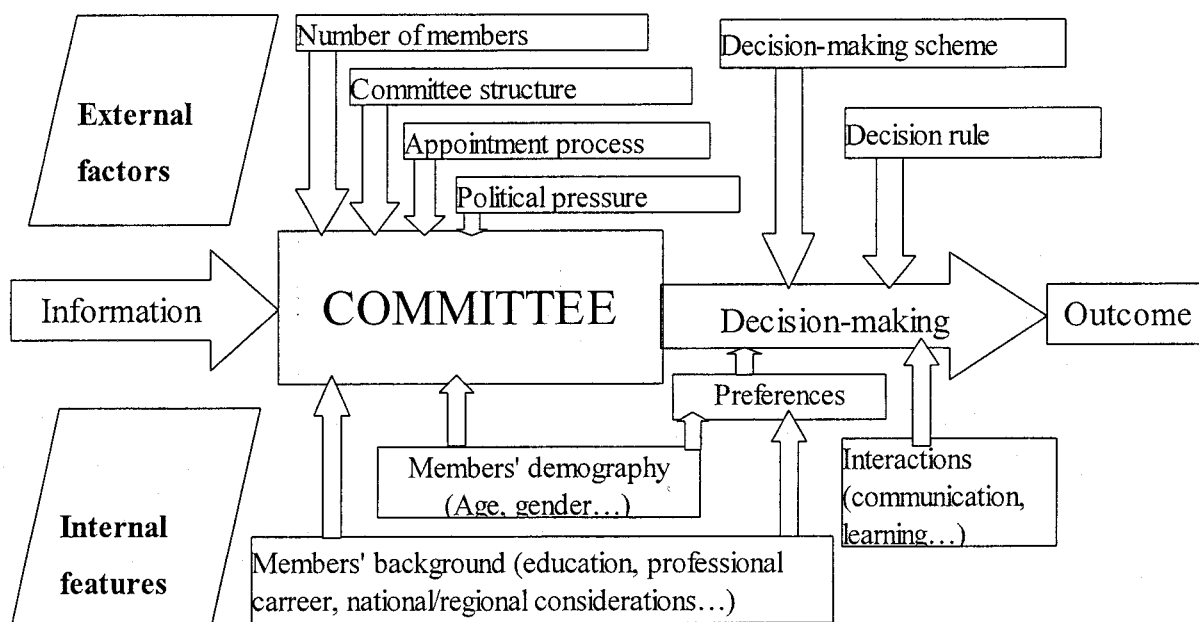
Figure 1.1. Decision-making by a committee

The simplicity and clarity of the illustration requires an omission of some interactions among internal and external factors. For instance, personal characteristics of (potential) committee members obviously influence their eligibility and, theoretically, the optimal number of members is related to the voting rule (see below).

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[4] See e.g. Maier and Bezoen, 2004.

Elements presented on figure 1 will be analyzed throughout the present chapter. Some of them are general enough to be investigated within a broad decision-making framework; others are specific (or have been analyzed in depth only with respect) to monetary policy making. Thus, the related research will be presented in two sections. Section one exposes theoretical research on the size, decision rule and communication between members of <u>any</u> committee. It ends with some solutions for possible improving collective decision making or proposing schemes equivalent to committee voting. The second section starts with some arguments for delegating monetary policy to committees rather than to individuals. It presents a parallel internal/external factors analysis applied to interest rate setting, but expanded to some particular questions such as appointment process and political influence as well as internal factors exerting effects on monetary decision making.

1. Decision making in committees

Before turning to a deeper analysis of MPCs, a general rationale of group rather than individual decision making will be presented. Simple and intuitive reasons for leaving some important decisions to committees are that collegial decision-making allows for sharing experience, knowledge as well as responsibility. Over two hundred years ago Condorcet (1785) argued that adding members to a jury increases the probability that the decision taken will be appropriate and that this probability tends to one as the number of jury members tends to infinity. This scope of research has continued, revealing that these findings are valid only upon fulfillment of strong premises, such as null cost of members' participation and information acquisition, sharing common objective, sincere and not strategic voting and no communication between committee members.[5]

There is, to our best knowledge, no general studies providing arguments of the superiority of collective decision making in all contexts. In fact, within some domains (private spending being probably the most obvious example), individual decisions will be surely more efficient. However, as recently proved by Méon (2006), the decision making by committee (deciding by simple majority) stabilizes, the potentially volatile preferences of its members.

Nevertheless, where some important stakes emerge and/or when a high degree of uncertainty exists, mankind tends (as mentioned in the introduction) to rely on collective

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[5] An interesting and pedagogical explanation of Condorcet's ideas as well as the alternative voting schemes are presented in Moulin (1988, chapters 9-11) while some more in-depth insights are provided e.g. by Austen-Smith and Banks (1996). Nevertheless, as will become clear below, this stream of literature lies only at the margin of the subject tackled in this dissertation.

decision-making. Some more precise arguments, within the specific context of monetary policy, will be given below in section 2. For now, let us take for granted that Condorcet's theorem works for small committees in a majority of decision fields (two heads are always better than one).

1.1. External factors.

Following the scheme visualized on figure 1, the factors influencing collective decision-making and external to the committee itself, will be presented. These aspects might be shaped by the laws (as usually are the number of members, committee structure and or decision rule) or might involve some other forms of external pressure, which is, however, usually proper for some specific kinds of committees. According to the general approach to collective decision-making followed in this section, the focus will be on the only two probably most important external features of the committee's functioning: number of members and decision rule.

Number of members

The first question to be raised after admitting the superiority of committees over individuals in decision-making is the optimal size of the committee. The Condorcet's jury theorem suggesting infinitely inflating the committees as a way of assuring efficient decision making seems unrealistic. Referenda, which might be thought of as its direct application, are not very commonly used (except, perhaps, in Switzerland[6]). The reason is relatively simple – in reality the costs related to increasing the number of voters are non-null. Though, the marginal (decisional) return - understood as the increase in the probability of taking the right decision implied by adding a decision-maker - is usually decreasing. This is the case especially when decisional skills are equally distributed among members. Thus, introducing a positive marginal cost of adding a member to the committee limits the optimal number of its members. This intuitive result has been demonstrated e.g. by Berk and Bierut (2003).

In reality, the above-mentioned costs of a bigger committee may take monetary form (e.g. salaries of the members or administration costs of their bureaux) or may be non-pecuniary. Berger (2002) has qualified the latter as "decision making costs" which might be understood as the time needed to improve the average accuracy of decisions.

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[6] For a deeper analysis of recent Swiss experience, see Kirchgässner (2007).

Restraining the number of voters (and time of discussion), while limiting the informational losses caused by lowering the number of members is possible through diverse decision-making schemes, such as rotation or grouping members in constituencies.[7] Bosman *et al.* (2005) lead an interesting laboratory experiment investigating how rotation schemes influence the outcome. The research is (as the authors admit) influenced by the rotational system at the Federal Open Market Committee (FOMC) but it seems that the adopted reform of the ECB (with its unequal rotation scheme) has been an additional motivation. The authors compare behavior and outcome of a five-person committee, whose members care about their individual pay-offs but also the common one (which is itself a weighted average of personal rewards), under three decision making schemes. In the first one all members are allowed to participate, the second is "equal" rotation scheme, where only three members are allowed to vote and rotate with equal frequencies and under the third scheme one member was granted a permanent seat and other four members rotated with constant (50%) frequency.

The main findings include the superiority of rotating (and thus smaller) committees in terms of speed of decision-making (and number of vetoes), at the cost of somewhat more frequent strategic voting behavior.[8] The rotation scheme marginally improved mean overall pay-off, however at the same time redistribution effects emerged (members earned more in rounds when they had voting rights). Thus, the pay-off variance also increased when the rotation scheme was applied. Interestingly, even if the applied decision rule was unanimity, the preferred outcome of median voter was the result in about 60% of decisions.

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[7] Description of main decision-making schemes applicable to central banking will be presented in chapter 4, while discussing diverse proposition for preparing decision making of the ECB for the enlargement of the euro area.

[8] Strategic, in contrast to sincere or naive, voting refers to the situation when a voter supports a different option that she would choose alone. The reasons for such a situation may be diverse, e.g. expectations of other members' behavior or the signals they revealed. Gerling *et al.* (2005), following Austen-Smith and Banks (1996) distinguish also between naive voting and informative voting, when the committee member votes according the information she has.

Decision rule

If larger committees are believed to spend particularly long time to agree on a decision, this can even be aggravated when they reach it by consensus rather than by simple majority voting. This indicates that the optimal size and decision making rule for a committee might be linked.

These two imminent characteristics of the committee are modeled by Persico (2004), although the main focus is on the decision rule. He defines it (analogically to other related works) as a minimal number of votes required to validly adopt a decision. The designer, simultaneously with the decision rule, chooses the size of the committee. The optimal size is always bounded as the system designer, incurring a small cost (relatively to the social gain from a correct verdict) of adding a juror, always chooses the smallest committee leading to the optimal outcome (highest probability of taking a good decision).

In this dual (convict-acquit) model Persico finds that the optimal decision rule, yielding the highest probability of taking a good decision while providing incentives for all members to acquire information (and to vote informatively) depends on the quality of information. More precisely, the fraction of members required to convict the defendant is close to the probability, that a juror obtains a correct signal.[9] Thus, the unanimity rule is efficient only if information is nearly perfect. Moreover the author proves that it is always better to enlarge a committee of size n deciding by unanimity by two members (the new committee counts $n + 2$ members) and change decision rule allowing one member to dissent ($n + 1$ votes are required to convict).

One should note, however, that Persico's model does not allow for the exchange of information (or other form of interaction, learning etc.) between committee members. However, anecdotal evidence or minutes (where available) from prominent monetary policy committees (FOMC, ECB Governing Council or British Monetary Policy Committee or Bank of Canada – see Macklem, 2002) corroborate that meetings start usually with a *"tour d' horizon"* where all members present their views about the current economic situation. Nevertheless, these mechanism are internal factors of decision making and thus will be analysed more deeply in the following subsection.

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[9] These probabilities are supposed equal for all jurors. Later, the author introduces heterogeneity into the committee, but it concerns members' disutilities of two types of errors and the cost of information acquisition. Persico (2004) finds that restricting to one type of jurors can only improve the outcome.

However, one of Persico's (2004) important findings, reflected in reality, is that the applied decision rule may critically influence the decisions of a committee. The most commonly analysed decision rules are simple majority and unanimity, even if (and because) they represent two extremes[10] of all the spectrum of qualified majorities (often used in important decisions such as constitutional amendments etc.). However, these two decision rules are the most interesting from the theoretical point of view precisely because they are both relatively simple to model and represent border cases – any other plurality voting rule is by definition contained between them. The practical importance of these rules is implied by their frequent application in the setup of MPCs: *de jure* supremacy of simple majority rule and possible *de facto* use of unanimity in the ECB.[11]

Gerling *et al.* (2005), in their game theoretic survey, alleviate the (unrealistic) Condorcet's hypothesis and analyze committee decision making from the perspective of information acquisition. They show that unanimity is an optimal decision rule only if some important requirements are met, i.e. if the committee disposes of perfect information and shares a common objective. In fact, these dispositions make the exact decision rule unimportant. However, when these premises are not fulfilled, unanimity rule has some undesired features. In general, when strategic voting is a plausible possibility, the unanimity rule, which gives a veto power to every voter, may lead to biased committee decisions even if the number of its members tends to infinity. This socially suboptimal outcome results from the fact that every member is pivotal which involves some kind of herding behavior: if all jury members convict – the last one will convict also, even if her own signal suggests the contrary.[12]

In spite of this argument, unanimous (or consensual) decisions are believed to work in environments where the first type error is costly (e.g. convicting an innocent). Thus, the unanimity rule is applied to some important decisions, especially in international context –

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[10] It has to be mentioned that the possibility of adopting (less important) decisions even without the consent of any kind of majority has also been analyzed. See Erlenmeter and Gersbach (2001). It seems, however, that in monetary policy such flexible majority rules, possibly allowing for minor interest rate changes with support only from a minority of voters, are not feasible in practice. To realize the possible negative consequences consider a case where there are two minorities who want a minor change, but in opposite direction. Moreover, such minorities desiring opposite changes, which would probably cancel each other out during one meeting, might emerge in two consecutive meetings which would lead to an undesirable interest rate volatility.

[11] Wim Duisenberg and Jean-Claude Trichet in their press conferences always claim that the decision taken by the Governing Council was consensual.

[12] See e.g. Feddersen and Pesendorfer (1999).

it applies within some multilateral negotiations such as WTO and some important issues within the European Union, but also American penal juries.[13]

On the other end of majorities required to adopt decisions is situated the simple majority rule. Though having been applied to public decisions since at least Athenian democracy and subjected to scientific analysis since at least Condorcet (1785), its simplicity was reinterpreted in terms of the median voter theorem only in the mid 20th century by Black (1948). Its weak form states that the alternative winning in elections guided by majority rule is always supported by the median voter while its strong form says that the median voter always obtains her most preferred policy. This means that any committee decision stated by simple majority can be (accurately) proxied by the preferences of the median voter, which are usually easier to obtain.

The applicability of the median voter theorem, however, crucially depends on the existence of the median voter, which is, in turn, contingent on the type of individual preferences. Some problems arise when available options are not quantifiable. A simple example is often given with three voters (A, B, C) and three alternatives (x, y, z): If A prefers x to y to z, B prefers y to z to x and C – z to x to y, there is no median voter nor optimal (stable) outcome.[14] However, if voter preferences are single peaked (in case of one-dimensional spaces) the median voter exists.[15] This is arguably the case in monetary policy, where the policy maker has probably her preferred interest rate and is the less pleased the more the rate set deviates from this optimal value. In case of two dimensions the existence of the median voter requires strongly symmetrical preferences. Nevertheless, it has been shown that a dominant part of political questions can be transposed to one-dimensional spaces (Poole and Daniels, 1985). Moreover, the median voter theorem has been also generalised to multidimensional spaces.[16]

To overcome the problems linked to unanimous voting while still assuring a greater probability of correct decisions than in case of simple majority (or, in more political terms, to obtain a higher degree of legitimacy) qualified majorities are required for some decision making bodies to adopt an act. Examples may go from constitutional amendments in

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[13] Feddersen's and Pesendorfer's (1999) results has been contested, at least with respect to juries, by Coughlan (2000).
[14] This is known as Condorcet's voting paradox and was also presented in his 1785 seminal work.
[15] This was shown originally by Black (1948).
[16] See Barberà et al. (1993).

virtually all countries[17] to majority of competencies of the Council (of Ministers) of the European Union. The latter example turns our attention to the fact that applicability of qualified majority is sometimes accompanied by weighting cast votes.

In case of weighted voting, several measures of effective power are applicable. First, and the simplest possibility of assessing a voter's influence is the elementary share of her vote (number of cast votes relative to the overall number of votes) compared to shares of other voters. However, this measure does not allow for objective appraisal of power during votes, when some coalitions may be formed.

To overcome this flaw, power indices have been developed.[18] The basic idea underlying these indices is that the real voting power is implied by the possibility of being pivotal i.e. the situation, when the voter membership in a coalition overbalances the result of voting (Banzhaf, 1965). Otherwise, this impact may be assessed by measuring the marginal coalition pay off implied by the last voter entry into the coalition. These contributions are summed up for each player and result in Shapley-Shubik power index. This index measures the real voting power more precisely when coalitions are formed consciously, with communication among members.[19]

The optimal weights ascribed to decision-makers depend on their abilities, as shown by Ben-Yashar and Nitzan (1997). Moreover, they show that the optimal decision rule also depends on these skills as well as on the priors on the state of the world. These meaningful theoretical advances seem, however, of limited relevance to real-life decision making, as, first, objective assessment of decision-making skills is difficult and second, weighing votes according to such a measure appear highly politically incorrect in the public domain.

A decision rule which has possibly much more practical applications was proposed by Caplin and Nalebuff (1988). They show that under some plausible assumptions a qualified majority (supermajority) requiring 64% of votes leads to stable outcomes even in multidimensional decisions.

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[17] The author is not aware of any democratic state where constitution amendments would require only a simple majority of votes.
[18] For a more precise appraisal of two most popular measures (viz. Banzhaf index and Shapley-Shubik index) see Banzhaf (1965) and Shapley (1997). For a recent comprehensive scrutiny of the subject see Felsenthal and Machover (1998) or Holler and Owen (2001).
[19] See e.g. Widgrén (1994).

Experimental studies and the role of psychology

A remarkable research program, aiming at (indirect) verification of Condorcet's theorem and creating important liaisons between decision-making and psychology, is emerging and takes the form of experimental studies. Questions like how groups make policy-type decisions compared to individuals or which kind of motivations may induced by different voting rules are being risen and tested. Recently, an example of this type of research in the field has been presented by Marchese and Montefiori (2005).

These authors compare how small committees deal with public choice problems (provision of a public good) under the mean and the median[20] rule. Moreover, they try to distinguish between sincere and strategic behavior under and without information about other members' preferences.[21] The results of the experiment support the relative advantage of the mean over median rule (in terms of social welfare losses).

Nevertheless, the setup of this experiment gives no explicit *ex ante* social optimum, and even if the players can infer it (it is supposed to be a simple mean of the three players), it has no weight assigned in their personal welfare functions. Moreover, there is no communication among voters. Thus the whole experiment incites to strategic and selfish behavior of participants (even if, probably due to some difficulties in finding the optimal strategy, some players chose to reveal their true preferences).

The problem of decision rule often emerges in the (general) context of international organizations. Maggi and Morelli (2006) focus on theoretical aspects of governance in such an environment and more specifically concentrate on implications of the lack of external enforceability mechanism. It means that even after collective adoption of a decision, it remains a country's sovereign decision whether to execute it or not.

The authors analyze collective actions, which are undertaken by an international organization if a majority of its members (or all of them) agree. Decision rule is chosen *ex ante*, under the "veil of ignorance" on the future costs of actions (benefits are normalized to 1). These costs can be lower or higher (i.e. exceeding benefits) with some fixed and commonly known and *ex ante* symmetric probability distribution. The authors also allow for correlation of cost probabilities among countries. After observing their respective cost realizations (which are private information) countries simultaneously signal if they wish to

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[20] This obviously stylizes simple majority voting. See above remarks on median voter theorem.
[21] Welfare functions are quadratic and thus one dimensional and single peaked.

participate in the common action (in opposition to *status quo*). Then, also simultaneously, countries choose their actions. "Pure" common actions are taken if all members participate[22].

The game is a repeated once and decisions are taken on the basis of common expected utility. Thus some member countries may vote for a common action *ex ante* (and apply it) even if it may reveal not to be beneficial for them *ex post*. In such a case the country must have incentives to comply with the previously taken decision. Such motivation is assured by the expected utility from future decisions.

The two considered decision rules are unanimity and "efficient" (qualified) majority, which is the optimal rule for a "one shot game" with enforcement (lowest majority assuring positive common *ex ante* utility).[23] Depending on discount factor (common to all governments), the optimal self-enforcing decision rule may be only one of these two. Thus, majority is more probable in organizations taking frequent decisions (or with more stable governments), where the discount factor is higher.

Some other important findings of Maggi and Morelli (2006) include that a higher correlation among members' preferences (higher organization's homogeneity) implies that majority rather than unanimity decision rule can improve welfare. The mechanism is that in more homogeneous organizations future common actions are more probable and thus expected value from cooperation is higher. Consequently, countries are more prone to accept instantaneous losses to yield from future activities. This is conform to the real world observation, an example being the European Union, a relatively homogeneous organization, where more and more decisions are taken by majority rather than unanimity.

Voting procedures, especially within international organizations has been also considered in some less conventional manners. These alternative decision making scenarios include for example market mechanisms (Casella, 2001) or possibilities of intertemporal transmission of votes (Casella, 2005). Although the first possibility was initially thought as a market tool for such "goods" as budgetary deficit limits (such as 3 percent allowed by the Stability and Growth Pact) and based on American experience of pollution permits,

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[22] The authors analyze also "impure" common actions, which are implemented only by a subset of countries. Nevertheless, for the purpose of the present dissertation, only "pure" common actions are of interest, because monetary decisions of the ECB always concern all countries participating in the euro area.

[23] This "first best majority rule" depends only on costs, benefits and number of members. This makes the analysis especially interesting, because further parameters (discount factor, correlation etc.) do not influence it.

possibility of votes being traded might be also considered and such an alternative is mentioned by the author, but rather as a possible by-product of storable votes.

However, this setup relies on the somewhat controversial assumption that the public authorities are profit-maximizing[24]. Another option is to allow for saving unused votes (when a decision-maker is relatively indifferent about the two alternatives being voted) and take advantage of them in an opportune moment (when a voter has a clear preference between possible choices). The proposition of storable votes seem to be politically acceptable[25] and, under some rather plausible assumptions, such a solution may better-off the *ex ante* welfare.[26] This hypothesis has been successfully tested in an experiment presented in a companion paper by Casella *et al.* (2006).

International organizations' voting scheme, without enforcing mechanism, may be completed by Widgrén's (1999) vision of the flexible integration being equivalent to a decision rule. He analyses European Treaties as an incomplete contract, which sets rules for bargaining between two levels of governments – supranational and national ones. Moreover, national governments signing the treaty differ from those deciding under the treaty provisions. The author defines *ex ante* efficiency as expectation to attain the preferred point of all local governments[27] and *ex post* efficiency as an outcome which is Pareto-efficient. Other crucial definitions include common policy, which is the outcome adopted by all governments, and flexible integration treaty, which requires a predefined majority to adopt a policy, but gives a possibility to minority members to apply an alternative outcome. In his analysis, Widgrén finds that there is a trade-off between *ex ante* and *ex post* efficiency if a common policy is to be applied in all states and only the flexible integration proves to be an adequate decision tool allowing to overcome this difficulty.[28]

1.2. Internal features

Modeling internal characteristics of committees in general, without any information about their purposes, external framework, information they proceeds, etc. seems difficult and even futile from some points of view. Thus, as mentioned in some paragraphs in the

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[24] Which cannot be overruled *per se*, nevertheless makes some feel uncomfortable. A more detailed discussion of a related subject (profit-minded behavior of a central bank) will be presented in Chapter 3.

[25] Although the author's plan to apply it to the ECB Governing Council might be difficult due to status quo prevailing in its decisions as well as a tendency to consensus.

[26] However, the author admits that some counterexamples may be found.

[27] These are supposed identical.

[28] This finding seem to offer a theoretical underpinning for a "multispeed Europe", which is, in fact, politically controversial, at least in some EU member states.

previous subsection, some internal characteristics of committees are assumed, without being explicitly modeled (this is the case of a common objective or homogeneous/heterogeneous decision-making skills). Nevertheless, some remarkable efforts in analyzing internal features, such as communication or seniority (order of speech) within a committee in general have been made and are presented below.

Communication

Possibility of communication and exchange of views is precisely one of the comparative advantages of the committee over an individual decision making. Resulting information pooling is believed to reduce incentives for strategic voting. Gerling *et al.* (2005) present some important theoretical implications of the revelation of private information by committee members prior to voting. First, exchange of information before choosing alternatives may help attenuate the adverse effects of conflicting interests.[29] Second, also in a setup with communication, the optimal size of the committee is smaller when information becomes costly, which confirms results exposed above. Finally, by eliminating strategic behavior and sharing all available information, communication allows for the optimal decision to be taken by all the members and, thus, makes the decision rule irrelevant. The authors remark, however, that such a vision is probably exceedingly optimist, as it also requires that decision-makers share common objectives.

Order of speech

Important in-committee factors include also the order of speech, which can be also connected to the role of agenda setter[30], and which is not neutral with regards to the real (in contrast to nominal) power of vote. In many committees, chairman, beside having a tie-breaking power, is also the first to speak. This advantage of being *primus inter pares*, may have some important implications, which have been modeled e.g. by Ottaviani and Sorensen (2001). In their model, votes (or private information revealing) are driven by reputation concerns, i.e. less informed decision makers, if speaking after members who are believed to be better informed, tend to adhere to their opinion (vote for the same option) while ignoring their own signal.

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[29] An in-depth analysis of conflicting and common interests in committees can be also found in Li et al. (2001).
[30] See e.g. Primo (2002) for a discussion of such a power implied by the possibility of offering the first proposal.

This setup, while suggesting a possibility of herding behavior, allows for some important insights. First, the authors show that anti-seniority rule (less informed members speaking before those endowed with supposedly more exact information) which in principle eliminates herding, is not always optimal. This is true, when a number of junior experts agree with an action, and when even more expert ones do not dare reveal their true signal, having doubts on its accurateness. Second, when facing an important number of equally skilled members, the design of an optimal order of speaking becomes impossible. These two remarks suggest that, in a restrained and heterogeneous committee, devising the optimal voting (and communication) order may be easier, thus allowing for better aggregation of information.

* * *

This section presented a general view on the decision-making literature being a background for the more in-depth analysis of monetary policy making by the committees. Interestingly, an overwhelming majority of discussed issues can be easily and directly translated into our external-internal factors analysis. Moreover, this literature provides some insights on important interactions among these issues, such as relations between committee size and the optimal decision rule or implications of communication and preferences on decision rule.

These general remarks are summarized in Table 1, below. Remarkably, they may be applied, and the scope of the analysis can be extended, to more specific aspects of committee decisions. Hence, the presented problems will find their counterparts in the framework of monetary policy made by a committee, exposed in the following section. Moreover, the literature exposed in section 2 will be more applied and empirical in comparison with the mainly theoretical research presented in section 1.

It seems important to notice, however, that the generality of considerations in this section lead to somewhat deeper analysis of influence of external factors on the committee than to modeling in-committee interactions. This imbalance will be reversed in section 2, as concrete examples of MPCs provoked the research to be focused on their internal features.

Table 1.1. Main questions analyzed by literature on collective decision making

Question	References	Findings
Committee or individual?	Condorcet (1785)	Committee, because the probability of a correct decision is higher
	Méon (2006)	Committee, because the volatility of majority decisions is lower than committee members' preferred outcomes
Optimal size	Condorcet (1785)	Unbounded
	Persico (2004)	Bounded, if adding decision-makers is costly
Decision-making scheme - rotation	Bosman et al. (2005)	Rotation may increase efficiency of decisions, at the cost of redistribution effects and strategic behavior. Unanimity outcome often overlaps with median voter's preferences
Decision-making rule	Persico (2004)	Optimal one depends on quality of information. Unanimity is optimal only if information is perfect.
	Black (1948)	Simple majority favors median voter
	Ben-Yashar & Nitzan (1997)	Optimal voters' weights depend on their abilities
	Caplin & Nalebuff (1988)	64%-majority rule is optimal in multidimensional decision making
	Gerling et al. (2005)	Unimportant, if information is perfect and objective is common. Otherwise, unanimity is undesirable.
	Marchese & Montefiori (2005)	Averaging of preferences is better than simple majority voting in provision of public goods
	Casella (2001 and 2005)	Storable or tradable votes may improve ex ante welfare
	Maggi & Morelli (2006)	Lack of enforceability of decisions in international organizations justifies the frequent use of unanimity. Nevertheless, if preferences of voters are correlated (or/and the issue is of smaller importance), unanimity is worse than other majority schemes.
	Widgrén (1999)	Flexible integration is equivalent to optimal decision rule.
Communication and order of speech	Ottaviani & Sorensen (2001)	Optimal speech order depends on skills
	Gerling et al. (2005)	Communications makes conflicting interests irrelevant and lowers optimal committee size if information is costly.

Source: author.

2. Monetary decision making in committees

The presence of MPCs in public consciousness is a proof of both its importance and the need for a more precise understanding of their functioning. A general view and analysis of collective decision making presented in the previous section is obviously valid also for decision-making process in monetary policy. Nevertheless, such a specific context necessitates also a deeper analysis and allows for more precise argumentation and modeling.

This section will, analogically to the previous one, present the research concerning MPCs by grouping it around two main lines: external and internal factors shaping decision-making process within the committee. The analysis will be started, however, by presenting some more precise arguments in favor of delegating the monetary powers to a *committee*, which is a relatively recent trend.

Individual central banker vs. monetary policy committee
Modeling of monetary policy making has been dominated by a vision of a 'central banker' whose decisions optimize social welfare usually defined as minimal gaps between natural and effective levels of inflation and output. This is true for the seminal Barro and Gordon (1983a and 1983b) models, which were themselves influenced by Kydland and Prescott's (1977) argument highlighting the advantage of rules over discretion. These works lead to the idea of a conservative central banker (Rogoff, 1985) as an effective cushion against inflation bias or time-inconsistency problems of monetary policy.

All these works as well as a considerable amount of other related research, contributing substantially to an understanding of the art and science of monetary policy, has not explored the collective dimension of monetary policy making, which became in recent years the rule rather than the exception.[31] Major theoretical works were rarely focused on this specific feature of monetary policy.

One of the early examples, founded on reputation motivations of monetary policy committee members (thus joining the above quoted time-inconsistency literature) has been presented by Cothren (1988). In his model of n-member committee serving for *n* overlapping terms, (*n* being an odd number), less experienced (and more sensitive for

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[31] These exceptions are constituted by New Zealand (with its "optimal central bank contract"), Norway, Malta and Israel (which recently announced its plans to reshape the central bank law and introduce an MPC, see Fischer, 2006). Blinder (2004, p. 35) remarks that probably Canada should also be considered as an economy guided by a single monetary policy maker. A few other countries where decisions are made by single person are, in fact, currency boards with no interest rate decisions to take.

future losses implied by higher inflation) members are able to outvote opportunistic ones, willing more inflation. Thus, individual considerations of finitely-lived committee members may generate credibility for the whole committee, which has been proved to be of special concern for the efficiency of monetary policy.[32]

Sibert (2003) analyzes individual credibility seeking and its implications for the committee.[33] In her model, social welfare depends negatively on (squared) actual inflation and positively on unanticipated inflation (because it boosts output). The MPC is modeled here as a two-member committee with staggered terms. A committee member may be more or less inflation-prone; her type is constant during the mandate and is drawn with a probability p, which is common knowledge. The focus on reputation issues, which may be traced back to Backus and Drifill (1985) and Barro and Gordon (1983a and 1983b), logically implies that the model is based on the standard time-consistency framework. During the meeting the committee members announce their preferred inflation rates (0 or 1, depending on type of policy maker), and if they agree, the rate is implemented while in case of disagreement some consensual rate α ($0<\alpha<1$) is decided upon. The author searches for the probability with which the junior opportunistic committee member votes for zero inflation (in order to gain reputation and be able to implement higher inflation in her second term).

Sibert (2003) analyses three cases: (i) full transparency of voting (implying that the type of the senior policy maker is publicly known), (ii) voting records published with a lag (making the junior member ignoring his older colleague's type) and (iii) hierarchical structure of central bank (where a senior member's vote is more important than the junior's one).

The presented comparison of efficiency (understood as expected social welfare) between monetary policy lead by the individual and the committee shows the superiority of the collective decision making (under some plausible assumptions about the consensual rate of inflation). This is implied by stronger reputation incentives for an opportunistic junior not to reveal his inflation preference if he takes part in the committee, than if he is the sole responsible for the policy making. Thus, on average inflation is smaller and expected

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[32] See e.g. Cukierman's (1992) reference work.

[33] Interestingly, the model employs a Bayesian updating in the private sector, who acquires the signal about the type monetary policy maker in order to form its inflation expectations. Bayesian analysis will be extensively used in second chapter of the present dissertation, proposing a Bayesian model of monetary policy making.

social welfare is greater. Moreover, when the committee makes decisions, inflation (and welfare) is less volatile because there exists a compromise level of inflation, while in case of single decision-maker inflation can be equal to either 0 or 1.

Other findings of Sibert's model include negative welfare implication of delaying the publication of voting record. This is so because it creates lower incentives for the opportunistic junior to vote against inflation. Thus, average inflation increases and expected welfare declines. Inversely, a higher weight of the senior committee member increases the incentives for reputation building of the junior one, hence expected inflation lowers and welfare increases.

The analysis, exposed in Sibert (2003), highly stylizes individual preferences categorizing policy makers as hawks or doves (who always prefer 0 or 1 inflation).[34] Doves, in their potential decision of voting for zero inflation are guided only by reputational considerations and hawks always vote for zero inflation, irrespective of prevailing economic conditions (which are not explicitly modeled). One might also argue that the quadratic loss function, although standard, is not a very realistic one.[35] Another potential flaw is that any interaction inside the committee is ignored (there is no explicit modeling and, moreover, junior member can only guess the type of the senior member if he knows the voting record of previous voting).

A possibility of testing empirically the hypothesis that groups make monetary decisions differently than individuals is offered by "laboratory experiments". Blinder and Morgan (2004) performed an interesting experiment facing individual students and five-student committees with a simple macroeconomic stochastic model and asking them to decide on monetary policy, which should accommodate unknown fiscal shocks. Participants were also incited to smooth interest rates (or discouraged to test the reactions of the economy), because each rate movement incurred a (small) cost. Unsurprisingly, group decisions, thanks to interaction, information and knowledge sharing as well as (supposedly) some heuristic techniques, outperformed individuals on average. The first participation in a group experiment[36] was also linked to a significant learning effect. The last, less expected,

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[34] This quite journalistic language is appropriated from ornithology (sometimes used, however, also in international relations, foreign affairs as well as in economic research): advocates of a looser monetary policy are called doves while more conservative central bankers are given the label of hawks. This makes allusion on the preferred level of interest rates (flight altitude).

[35] For a review of more "behavioral" central bank loss functions see Al-Nowaihi and Stracca (2003) and box 1 in chapter 2 of the present dissertation.

[36] The same individuals took part in individual and group decision-making experiences.

result was that the group did not need more time to take their decisions to change rates[37]. In fact, committees took their decisions with smaller lags on average, though the difference was not significant.

A similar experiment, which yielded analogue results, was lead by Lombardelli et al. (2006). Differences concerned the applied model (which was slightly simpler), and the focus of their research – beside individual versus committee comparison, the authors looked for a more precise assessment of learning effects. They found significant improvement of the quality of decisions taken when the experiment progressed, with the exception that groups outperformed individuals independently on the stage of the research.[38] Perhaps surprisingly, the authors did not found any support for a positive impact of interaction among committee members.

These two experiments test only a restrained scope of committee decision making in monetary policy. As both used exclusively five-person groups, it is impossible to measure any impact of the committee size on the decision making process. Similarly, as in both experiments the subjects were only economics students (Princeton University in the case of Blinder, 2004; and the London School of Economics in the case of Lombardelli et al., 2005) which make the samples much more homogeneous then real life MPCs[39]. Finally, in both cases groups prove to be good bumpers against the worst individuals (who, besides, are able to learn the most during the experiment). The groups perform, however, similarly to the best individuals, but not significantly better than them. However, the difference between the group's and the best individuals' performance is probably of little relevance to the real world, where MPC members are usually chosen very carefully among the individuals with the best educational and professional background.

2.1. External factors

After both theoretical and empirical confirmations that committees outperform, on average, individuals in monetary policy making, the question to be asked is how to reach these good

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[37] At least in terms of 'lags' – number of meetings between the fiscal shock and accommodation of the policy stance. However, groups required more 'clock time' to reach a decision, but this was not taken into consideration. This experimental design corresponds closely to the real world requirement to get the right decision during the scheduled meeting, no matter how long it would take.

[38] The experience consisted of sixteen stages (ten periods each), four individual, then eight in committees (four and four without possibility of interaction) and once again four individual.

[39] Whose members are usually issued from various economic environments, such as private or public sector, government institutions, and central banking circles or others. Moreover, the educational attainments of MPC members are very often relatively heterogeneous. More on these subjects in chapter three.

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decisions. The framework to be defined includes, as exposed in section 1, the number of members, the voting rule, the decision-making scheme as well as appointment process and potential political pressure.

Number of members

The attribute of a committee which is the easiest to perceive is its size. Although intuitive remarks, indicating relations between the size and accuracy of decisions or the size and time needed by an MPC to reach a decision have been given (e.g. Berger, 2002, Blinder, 2004), a complete theoretical analysis of the subject has not been presented. This gap is, at least to certain extent, filled in by two studies by Berk & Bierut (2003 and 2004). The former article, even if focused mainly on optimal structure of the committee, confirms the Condorcet theorem (provided that members vote individually and assess the true state of the economy with a probability higher than 0.5). Further, the authors, by introducing a small marginal cost of adding a decision-maker, prove its intuitive bounding effect on the committee size. Additionally, the authors show that (in the setup with marginal cost) the optimal size is larger if a fraction of members (the board) can interact prior to the meeting. Such prior meeting may end with taking a common position by the board, if a (qualified) majority emerges. Thus, some information may be lost through such an interaction, and adding some members should compensate this loss.

In their following work, Berk & Bierut (2004) introduce a possibility of learning (see below for details). The impact on the optimal size of the committee depends on the amount of time the committee designer is willing to assign to the committee. As learning requires time, if committee meetings are long-lasting, the number of members should be reduced and inversely, if the decision-makers' time is costly, it is better to increase the committee size (and shorten the meetings).

In their two studies, Berk and Bierut (2003 and 2004) have assumed that the committee takes its decisions by simple majority rule (when equal skills are assumed) or by the optimal weighted voting rule (as proposed by Ben Yashar and Nitzan, 1997, and mentioned in section 1). Nevertheless, this interesting factor is not expressly modeled in these (and many other) works.

Appointments

Chang (2003), in her theoretical model of appointments to the FOMC has shown that appointing is an effective method of affecting monetary policy stance. She proves that the President must take care about Senate's preferences so that the appointee could be accepted. This spatial bargaining model stylizes twelve-member FOMC appointments and predicts balance of power between main American political bodies. It clearly shows, using (similarly to Waller, 2000), the median voter theorem, that appointing candidates to the policy board in order to replace the members stepping down allows for influencing policy stance and its future path.

The author verifies empirically the model, using original datasets for FOMC members' preferences at the time of each meeting[40] and on Senate's signaling as well as existing Presidential signaling[41] and macroeconomic data. An important contribution of the book is an estimation of "ideal points" of every FOMC member (as well as members of Senate Banking Committee and US Presidents) during 1970-1995, which proxy their policy preferences. In what follows, Chang uses these estimations to confirm her theoretical model where presidential appointees must also satisfy Senate's preferences. In the context of the present dissertation, it would be interesting to ask which features of FOMC members, shape their tighter or looser monetary policy preferences.

Such a question was raised by Chappell, McGregor, Havrilesky and Vermilyea in a series of publications.[42] This stream of literature is founded on the observation that, for most of the twentieth century, the American monetary policy has been gradually politicized (Havrilesky, 1991). The proof is a significant decreasing trend in the participation of members with private sector experience (and an increase of politically associated ones) on the FOMC.[43] It seems that the signal to initiate the debate was given by Belden (1989). In that early article, dissent votes have been used as a proxy for policy preferences. The obvious advantage of this approach (compared to e.g. Chang, 2003), is the full

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[40] This is different from usually constructed datasets based on dissenting votes. Moreover, the setup is binary (tighter-easier) and does not allow for status quo. The obvious advantage is that the author obtains more estimation points but at the cost of objectivity (the argument that voters always have some bias on the policy does not seem fully convincing).

[41] These have been constructed by Havrilesky (1995).

[42] Havrilesky and Schweitzer (1990), Havrilesky and Gildea (1991), Havrilesky (1991 and 1995), Chappell, Havrilesky, McGregor (1995), Chappell, McGreggor (2000), Chappell, McGreggor, Verlmilyea (2004 and 2005)

[43] The trend to politicization of the FOMC might have been a factor towards a loosing of monetary condition (*ceteris paribus*), as private sector (as well as Federal Reserve Bank) career is believed to make a person a more conservative central banker (Havrilesky and Schweitzer, 1990). More on this in chapter 3.

observability of the explained variable achieved, nevertheless, at the expense of the number of observations.

Political influence

The appointments analyzed above are believed to be substantially influenced by political preferences. Waller (1992 and 2000) exposes (bi)partisan bargaining models. In the latter model, the board, which members are chosen for overlapping staggered terms by two partisan branches of government (appointing – the President and confirming – the Senate) assures monetary stability equal to that of a policy rule, while allowing for political accountability. Thus, Waller (2000) shows that if the institutional (external) setup is correct, political bargaining over monetary policy institution is innocuous by itself. Nevertheless, the author ignores (which is natural in such a theoretical setup) how political affiliations will in reality influence the work of an MPC. This gap is filled by the exposed above empirical literature on the FOMC.

An interesting discussion, which comes within the scope of this topic, took place on the pages of the *Journal of Monetary Economics*. Grier (1991 and 1996) argued that more liberal preferences of Senate's committees (principal) supervising the Fed (agent) were translated into looser monetary policy, measured by higher money base growth. This finding has been challenged by Chopin *et al.* (1996a and 1996b), who found that the Fed may actually counterbalance Congress preferences by contracting monetary growth when Democrats (with more expansionist preferences) possess majority. This exchange of views, although empirical and concerning only one country, is very interesting from a theoretical point of view, as it reflects the debate on central bank independence[44] and central bank as an agent of society.[45] In fact, Grier's results support the principal-agent theory, where the preferences of the principal (proxied by the preferences of the Senate Banking Committee) are translated into the Fed's monetary policy, while Chopin *et al.* show that the Fed is indeed independent. As both researches are purely empirical, the diverging results are probably caused by different measures of congressional preferences. Another, broader explanation, is that the policy of the Fed is determined by personal preferences of the FOMC members. These preferences, however, may be shaped by different factors, other than the wishes of the principal (see subsection B below).

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[44] See e.g. Cukierman (1992), Cukierman et al. (1992), Alesina and Summers (1993) for first empirical explorations of the concept or Berger *et al* (2001) as a recent critical review of evidence.
[45] See Persson and Tabellini (1993) as well as Walsh (1995a and 1995b).

Decision rule

The starting point for the majority of studies in the field is admitting that the simple majority rule is the most frequently used in legal acts regulating the activity of central banks. Hence (as discussed in the previous section), median voter theorem is the most frequently applied to the modeling of monetary policy decisions and for analyzing the implications of appointments, different preferences of members etc. (see subsection B below). Nevertheless, studies modeling explicitly the implications of different decision rules for the outcome of MPCs are relatively scarce.

An interesting attempt in such an analysis by introducing the "state of economy" as the foundation of "an optimal level of interest rates" has been presented by Gerlach-Kristen (2005). Her model focuses on the impact of the application of several majority rules in a committee, which members observe the state of the economy (which follows AR(1) process[46]) with a given precision, which is common to all committee members[47]. Their opinions are also influenced by (imperfect) understanding of other members' signals. After having assessed the state of the economy, committee members set the desired interest rate (by voting) as close as possible to the imperfectly observed optimal one. This instrumental variable may be only adjusted gradually, and steps reflect central bank tendency to change interest rates by threshold of 0.25 basis points (or its multiples).

The author shows that too strict majority requirements, approaching unanimity, may cause a high (suboptimal) degree of interest rate inertia. Likewise, a higher uncertainty in optimal interest rate observation (lower decision makers' ability) implies that policy reactions lag behind changes occurring in the economy. This signal-extracting Bayesian analysis framework seems an excellent starting point for the exploration of inside-committee affairs. However, some further insights, such as allowing for differences among committee members (be it in their way of acquiring signal, which is probably costly or a way of perceiving "optimal" interest rate, which can be biased for some members[48]) or communication appear necessary to make it closer to the reality of monetary policy making.

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[46] Demeaned optimal interest rate, i, is supposed to follow $i_t = \rho\, i_{t-1} + e_t$, where $0 < \rho < 1$ and $\varepsilon \sim N(0, \sigma^2)$

[47] Thus, committee members are supposed equally skilled. More technically, all members observe the true state of the nature with an error, following a zero-mean normal distribution. Additionally, observation errors are correlated among committee members.

[48] E.g. stylizing Sibert's (2003) hawks and doves framework.

Committee structure

According to the simple diagram introduced at the beginning of this chapter, committee structure is another external feature impacting on its decisions. Berk and Bierut (2005) directed their research on this topic. They find that an appropriate central bank design may allow to overcome the non-optimality of the simple majority as a decision rule[49]. Namely, the committee consisting of the core (with members responsible for preparing the meeting and endowed with information of higher quality) and spokes (regional representatives) can assure efficient decision-making under simple majority rule. Such a structure is clearly influenced by real life examples: the ECB Governing Council and the American FOMC.

The mechanism on which this finding relies is implied by the fact that better informed (or alternatively better skilled) members of the core adopt a common position prior to the meeting. Thus, as all core members vote for the same option, their opinions are *de facto* weighted.

The structure, being one of the exogenous factors influencing the work of the committee, determines also some intrinsic features. Namely, as mentioned and analyzed by Berk an Bierut (2003 and 2004) in their works, the design of the central bank board influences the interactions taking place between members. Thus, members working in the "core" of the committee have increased possibility to interact and, as mentioned, to learn from each other.

2.2. Internal features

Taking into consideration the specific aspects of decision-making within the MPCs allows for a more detailed research and modeling of the inside-committee interactions. That is, the precise definitions of monetary policy tools (adjusting interest rate) and goals (price stability and possibly fostering growth or, more or less equivalently, fighting unemployment) permit to model information flows (among MPC members) as well as personal and collective preferences. Moreover, this knowledge along with the observation of the macroeconomic performance of the country(s) makes possible the assessment of an MPC efficiency (with respect to achieving the objectives).

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[49] As exposed in the previous section and proved by Ben-Yashar and Nitzan (1997).

Communication and learning

Communication and the related possibility of learning from better skilled individuals were the focus of attention of the second of the above-mentioned theoretical works of Berk and Bierut (2004). They prove that interaction (which is supposed to improve decision abilities of the less skilled members) may ameliorate the outcome though it occurs at the expense of time of discussion. Thus, there is a trade-off between the discussion time and the committee's size assuring optimal decisions. This result, however, depends on the premise that interaction leads only to improving skills and not to realigning positions (members should vote according to their own information).[50] This seems also somewhat at odds with their own findings on structure[51], where they argued that such a design and common position adopted by the "core" members improve the results (see above).

All in all, the research of Berk and Bierut (2003, 2004 and 2005) is clearly influenced by the structure of the ECB Governing Council. However, an important number of theoretical advances in modeling monetary policy making by a committee have been inspired by the relative success of the Federal Open Market Committee (FOMC). The American monetary system has been also subjected to extensive empirical research, aiming at confirming different theoretical approaches.

Personal characteristics of committee members

Havrilesky and Gildea (1991) in their critique of Belden's (1989) work underline that the dissenting votes are shaped by three categories of factors: the state of the economy, political (partisan) influences but also (and what is especially important for the present dissertation) training background and career experience. Their probit regression on dissents (0 for tightness and 1 for ease) taking as explaining variables only career and educational characteristics of voters, confirms the significant impact of prestige degree and private banking experience on tighter monetary preferences. However, in this setup they fail to prove the hypothesis that government exercise or Ph.D. make a person more inflation-prone.

In further works Chappell et al. (1993, 1995 and 1997) as well as Chappell and McGregor (2000) explore dissenting votes by estimating underlying interest rate preferences of

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[50] This hypothesis, taking into account the possibility that members are not able to convince each other, leads to the result which is contrary to e.g. Nitzan and Paroush (1985), who argued that communication implies information losses through interdependent voting.

[51] Berk and Bierut (2005).

FOMC members. The authors follow roughly the same methodology throughout these articles. They assume that these unobserved preferences after a (weighted) averaging are translated into the policy directive. Thus, even if the true desired interest rate remains unobserved, the authors are able to impute them to every policy maker. They estimate reaction functions (which differ with respect to the constant, which demonstrates tighter or easier policy preferences) characterizing different individuals (or their categories such as Federal Reserve Bank Presidents vs. Governors, or, within the latter, Democratic vs. Republican appointees). Moreover, they take into consideration (and estimate) a dissent threshold, which turns out to be relatively large (exceeding 2 percentage points). Policy makers are supposed to react to macroeconomic variables, such as inflation, unemployment, monetary base and industrial production growth or (in extension) presidential signaling. Two of these papers are of special interest, as they indicate (without giving conclusive answers) some of the problems, which will be approached in the following chapters of this thesis.

First, in their 1995 article, the authors argue that a possible reshaping of the Fed[52] might have significant implications for long-term inflation performance. After presenting convincing evidence that regional Reserve Bank Presidents tend to be more "hawkish", they assess a potential impact of a relative increase of the voting power of Presidential appointees on inflation bias. They find it as large as 3.5 percentage points higher steady-state inflation if all FRB Presidents were replaced by new Governors (which, however, had not been proposed) and 0.8 average inflation increase for the precise case of the reform proposal. A similar case for the reform of the ECB has been undertaken by the European Union in 2003 in order to prepare it for the enlargement of the euro area. This will be discussed in details in chapter 4.

The second interesting fact, pointed out by Chappell and McGregor (2000), is that policy-maker's gender may also play a role in shaping their preferences. Namely, applying the method above described , they rank all FOMC members who served between 1966 and 1996 in order of their "conservativeness". They remark that six women (out of seven overall) have been ranked among the 13 members with the highest "preference for ease", which seems to confirm that female policy makers are on average more "dovish". This, however, could be influenced by their political affiliation (Democrats are known as

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[52] A project of "Sarbanes and Gonzales bill" was presented to the Congress at the time, aiming at giving more influence to the centrally appointed Governors instead of Federal Reserve Bank Presidents.

monetary "doves" and at the same time are more sensitive to gender equality), which has not been tested by the authors. Nevertheless, influences of personal characteristics of MPC members on policy efficiency will be scrutinized in the empirical part of this thesis – chapter 3.

In recent contributions, Chappel *et al.* (2004 and 2005) refine their methodology for the subsample for which minutes of discussion are available. Basing their study on an original dataset, which is derived from the analysis of "Memoranda of Discussion" and the Ford Library Transcripts[53], they are able to estimate more precise reaction functions for each FOMC member. Analyzing the discussions within the FOMC, they are able to directly observe the desired interest rate of some members. The authors test the hypothesis of a simple majority voting within the FOMC (applying the median voter theorem), a more consensual approach (with the mean of desired interest rates) as well as a chairman's dominance hypothesis and find significant support for a chairman's vote weight as large as 0.48.[54] Nevertheless, mean and median desired federal rates were also significant, which supports the thesis that other members' preferences are important as well.

Other interesting results about chairman's dominance concern the difference in other members' behavior when they speak before and after the chairman. The average difference between stated desired rates was significantly higher when the other member spoke before Burns, the gap being more important in case of Governors than for Federal Reserve Banks Presidents (which indicates that the latter are more independent).[55]

The publication of FOMC voting records and discussion transcripts allows for the analysis of individual policy preferences and has been certainly a major determinant (beside the importance and exploit of the Fed in maintaining monetary stability and contributing to the general American prosperity) of the development of research in that field. A similar exercise would be, however, much more difficult in case of other principal central banks,

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[53] The last published "Memoranda" concern 1976 (they were published with a five-year lag). Thus, the second one (being the originals belonging to Arthur Burns) completes the account of all 99 meetings under Burns' leadership (1970-78).

[54] This value is a simple average of two estimates reported by the authors (0.38 and 0.58).

[55] This result seems to confirm the founding hypothesis of Ottaviani and Sørensen (2001) that a member of a committee who is supposed less skilled does not dare to reveal his personal information if it is contrary to the previously revealed information of a higher-skilled member. Building on such formalized assumption they show that anti-seniority rule allows for a better information accumulation.

be it because of much shorter time span (as in the case of British MPC, which was inaugurated in 1997)[56] or of lower "procedural transparency"[57].

Both of these limitations are true for the European Central Bank, which was inaugurated in 1999 and whose minutes and votes will be published only after a fifty-year lag. This lack of openness can be, however, at least to a certain extent, explained by the necessity of (collective) credibility building and repelling any accusations of (too much/any) weight put on national (regional) considerations.[58] Nevertheless, researchers focusing on the FOMC are endowed with a huge comparative (and absolute) advantage in terms of data availability over those focusing on other central banks.

This does not necessarily mean that some studies focused on other central banks or cross-country studies are not possible. While facing unobservable voting behavior, the attention has been paid directly on policy outcomes. Interestingly, personal features of central bankers in different countries as factors influencing monetary policy has recently entered into the focus of researchers' scrutiny. Thies (2004) put the stress on the fact "that different types of individuals working within different types of institutions achieved different levels of success in attaining price stability during the Asian Crisis." He has studied the impact of "conceptual complexity"[59] of central bankers on their inflation performance during the 1998-2001 financial turmoil and finds that higher levels of complexity are associated with lower levels of inflation. The article, though being eminently stimulating in itself, leaves some doubts on the objectivity of the concept, however. It seems that applying some more objective measures of central bankers' capacities might yield different results.

Göhlman and Vaubel (2006) have presented such preliminary attempts. They investigate the impact of educational backgrounds and past careers of central bankers on inflation.

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[56] Which, however, is not impossible and has been performed by Cobham (2003), Gerlach-Kirsten (2004) or Bhattacharjee and Holly (2005).

[57] This term has been introduced by Eijffinger and Geraats (2003) in their transparency index to encompass explicit strategy, publication of voting record and minutes of policy meetings. In their last observation (July 2001), only Japan, UK, US and New Zealand were publishing votes and minutes (moreover, in the last case these data are not very valuable, as monetary decisions are taken by the sole Governor).

[58] It is interesting to remark (after Chant, 2003), that in Eijffinger and Geraats' (2004) index, among five covered federal countries only the US publish their minutes while four other (monolithic) countries follow full "procedural transparency". Longworth and Cosier (2003) quote Chant (2003) arguing "the disclosure of minutes and voting records pose significant dangers by creating identifiable regional pressures on monetary policy". The important question of regional influences on federal-type central bank will be also tackled in chapter 4.

[59] The author assesses this personal feature through the analysis of the speeches of central bankers. Direct and simple wording indicates a low level of "conceptual complexity", which may be insufficient to cope with an unusual situation whereas indirect expressions and more complex wording signify a high level of "conceptual complexity" which is a sign of a higher potential of reaction to unpredictable difficulties like financial crisis.

Unsurprisingly, in their (unbalanced) panel data analysis with (two-year) lagged inflation as the explained variable, the authors find a significant impact of professional experience of MPC members. The results of educational background effect on inflation seem less convincing.

This first (to our knowledge) empirical cross-country time-series study of MPC members' personal features on central bank performance leaves, however, some questions without answers. Namely, institutional design (central bank independence, MPC structure etc.) should also influence inflation performance. The question of preponderance or correlation of either factor remains thus opened. Moreover, the only independent economic variable explaining inflation used in regressions is unemployment, which also leaves some important doubts about their model specification.

Finally, a highly technical vision of interest rate decisions has been presented by Rizzi *et al.* (2003). The authors show that an adaptive fuzzy expert system may perform comparably to a human committee (viz. ECB Governing Council). Nevertheless, a real transfer of monetary policy making to some software neither seems to be politically acceptable in any foreseeable future. Moreover, designing a system, which can (even perfectly) mimic human behavior or decision-making only in quantitative dimension is not equal to devising a software being able to implement monetary policy. This is obviously not to say that computer aided tools and models are not useful in preparing policy decisions, but it seems that final decisions, as touching the whole human societies, should be taken by human beings.

* * *

The literature reviewed in this section (and summarized in Table 2 below) explores in a more detailed manner general questions concerning committees that were surveyed in the first section of this chapter. It is remarkable that the common trunk of collective decision making problems in general and its more specific applications to monetary policy are very similar. Nevertheless, some detailed aspects, impossible to investigate within a framework of general models, have attracted much of the attention from MPC explorers. On theoretical grounds these are external (size, decision rule and structure) and internal (communication, learning and signal-extracting processes) elements of the monetary policy-making framework. On the empirical side, the most attractive subjects concern internal (i.e. career and education related) and external (i.e. appointment and pressure related) determinants of MPC members behavior.

Table 1.2: Main problems of collective decision making in the field of monetary policy

Question	References	Findings
Committee or individual?	Cothren (1988)	Committees are a tool guaranteeing stable and "conservative" policy, without unreal assumptions of "ever-living" agents with an infinite horizon of expectations.
	Waller (1992)	Committee with staggered terms assures monetary stability equal to a policy rule
	Sibert (2003)	Committees, clearly outperform individuals in reputation building.
	Blinder (2004)	Committees, because allow for pooling more information and application of more heuristic techniques which makes policy less volatile and moderate.
	Blinder & Morgan (2004)	Committees outperform individuals in term of optimality of the policy with insignificantly lower lag of reaction.
	Lombardelli *et al.* (2005)	Committees always outperform individuals.
Optimal size	Berk & Bierut (2003)	Limited if additional members are costly and the smaller the bigger are these costs. Optimal size also diminishes if a part of members may interact prior to the meeting.
	Berk & Bierut (2004)	A trade-off exists between the optimal size of the committee and the time required to get the optimal decision.
Decision rule	Gerlach-Kristen (2005)	Too strict majority requirement leads to a suboptimal committee inertia.
	Waller (2000)	Median voter (simple majority rule) assures policy smoothing, which is influenceable by appointments.
	Berk & Bierut (2003)	Unanimity leads to "zero activism" and allows for good decision only if decisional skills of voters are very high.
Committee structure	Berk & Bierut (2005)	Simple majority is suboptimal, but can be eliminated by an appropriate structure ('hub-and-spokes') of the committee.
Influencing the committee decisions and its members' preferences	Havrilesky & Gildea (1991)	Dissent votes (as measured by Belden, 1989) are shaped by three categories of factors: state of the economy, partisan issues and personal experience
	Chappell *et al.* (1993, 1995, 1997, 2004, 2005), Chappell & McGregor (2000)	FOMC members' votes may be explained by their individual reaction functions (on economic variables), but also by other factors: political affiliations, professional experience, position in the FOMC (Governors vs. FRB Presidents), or potentially other features like gender or age.
	Chang (2003)	Appointments to monetary committee (and thus appointer's preferences) affect policy stance and its future path
	Göhlmann & Vaubel (2007)	Preferences of committee members with regard to inflation are clearly influenced by their educational and career experience
	Grier (1991 and 1996), Chopin *et al* (1996 a&b)	Incumbent Senate's preferences (and its Monetary Committee's ones) influence FOMC decisions, but the direction is uncertain (discutable).
Communication, interactions, learning...	Berk & Bierut (2004)	Interaction between members is beneficial as a possibility of learning.
	Lombardelli *et al.* (2005)	Interaction between policy makers has no effect on decisions but learning effects are significant.
Alternatives to MPC	Rizzi *et al.* (2003)	An adaptive fuzzy expert system performs comparably to the ECB Governing Council

Source: author.

Conclusion

The aim of this chapter was to survey the existing literature on collective decision making with a special focus on its application to monetary policy. The lessons that can be drawn from the reviewed articles may be summarized as follows.

First, it seems that committees outperform individuals in decision-making, which is even better documented in case of monetary policy making than in general theory. That is so, because a more specific context of monetary policy making allows for a better modeling of such decisions. Consequently, the results are more convincing, because they are based on theoretical as well as experimental research. Beside the preference given by all the studies to collective decision making, some offered also arguments supporting the thesis that the number of committee members is limited, especially under the plausible assumption that expanding the committee is costly. This finding can be found in both general studies and these focused on monetary policy committees. It seems, however, that important further advances may be made in exploring such relations as the linkages between the number of members, their expertise as well as the heterogeneity of the committee.

Second, studies concentrated on decision rule yield the conclusion that both most commonly analysed solutions - simple majority (favoring the median voter) and unanimity (granting veto power to each decision maker) - are suboptimal. The truly optimal rule would weight the decision-makers according to their abilities or, equivalently, according to the quality of information they possess. These general findings are confirmed in the particular context of monetary policy. However, the simple majority rule, assures policy smoothing which seems positive in monetary policy, and unanimity (as well as too strict majority requirements) leads to suboptimally high policy inertia. Moreover, the suboptimality of the simple majority rule might be reduced by a suitable committee design: structure or rotation scheme. The latter, however, increases the efficiency of decisions at the cost of incentives to strategic behavior.

Third, interactions between members positively influence the outcomes, especially because of their important learning effects and reducing conflicting interests. However, here also the abilities matter and the best skilled members should speak later during the meeting.

Finally, empirical studies on monetary policy committees prove that personal preferences matter for the decisions made and that they may be shaped by personal experience, political affiliations, education, demographic features etc.

Chapter 2

Central Banking by Committee: A Bayesian Model

"Bank's monetary policy can be described in the form of a rule. If inflation one to two years ahead is forecast to be above the Bank's target, the key interest rate is raised, and vice versa if it is forecast to be below the target"

Riksbank (2005), p. 8.

This chapter presents a model of monetary decision-making by a committee, whose members have some prior beliefs about the economy and analyze a signal about its current state in order to decide about changing (raising or cutting) interest rates or keeping the status quo. An important assumption is that the precision of the acquired signal depends on the effort an individual decision-maker exerts to acquire it and thus remains under her own control.

Such a setup requires the use of Bayesian analysis, as both the existence (and use) of prior information along with a noisy character of signal may have an important effect on perceived state of economy after the signal have been obtained. Thus, the monetary policy committee member, while choosing the precision of the signal, anticipates the effects of getting more informed on the social loss along with the personal cost of effort. Consequently, she will opt for a level of precision of information, optimal from her personal point of view (as will become clear further, without taking into consideration cost of effort, the precision of information would be infinite), which depends on other parameters of the model.

A similar analysis, but applied to corporate governance was presented by Hermalin (2005). In his model, a firm's board decides whether to keep or fire the incumbent CEO. This hypothesis makes the task of firms' boards very similar to that of Monetary Policy Committees (MPCs) even if the instrument (interest rate change or CEO turnover) seems

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quite distant at the first sight. The incumbent CEO loses his job if he proves to be incompetent (in Hermalin's model, if the signal about his abilities does not satisfy the board's requirements) while an MPC member changes policy rates in response to economic data (or forecasts which are based on such data) supporting the hypothesis of a necessary adjustment in monetary policy stance.

Moreover, MPCs are quite similar to bards of enterprises on institutional grounds even if some important elements, such as the appointment process, may significantly differ. Thus, an ideal committee in any field should be quite alike: more or less homogeneous group of people, with a certain expertise in the field, whose main task is to take decisions about changing strategy - adjusting an instrument (variable) under their control. Usually, collective decisions are made by voting, which involves many institutional elements such as quorum, voting rule (majority requirements), voting schemes (rotation etc.). A comprehensive conceptual framework for an analyze of any collective decision making (thus encompassing both monetary policy committees and enterprise boards) was presented in chapter 1.

However, in spite of clear similarities between monetary committees and executive boards, a direct application of Hermalin's (2005) results to monetary policy would be inappropriate for a few reasons. First, even if MPC changes the interest rate, it does matter in this case if the movement will be upward or downward. Thus, there are three cases which have to be analysed, which differs from Hermalin's setup, where only the CEO's turnover matters (keep-or-quit decision). Second, this fact introduces two cut-off points, which necessarily leads to somewhat more complicated posterior analysis, which was not necessary in corporate governance field. Moreover, and even more importantly, Hermalin's (2005) analysis treats the board as a homogeneous entity, while the present analysis considers each decision-maker separately.

A similar analysis applied to monetary policy, however focused solely on collective decision-making and simplifying the individual reasoning to "change or not" decision was also lead by Sibert (2005). The model presented in this chapter extends Sibert's (2005) analysis by introducing a continuous quality of information rather than the discrete one (her model allows only the decision maker to become or not become informed while the present one considers the continuous precision of information as a choice variable).

However, her results will be extremely useful for the analysis of implications of the individual decision-making for a committee.

Thus, the present chapter contributes to the existing literature in several ways. First, it develops an original approach to decision-making in monetary policy, which is immune to the certainty equivalence problem and gives some insights on the formulation of the monetary policy targets. Moreover, its resolution generalizes the method used by Hermalin (2005) in a similar setup (applied, however, in a different domain). Moreover it allows to shed some light on collective monetary policy making in a monolithic country as well as in an enlarging monetary union.

The remaining part of the chapter is organized as follows. The first section presents the assumptions of the model, including loss functions and a definition of the monetary policy target. Second, the analysis will starts with decisions taken by one member, which is extended in the third section to a decision making by a committee.

1. The model

The aim of this chapter is to model the decision making process in monetary policy (lowering, rising or keeping interest rates unchanged) on the basis of some prior information about the (probability) distribution of the state of the economy and an (imperfect) signal about the current situation of the economy. Getting informed requires some effort from the decision-maker and thus may be perceived as costly from her personal point of view. Within such a framework, Bayesian analysis will allow for some insights about the factors and parameters influencing the probabilities of different states of nature, decisions and incentives for information acquisition.

As a starting hypothesis of the model, allowing for a special focus on decision-making process, we consider the formulation of monetary policy objective as the following: the main task of the MPC is to keep the state of the economy, y, within a target. Two features of this goal need to be underlined. First, in order to steer the economy towards the target, the MPC may take one among the three possible decisions: increase, keep unchanged or decrease interest rates - its main (the only one within this model) instrument. Second, the target is defined as a range, which is somewhat unusual compared to the literature, where log-linear models with quadratic loss functions (implicitly supposing point target values)

are widespread.[60] However, a formulation similar to the ours was used by Orphanides and Wieland (2000).

Defining the main objective of the monetary authority as a range has some important underpinnings, stemming from the observation of real world definitions of central banks' tasks and objectives[61] and the analysis of their behaviour[62], as this has an important impact on the central bank's responses to economic news. As Orphanides and Wieland (2000) put it: "Fundamentally, a monetary policy that focuses on containing inflation within a zone implies a different response to shocks depending on whether inflation is within or outside the zone. This difference in policy responsiveness at the margin is inconsistent with the conventional linear-quadratic framework which implies that the optimal policy rule is linear." (p. 1352). A short discussion of central bank goals and corresponding formulations of loss functions is presented in box 1 below.

Box 1: Central bank objectives and loss functions

As Bofinger (2001) remarks "The ultimate goal of monetary policy is social welfare.(...) In the long run, price stability is clearly the main goal of monetary policy. (...) In the short and medium run, monetary policy should focus its efforts on stabilizing nominal income. (...) Combining the short, medium and long run, it becomes clear that monetary policy maximizes social welfare by contributing to real growth in the long run (which requires a low inflation rate) and to a stable real income path in the short and medium run" (p. 127). The most common analytical presentation of central bank's one-period loss function is a linear combination of squared deviations of inflation and output (output gap or, unemployment) from their respective targets, ie. inflation target and desired output level (zero output gap or NAIRU in case of unemployment):

$L = (\pi - \pi^*)^2 + \lambda(y - y^*)^2$ (1a B1)
$L = (\pi - \pi^*)^2 + \lambda(u - u^*)^2$ (1b B1)

The formulation presented above is a very convenient way of exposition of central bank's preferences and leads to many important findings for monetary policy. First, under similar loss function, the ideas of time inconsistency (Kydland and Prescott, 1977) and inflation bias (Barro and Gordon, 1983) emerged. In this last example, the loss function was even linear in output (the more output, the better), which clearly made the central bank try to expand output by creating monetary surprises, thus leading to sub-optimally high inflation. A similar inflation bias might be also implied by a loss function which is

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[60]See e.g. the seminal papers of Barro and Gordon (1983), Rogoff (1985), and more recent works of Clarida *et al.* (1999), Walsh (1995) or Svensson (2000) among many others. For a short discussion of motivations and criticisms towards the standard central bank loss functions see box 1.

[61]E.g. the ECB's definition of price stability involves inflation (annual HICP increase) "below but close to" 2%, which implies a (somewhat fuzzy) target range between 0 and 2 percent; Bank of England (its Monetary Policy Council) should target annual 2.5% inflation, but need not explain to the Chancellor the reasons of its failure, unless the difference exceeds 1% (which implicitly makes an inflation range between 1.5 and 3.5%). Similar arrangements may be also observed in Canada, New Zealand, Sweden, Poland and other countries.

[62]If monetary policy committees strictly respected their statutory point objectives, they should adjust key interest rates on virtually every meeting: the medium term forecasts (e.g. illustrated by "fan charts" by the Bank of England) quite seldom hit precisely the target.

quadratic in output (or, equivalently, unemployment), but where the target value is higher than the equilibrium value (zero output gap or NAIRU, in case of unemployment).

The analysis based on a quadratic loss function allowed thus for some major improvements in monetary policy, such as providing important arguments in favour of appointing a "conservative central banker" (Rogoff, 1985), granting central banks more independence (see Cukierman, 1992, for a seminal early discussion of the subject) or finally, giving incentives reducing inflation bias by a contract (Walsh, 1995).

A quadratic central bank loss function has also two convenient mathematical features: it is relatively tractable and yields a linear reaction function (with respect to shocks). Thus, it supports simple monetary policy rules, such as Tylor's (1993) rule. Moreover, for small deviations from the target value, the quadratic loss function is a good approximation of any convex loss.

Although standard, the quadratic central bank loss function has some important caveats, which are non-innocuous for monetary policy. First, it leads to certainty equivalence (an expression owed to Theil, 1958), meaning that the policy maker reacts only with respect to the (expected) mean value of the relative variables, no matter the uncertainty associated (analysed, within the context of monetary policy, in Al-Nowaihi and Stracca, 2003, or Orphanides, 2003). It seems to be at odds with the evidence and some central bankers' testimonies. And, second, it is also behaviourally questionable from at least a few points of view. The central bank is usually seen as an agent of the society (or government), whose main task is to care about the value of the money (Walsh, 1995). Thus, it is difficult to show why its loss might be infinite even for large errors (Bray and Goodhart, 2002). The convexity of loss is also at least debated, the most important voice in favour of its non-convexity being Kahnemann and Tversky (2000). Among central bankers some also questioned this feature. As Goodhart puts it 'I could never see why a 2 per cent deviation from desired outcome was 4 times as bad as a 1 per cent deviation, rather than just twice as bad' (Goodhart, 2001, p.179). This view supports rather the linear loss functions, applied in the model proposed within this chapter.

Within the framework of the model the target may be understood simply as an inflation target (in that case the central bank would be an "inflation nutter", to employ Mervin King's (1997) term) or some kind of combination of macroeconomic variables such as inflation, unemployment, growth etc., presented in a one dimensional space. Nevertheless, the model takes into account general economic volatility and the will of policy-makers to attain some economic targets, which allows to focus on their determination to become optimally informed (about the economic conditions, possibly including these somewhat disregarded relations). An important impact of uncertainty (or volatility) on decisions in monetary policy was demonstrated notably by Orphanides (2003).

The MPC member knows that the state of economy y is normally distributed with known both mean and variance - for simplicity and without the loss of generality it is supposed to be standard normal distribution: $y \sim N$ (0;1). The centre of the target range is equal to the

mean value of the state of economy which is also the median and mode (most probable value *ex ante*). Thus, the target value of state of economy, y^* belongs to the interval between $-\zeta$ and $+\zeta$, where ζ characterises the width of the target. $(y^* \in]-\zeta, \zeta[ )$.

The MPC member monitors the economy and, before the realisation of y, acquires a signal about the general economic conditions, m. The signal is also normally distributed around the true value of the state of economy y with precision r, $m \sim N(y; 1/r)$.[63] The member may choose the precision with which it monitors economy, which should be understood as the effort the MPC member spends to acquire and analyze available information.

Then, the MPC member makes her decision taking into account the state of the economy she believes true after updating the commonly known distribution with the obtained personal signal. If she judges that the state of the economy is outside the target, she takes the decision to lower (or raise) the interest rate. The decisions will be denoted respectively a_1, for cutting interest rates, a_2, for keeping the *status quo* and, finally, a_3, for raising the interest rates. Thus, monetary decision-making as described by the model can be treated from the mathematical point of view as an estimation of the current state of the economy and, next, testing the hypothesis of its three possible classifications, given prior beliefs, the signal and the loss function.

Finally, the true state of economy becomes known and the social and MPC losses can be computed. The precise form of the adopted loss function is defined below. The timing of the game is presented on figure 2.1.[64]

Known priors and target (q, p, ζ)	Choice of signal precision – effort (r)	Signal obtained (m)	Decision taken (a_i)	State of economy known (y)	Loss incurred (L_i)
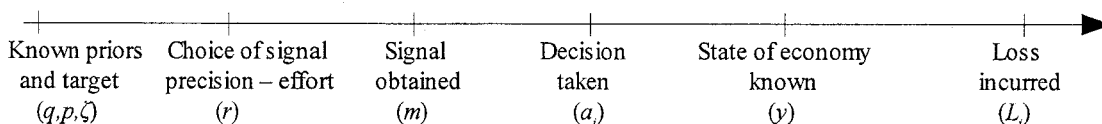
Figure 2.1: Timing of the model

Thus, the decision making problem consists in extracting and analyzing the signal in order to assess the most probable state of the economy and take the adequate decision.[65] An important insight into monetary decision making provided by such a formulation is the certainty equivalence problem: in a majority of models (at least within the standard linear-

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[63] Throughout the present article and accordingly to the literature (e.g. Hermalin, 2005) the precision is understood as the inverse of the variance.

[64] A reaction of an MPC member to a stochastic shock, which can be imperfectly predicted by the signal (while the *ex ante* state of the economy is perfectly known) could be an alternative interpretation of the model. This interpretation, obviously, does not influence the analysis presented below.

[65] A similar problem, but within a model taking into account the underlying economic structure, was presented by Swanson (2004).

quadratic framework), the optimal reaction depends only on the expected value of important variables but not on their higher moments (see also box 1 above).

However, Orphanides (2003) admits that "when the underlying data describing the economy are noisy, the most recent observations do not provide the best assessment of the underlying inflation and output gap" (p. 612). "As a result, an efficient policy that properly accounts for the noise in the data might seek a balance and call for *less activism* than would be appropriate in the absence of noise" (p. 609, emphasis added).

The present analysis will confirm that result, though not in the sense that reaction coefficients (to inflation or output gap) are weaker in presence of noise than under "naive policy"[66]. Such inference would be impossible within the present model as it does not precise the underlying economic structure and thus there is no properly defined reaction function. It may be shown, however, that a greater noise (limited precision of information) will influence MPC member's (and thus committee's) decisions. More precisely, the noise (variances of signals) will lead to an increased *status quo* bias (lower probability of interest rate changes, *ceteris paribus*).

In Bayesian decision theory the loss depends on two parameters – the decision taken and the state of nature. Here, a simple zone-linear loss function is proposed, based on three possible states of nature: y_1 - "the economy is below the target", y_2 - "the economy hits the target" and y_3 - "the economy exceeds the target". The three analysed cases are related to three respective decisions (actions): the interest rate is lowered (a_1) with the corresponding loss function L_1, interest rate is unchanged (action a_2 and loss L_2) and MPC increases interest rate (a_3), where L_3 is the corresponding loss function. Compared to Orphanides and Wieland (2000), a linear (and not quadratic) loss function is used here and in place of somewhat complicated zone generating function, a simple the absolute value is applied. However, similarly to their work and to facilitate the comparison of results, the symbol ζ is used as characterizing the target width. Moreover, contrary to Orphanides (2003), the present analysis will allow for an assessment of the impact of target width on reactivity and incentives for information acquisition by MPC members.

The linearity of these loss functions means that, for example, if the decision is to lower the interest rate (i.e. action a_1 is taken) and the economy is truly below the target, no loss is incurred but if it is not, the loss is proportional (equal) to the distance between the actual

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[66] "[R]ules deemed optimal in the absence of noise" - Orphanides (2003), p. 616

state of the economy and the lower bound of the target. Analogically, when *status quo* (action a_2) is adopted an economy is within the target bounds - the loss is nil except if the economy turns out to be "overheated" or "overcold" - then the loss is proportional to the distance from the real state of the economy to the closer bound of target. L_3 is constructed in the analogical manner. The linearity of the loss function has some important advantages: relative simplicity and tractability. Moreover, it seems to be closer to revealed behavioral loss function (see Kahneman and Tversky, 2000, and box 1 above) and does not lead to the (debatable) result of certainty equivalence. The three respective loss functions are presented graphically and algebraically on figure 2.2 below.[67]

$$L_1 = max\{0, y + \zeta\} \qquad L_2 = max\{0, |y| - \zeta\} \qquad L_3 = max\{0, -y + \zeta\}$$
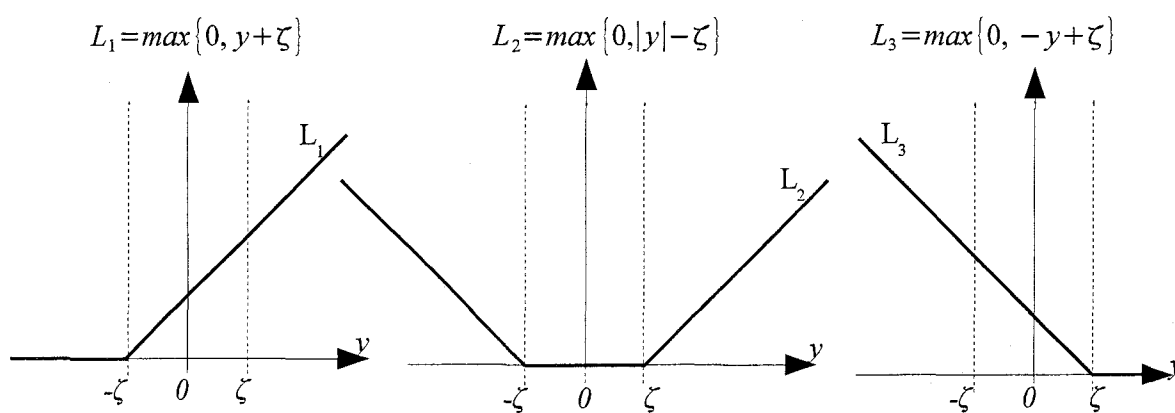
Figure 2.2: Bayesian social loss functions

The loss function as presented above may be justified by several reasons, admitting that inflation is a target variable for the majority of central bankers. First, in some countries (Poland, Sweden etc.) inflation targeting framework explicitly gives a range of inflation which is considered as acceptable. Second, if formally inflation target is a point value or even if there is no inflation target, in most countries the monetary policy authority usually adjusts the main interest rate not on a continuous basis but step by step (the step being the most often of 25 basis points)[68].

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[67]Obviously, the loss being computed *after* state of economy is realized, only one of these presented on figure 2 is applied. Thus, the three functions cannot cross-check each other, because they illustrate different possibilities of loss function under three different decisions taken.

[68]In recent years among prominent central banks only the Bank of Japan (whose monetary policy was bounded by zero nominal interest rate) used smaller steps (e.g. lowered its discount rate from 0.25% to 0.10% on September 18th 2001).

The MPC objective is to minimize the social loss function. However, during the decision-making process, members incur personal costs while searching and analyzing information. Thus, the loss function of an MPC member is:

$$L_M = L_i + \alpha\, c(r), \quad i=1, 2, 3 \tag{2.1}$$

(i corresponds to the respective decision taken). The function $c(.)$ is a twice differentiable cost function with positive first and second difference - strictly increasing in r and strictly convex, which is standard for a cost function of the effort (see e.g. Varian, 1996, chapter 36.7, or Sibert, 2005, p. 103, in the monetary policy context). The parameter α stands for "degree of selfishness" or "information aversion" of the MPC member (the higher α, the more she cares about her personal cost of information acquisition). Thus, the objective function of the MPC member is the social loss function augmented by her personal cost of information acquisition.

The introduction of a personal cost of acquiring information by an MPC member may be justified in several ways. First, if information were free, the MPCs should be very large (according to Condorcet's Jury theorem their size should tend to infinity)[69]. The limited number of MPC members in the real world suggests that some kind of decision making costs are present. Second, for some MPCs the appointment does not totally exclude other positions (e.g. members of the Executive Board of the ECB cannot take any positions without a consent of the ECB President, but some seat in faculty boards; in the Polish MPC external duties are restricted to academic and teaching positions). This implies that the member must share her time between different tasks (and thus the time spent on preparing to an MPC meeting has an alternative cost of not doing something else) or to "shirk"[70] - expend less effort than necessary. And third, MPC members differ, and for some of them getting and analysing complex macroeconomic information may be easier than for others (this may depend e.g. on their education or previous professional experience, which was indirectly shown by Göhlman and Vaubel, 2007, and will be confirmed in the chapter 3 of the present dissertation).

Now, the resolution of the model will be presented step by step. First, the analysis of a purely benevolent central banker will be presented in order to show that the society is better-off if the precision of information increases (because the decisions are better on

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[69]For more theoretical arguments for the existence of information acquisition costs, see chapter 1 of the present dissertation or Gerling et al. (2005).
[70]See Shapiro and Stiglitz (1984).

average). Further, the model will be augmented with a cost of information acquisition as introduced above which will allow for existence of a personally optimal level of information precision. Next, the factors influencing this optimal level will be analysed.

In what follows, an important distinction will be made: between *prior* and *posterior* analysis. This distinction will concern, respectively, situations when the signal has been or has not been acquired yet. To understand the rational decision making by an MPC member, the *prior* analysis is more important. Nevertheless, to solve these problems, I proceed by backward induction: *posterior* choice will be explained first. However, some preliminary remarks will start the presentation.

1.1. Acquiring information and updating beliefs

While acquiring signal, the MPC member adjusts its beliefs about the state of the economy (its distribution). As demonstrated in the Statistics literature[71], before the signal is acquired, its *marginal* distribution (conditional on *prior* distribution of the state of economy) is normal with mean $q=0$ and variance $(1 + 1/r)$ (distributions of signal and state of economy are assumed independent). This distribution allows, among others, for verification of the prior: if sample values approximately follow the marginal distribution, that means that the adopted prior was correct. It can thus be used for generating the expected of distribution of the samples.[72] Thus, in this model, the marginal distribution serves for computing the expectations of the signal *m*.

Defining the precision *H* of the marginal distribution of the signal:

$$H = \frac{r}{1+r} \qquad (2.2)$$

where 1 and *r* are, respectively, precisions of the prior and monitoring, the distribution function can be expressed as[73]:

$$f(m) = \sqrt{\frac{H}{2\pi}} e^{-H\frac{m^2}{2}} \qquad (2.3)$$

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[71]e.g. Berger (1985) p. 126.
[72]That is why the marginal distribution is sometimes called *predictive distribution;* Berger (1985, p. 95).
[73]Throughout the chapter, somewhat unusually for monetary policy models, π stands for the mathematical constant ($\pi \approx 3.14$) and does not mean inflation rate. This is justified by frequent referring to precise functional form of Gaussian (normal) distributions.

Figure 3 below, presents as an illustration, the case of the marginal (expected) distribution of the signal, m, as a function of its precision, r.

When the signal has been acquired, the MPC member's estimation of the state of economy changes. Its distribution, conditional on the signal, still follows normal law, but the moments change: the mean becomes $\mu_{y|m}$ and the variance $\sigma^2_{y|m}$, with:

$$\sigma^2_{y|m} = \frac{1}{1+r} \quad \text{and} \quad \mu_{y|m} = \frac{rm}{1+r} \tag{2.4}$$

Thus, the *posterior* distribution of the state of economy, given the signal obtained, can be expressed as:

$$\hat{y}(y|m) = \sqrt{\frac{1+r}{2\pi}}\, e^{-(1+r)\frac{\left(y-\frac{mr}{1+r}\right)^2}{2}} = \sqrt{\frac{1+r}{2\pi}}\, e^{\frac{-(y+yr-mr)^2}{2(1+r)}} \tag{2.5}$$

That is how the (distribution of the) state of economy is perceived by a decision-maker after she has received the signal. As an illustration, this posterior distribution of y, for $m=1$ is presented on figure 2.4. The juxtaposition of figures 2.3 and 2.4 allows for a comparison of the expected distribution of m and the posterior distribution of y (given $m=1$), as functions of the precision of the signal, r. Both of them become more concentrated when the precision of the signal, r, increases. Moreover, the mean (as well as the mode and the median) of the *posterior* distribution bends towards the mean (value) of the signal.
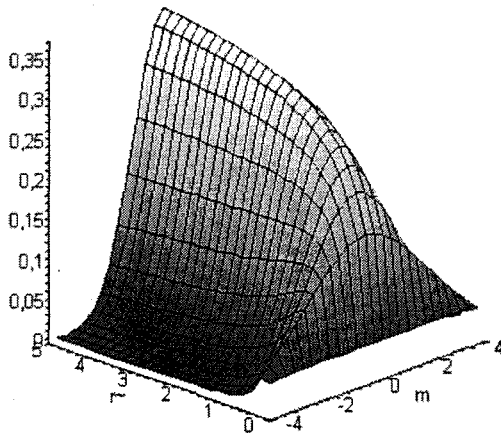
Figure 2.3: Marginal distribution of m Figure 2.4: Posterior distribution of y ($m=1$)
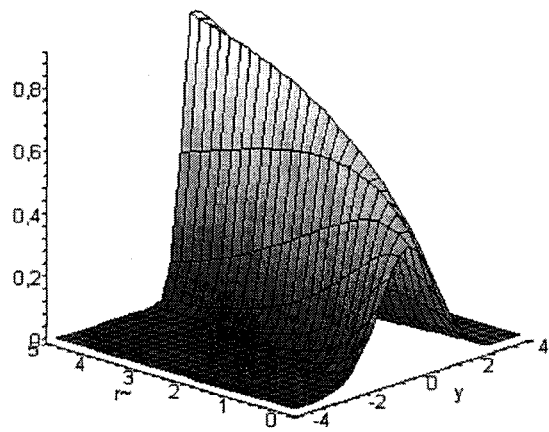
When an MPC member acquires the signal, she verifies if the new estimated state of the economy (i.e. the mean of the *posterior* distribution) falls into the target. I suppose that the MPC member follows *the maximum likelihood* principle: she changes interest rates if the *posterior* mean[74] falls out of the target (and inversely: she keeps interest rates unchanged if the most likely value of the distribution is contained within the bounds of target). This rule is robust to some classes of loss functions[75], including the linear, quadratic and any loss function which equally weights over and underestimation. Thus, this approximation of the personal decision rule is compatible with this model, which will be confirmed in what follows.

Given the above-mentioned decision-rule, let us check for which m the condition

$$|\mu_{y|m}| < \zeta \tag{2.6}$$

is verified. This condition defines the monitoring *value* (m), for which the mean of *posterior* distribution – the most probable value of the true state of economy – will hit the target. The solution is[76]:

$$\underline{M} < m < \bar{M}, \text{ where } \underline{M} \equiv -\zeta \frac{1+r}{r}, \bar{M} \equiv \zeta \frac{1+r}{r} \tag{2.7}$$

$\underline{M}$ and $\bar{M}$ are thus the *status quo* thresholds – in other words they are the cut-off values of the signal (if the signal is included between these values, the member will opt for *status quo*). One may observe that the "*status quo* area" (the interval $\underline{M}; \bar{M}$) is larger than the target for y (interval $-\zeta; \zeta$). Thus, the inaction zone is equivalent to the target only if the precision of the signal, r, tends to infinity.

For monetary policy that would mean that a signal (information) of poor quality should attain a sufficiently important value in order to make a decision-maker vote for a change. In a monetary policy committee, people endowed with poorer information on average (or with smaller abilities of economic analysis)[77] would rather opt for *status quo* (or, possibly, would present more herding behavior - hardly ever dissenting with the majority or the chairman). Thus it may be supposed that central bankers with economic educational and/or professional experience within the sector are more able to deeply analyze the available

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[74] Remember that for the normal distribution the mean overlaps with the mode and median at the same time
[75] See Berger (1985, p. 162 and the following).
[76] Recall that q has been normalized at 0.
[77] As will become clear further, smaller abilities lead to less information acquisition in personal equilibrium. See comparative statics of the model below.

information. Göhlman and Vaubel (2007) put it somewhat differently "economists are more likely to attain the inflation rate which they prefer".

This hypothesis might be tested within the committees which disclose the individual voting records (such as the FOMC, the British or the Polish MPC). The methodology might be similar to the works of Chappell et al. (1993, 1995, 1997, 2000, 2004 and 2005), presented in details in chapter 1, section 2.2, but exogenous variables should also include these tested by Göhlman and Vaubel (2006) - i.e. educational and professional backgrounds of policy-makers. The latter work, however, did not tested voting behaviour but policy outcomes (inflation).

Before turning to a deeper analysis of the present model and its further consequences for monetary policy, a simple numerical example will be presented, in order to shed some light on the decision-making process it describes.

1.2. A numerical *posterior* example

To make clearer the decision process modeled in this chapter, let us consider the following example, illustrated by the figures 2.5 and 2.6 below. We consider two independent monetary policy makers members (A and B), who observe an economy Y, which is supposed to follow a standard normal distribution ($Y \sim N(0,1)$) with a target comprised between -0.5 and 0.5 ($\zeta=0.5$). Decision-maker A deeply analyses information and opts for a signal precision $r_A=4$ (with the variance of the corresponding distribution being equal to 0.25), while decision-maker B is willing only to acquire the information with precision $r_B = 0.5$ (with the corresponding variance equal to 2). Furthermore, the values of the signal obtained by central bankers A and B are equal, respectively, to 1.3 and -0.8. What interest rate moves would they support, assuming the social loss function as defined in section 1.2 of the present chapter? As this is an *ex post* analysis, the costs of information acquisition are ignored and the focus is on the updating of their beliefs and *posterior* expected *social* losses.
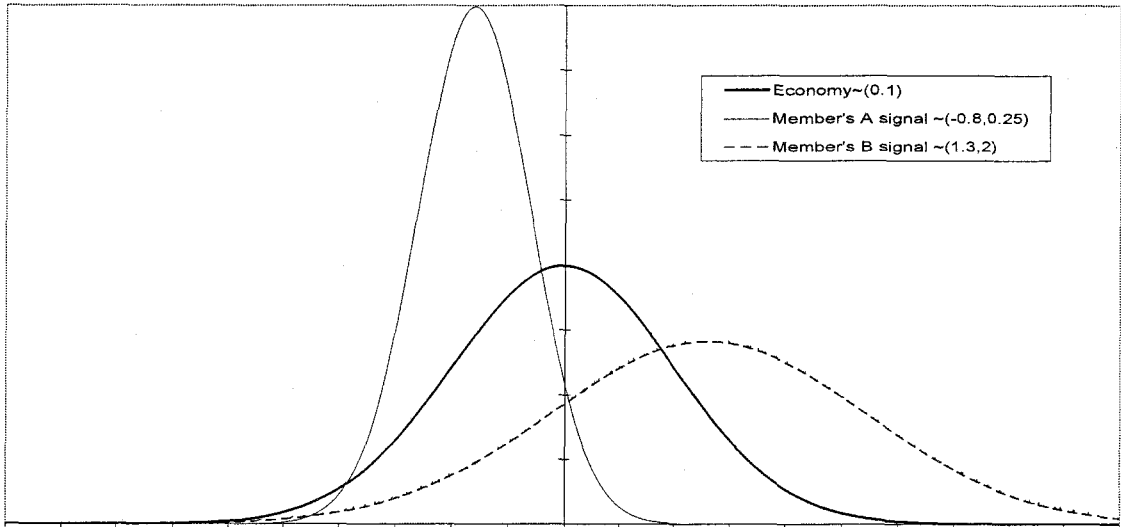
Figure 2.5: Distributions functions of the state of economy and monitoring by two different MPC members

After receiving the signals, both of them update their beliefs about the state of economy. They compute the new mean/median value and variances/precisions of the *posterior* distribution of the state of economy and expected *posterior* losses, according to these distributions. The new (*posterior*) moments of distribution for the member A become

$\mu_{y|mA}$ =-0.64 and $\sigma^2_{y|mA}$ =0.2 (with the corresponding precision equal to 5), while respective values for member B become $\mu_{y|mB}$ =0.433 $\sigma^2_{y|mB}$ and = 0.667 (precision 1.5). Clearly, only the decision-maker A will believe that the economy is outside (below) the target, and thus will opt for an interest rate change (a cut). These results are illustrated by figure 6 and checked by a simple comparison of the received signal values with "intervention thresholds" computed according to formula (7) or comparing *posterior* loss functions expected by the two MPC members.
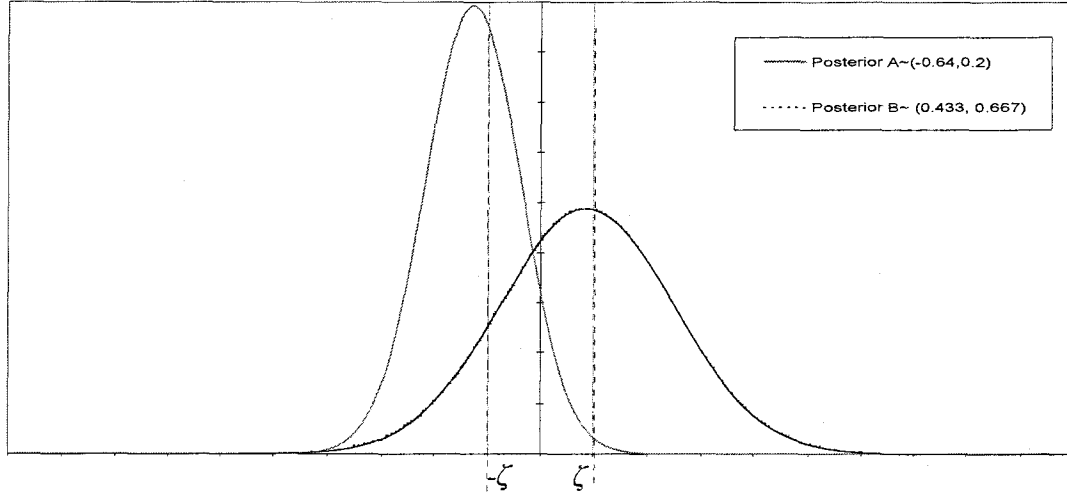
Figure 2.6: Posterior distributions of the state of economy conditional on signals obtained by members A and B

As remarked above, formula (7) reveals that *individual* cut-off values of signal depend on the target width ζ, but also on the precision of *prior* distribution of the state of economy, and the precision of the signal (individual decision-maker effort). Inserting values from the example, we obtain:

$\underline{M_A} = -0.5*(5/4) = -0.625,\quad \bar{M}_A = 0.5*(5/4) = 0.625,$

$\underline{M_B} = -0.5*(1.5/0.5) = -1.5$ and $\bar{M}_B = -0.5*(1.5/0.5) = 1.5.$

Thus, the decision-maker A interprets its signal value $m_A = -0.8$ as a sufficient condition in favor of the interest rate cut, while the decision-maker B finds the signal $m_B = 1.3$ too weak to opt for an interest rate hike.

To analyze the problem in an even more precise manner, one may consider the respective expected[78] social losses. In this case, respective losses of MPC member A can be written as

$$L_{1A}^E = \int_{-\infty}^{\infty} max\{0, y+0.5\}\sqrt{\frac{5}{2\pi}}e^{-(5)\frac{(y+0.64)^2}{2}}\,dy \approx 0.117$$

$$L_{2A}^E = \int_{-\infty}^{\infty} max\{0,|y|-0.5\}\sqrt{\frac{5}{2\pi}}e^{-(5)\frac{(y+0.64)^2}{2}}\,dy \approx 0.258$$

$$L_{3A}^E = \int_{-\infty}^{\infty} max\{0,-y+0.5\}\sqrt{\frac{5}{2\pi}}e^{-(5)\frac{(y+0.64)^2}{2}}\,dy \approx 1.141$$

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[78]In the formulas below the symbol E (in the exponent) stands for expectations operator, while e is the mathematical constant ($e \approx 2.71$)

Having compared these three expected losses, the decision-maker A would choose the action a_1 (an interest rate cut). Decision-maker B faces the following problem of choice among three expected values of the respective loss functions:

$$L^E_{1B} = \int_{-\infty}^{\infty} max\{0, y+0.5\} \sqrt{\frac{1.5}{2\pi}} e^{-(1.5)\frac{(y-0.433)^2}{2}} dy \approx 0.984$$

$$L^E_{2B} = \int_{-\infty}^{\infty} max\{0, |y|-0.5\} \sqrt{\frac{1.5}{2\pi}} e^{-(1.5)\frac{(y-0.433)^2}{2}} dy \approx 0.345$$

$$L^E_{3B} = \int_{-\infty}^{\infty} max\{0, -y+0.5\} \sqrt{\frac{1.5}{2\pi}} e^{-(1.5)\frac{(y-0.433)^2}{2}} dy \approx 0.36 \quad \text{which favors status quo.}$$

These results, as well as the figure 2.5 above, clearly illustrate the fact that the precision of information has an important effect on the decisions taken by central bankers. Remarkably, the decision maker B, in spite of having a more important signal (in absolute terms), prefers the *status quo*, because her information is too noisy, while decision-maker A opts for an interest rate cut, because the precision of her signal (and thus the posterior distribution of the economy) is much more accurate. Moreover, the expected value of the loss concerning the chosen option is much lower for the decision-maker A.

Having seen the *ex post* reasoning by an individual member, let us turn to the prior analysis - when a decision-maker has to choose her own signal precision. While deciding about the effort to expend, she knows the consequences - including the costs of information acquisition and the potential gains for the society (lower expected loss function) - which will be seen in the following subsection.

2. Solving the model

The resolution of the model will rely on computing the expected loss functions, which necessitates the computation of the *ex ante* probabilities of different states of nature and respective decisions. Once the form of the loss function is known, comparative statics of the solution integrating the personal cost of decision-makers' effort will be presented.

2.1. Expectations and *prior* analysis

In this subsection a Bayesian *prior* analysis of the presented problem will be exposed. To get a better understanding of the problem faced by a decision maker while deciding of her effort to acquire more precise information, consider the last game of a chess player in

an important tournament. In a quite complicated position (many figures attacking and under attack at the same time), he sees a possibility of an interesting sacrifice of the queen for a promising but uncertain attack[79]. The effort here relies clearly on analysing numerous possibilities and its cost is obviously time, limited in tournament games. The level of complexity of the position seems to be a sound analogy to the volatility of the economy, while the target width ζ may be determined by the tournament table (if a player is already sure to win the tournament or if he must win or if a draw is sufficient to finish first).

Taking its decision to analyze the sacrifice of the queen will depend on the subjective assessment of the position and especially of the success probability of the "queen's offering" as well as of the associated risk (if there is not check-mate, maybe at least draw will be attainable by repeating moves). The time left on the clock will determine the possibility of analysing all the possible combinations (less time means that analysing becomes more costly *ceteris paribus*) while the level of complexity of the position may have a twofold impact: facing the already high level of effort may make weaker the marginal cost of analysing one more possibility or, inversely, it might be judged appealing to make the position simpler.

Similarly, an MPC member choosing her preferred precision of signal (effort) will have to do it before the signal is acquired. This leads the model in the sense that the choice of r will influence (as shown above) the probability of taking each of respective decisions (interest rate cut or rise and status quo) but also *posterior* distributions, determining losses incurred by each decision.

An important remark allowing to understand the following analysis is that the MPC member knows that she will (vote for a) cut or increase interest rate only if she obtains the signal in favor of such decisions (the value of monitoring is outside of the "status quo bands"). In other words, she will opt for an interest rate change (cut or increase) *if and only if* her updated belief about the state of the economy is outside the target[80]. Thus, the expectations of the *posterior* distribution will differ, according to each possible decision, even *prior* to the signal acquisition. Clearly, these *ex ante* expectations about *posterior* distributions of the state of nature will have equal precisions (the sum of the precision of

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[79]A chess fan might thing of a game like the beautiful Awerbach-Kotow, Zurych 1953 (deliciously commented by Bronstein in *International tournament of Grand Masters*, Moscow 1983, 3rd edition, in Russian).

[80]In case of binary decision this is also equivalent to the situation when the likelihood ratio exceeds one (Sibert, 2005, p. 99)

the state of economy and the decided precision of the signal), but will differ with respect to their means. Hence, the question is, what are the *prior* expectations of the *posterior* distributions in each of the three possible situations?

First, the respective *prior* probabilities of states of the nature and decisions will be computed. Subsequently, knowing these probabilities, the Bayesian question will be asked: given the outcome (signal), what is the probability of the cause (state of nature)? Or, more precisely, given the meaning of the signal ("cut interest rates"/ "keep the status quo"/ "raise interest rates"), what is its expected *value*? In other words, what is the average value of a signal in favour of each decision? These values (themselves functions of the effort, *r*) will be re-inserted into the posterior distribution (equation 5) to allow for the expectations of the social loss and the private MPC member's loss (social loss augmented with the cost of effort spent for information acquisition).

Probabilities of the decisions

The *prior* probability that the economy will require an interest rate cut is equal to the probability that the true (and yet unknown) state of economy will be lower than $-\zeta$. Probability that the *status quo* would be optimal is equivalent to the probability that the state of economy is contained between the target bands: $]-\zeta;\zeta[$. Finally, the *prior* probability that an interest rate hike is needed is equal to the probability that the economy will be above the target band, ζ.

Let us define, for more tractability of the following formulas, $\varphi(.)$ as the standard normal distribution $(\varphi(.)\sim N(0;1))$ and $\Phi(.)$ as its corresponding density function.[81] Recall that the mean value of the *prior* is supposed equal to 0 and its standard deviation equal to 1 (being also its variance and precision). Thus, the *prior* probabilities of the three states of nature can be written as:

$$P(y_1)=\Phi(-\zeta); \ P(y_3)=1-\Phi(\zeta); \ P(y_2)=1-(\Phi(-\zeta)+1-\Phi(\zeta))=1-2\Phi(-\zeta) \quad (2.8)$$

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[81] Thus, $\phi(x)=\dfrac{1}{\sqrt{2\pi}}e^{\frac{-x^2}{2}}$ and $\Phi(z)=\int\limits_{-\infty}^{z}\varphi(x)dx$. The latter differs from the traditional definition: $\Phi(z)=\int\limits_{0}^{z}\varphi(x)dx$ (see e.g. Weisstein, 2005). Nevertheless this is in line with Hermalin's (2005) formulas. Though, differing by a constant value of $\Phi(z)=\int\limits_{-\infty}^{0}\varphi(x)dx=0.5$, both functions clearly have the same differentials. This formulation seems also more useful (easier to handle) in case of two-tailed distribution problems, as in the present model.

Remarkably, P(y_1) and P(y_3) are equal. This, as well as the last equality in formula (8) comes from the fact that $\Phi(-x)+\Phi(x)=1$. This, in turn, results from the symmetry of the standard normal density function: $\varphi(-x)=\varphi(x)$. These properties are illustrated by figure 7 below, and may be analogically interpreted with respect to the probabilities of the three possible actions of an MPC.
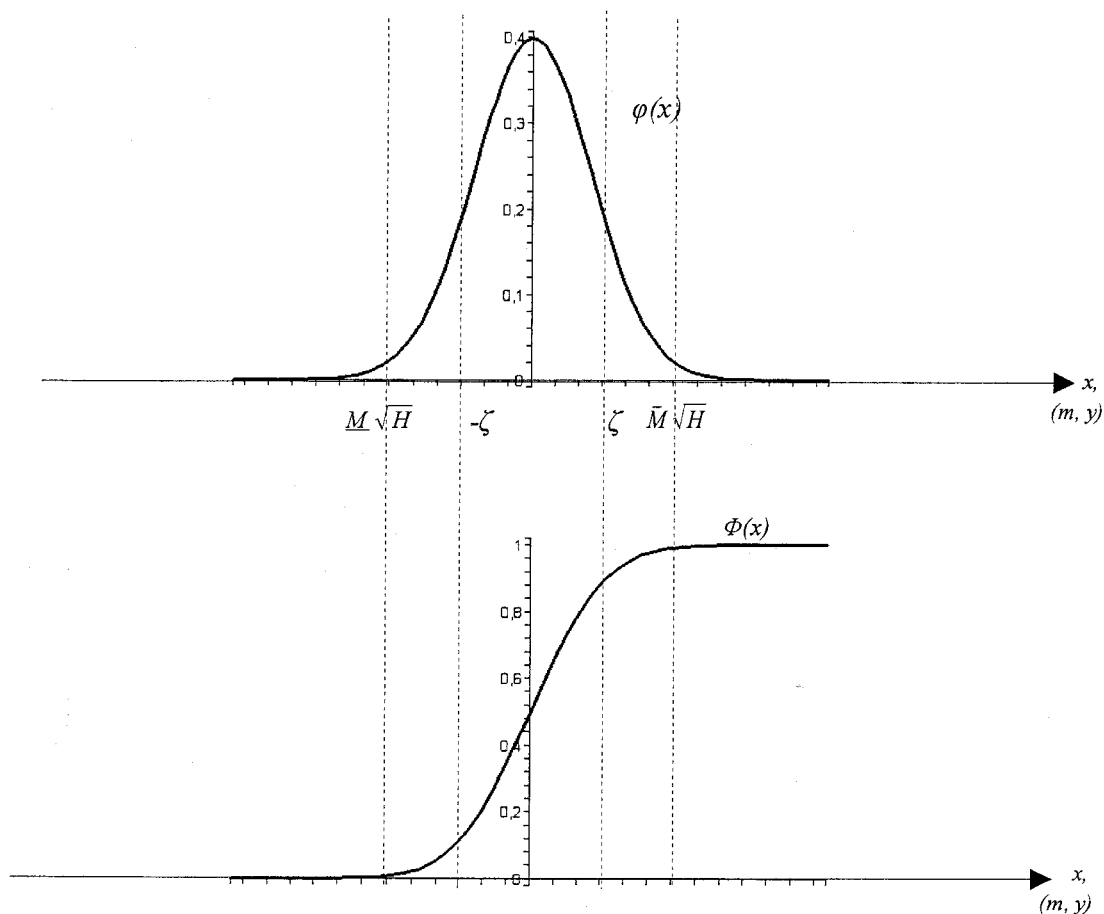
Figure 2.7: Distributions and density functions of monitoring and states of economy

Obviously, and logically from the committee's point of view, the respective probabilities of the states of economy do not depend on the effort of MPC members (r does not enter into $P(y_i)$, in formula 2.8).

The *prior* probabilities of receiving different signals (and consequently of making different decisions) are, as mentioned above, determined by the marginal distribution of the signal and the width of the target band. Consequently, the probability of a decrease (an increase) in interest rates is equal to the probability that the standard normal variable assumes a

smaller (greater) value than the normalized lower (upper) cut-off value of the signal. Remark that the factor $\sqrt{H}$ normalises the variables (the cut-off values of the signal) as H is the precision (inverse of variance) of the marginal distribution (which allows for expectations of the signal). Thus, the respective *ex ante* probabilities of changing interest rates may be expressed as:

$$P(a_1)=\Phi(\underline{M}\sqrt{H})\text{ and }P(a_3)=1-\Phi(\bar{M}\sqrt{H})=1-\Phi(-\underline{M}\sqrt{H})=P(a_1) \qquad (2.9)$$
$$P(a_2)=1-P(a_1)-P(a_3)=1-2\,\Phi(\underline{M}\sqrt{H})$$

Proposition 1: *Probabilities of changing interest rates are influenced by the precision of the information obtained by the MPC member (which is under control through her effort for acquiring it) and on the target width. The more precise the signal, the higher the probability of an interest rate move (a cut or a hike). The larger the target, the lower the probability of an interest rate move.*

Proof: Consider the partial derivatives of the probability of an interest rate cut, $P(a_1)$, with respect to this effort, r

$$\frac{\partial P(a_1)}{\partial r}=\frac{\zeta\sqrt{H}}{2r^2}\varphi(\underline{M}\sqrt{H})>0 \qquad (2.10)$$

and with respect to the target width, ζ:

$$\frac{\partial P(a_1)}{\partial\zeta}=-\sqrt{H}\frac{1+r}{r}\varphi(\underline{M}\sqrt{H})<0 \qquad (2.11)$$

The expression (2.10) is clearly positive as the parameters (r,ζ) are positive by definition, as well as H - precision of the marginal distribution and the standard normal distribution $\varphi(.)$. Thus, the more precise the information a member possesses, the more she is willing to change the interest rate, *ceteris paribus*. The same holds also for an increase in interest rates, because *ex ante* probability of an interest rate increase, $P(a_3)$, is equal to the probability of an interest rate cut, $P(a_1)$ (see expression (9)).

Inversely, expression (2.11) is negative for all acceptable values of the parameters. This means that the probability of changing interest rates is higher when the target range is smaller, *ceteris paribus* (MPC members accept less volatility).

Economically, this result means that a better information reduces a suboptimally large inaction zone (as it restrains the area where a decision of adjusting interest rates should be taken, but the decision maker prefers the *status quo* because she does not possess a precise enough information). Consequently, a better information precision improves the social welfare, which will become even more explicit in course of the further analysis.

The second part of proposition 1 is also quite intuitive: a small target range makes the MPC members intervene more frequently in order to "fine tune" the economy to the "fine target".

From equation (2.9) one may also remark that all the partial derivatives of $P(a_2)$ will have the opposite sign compared to the respective derivatives of $P(a_1)$. The status quo will be therefore the more probable the less precise is the information and the larger is the target width.

All these results confirm that the model is immune to the certainty equivalence problem, as the precision (variance) of information influence the decision-making - a *status quo* bias emerges when information is imprecise (noisy). However, as we analyze only the probabilities, an important shock[82] may occur, and might be correctly anticipated and consequently the interest rates would be accordingly adjusted.

The results on the probabilities of changing interest rates is also in line with Orphanides (2003), who remark: "Even if policy were based on a simple reactive rule, mere variations in a policymaker's confidence in his knowledge of the economy in real time would lead to substantial changes in the efficient response of policy to developments in both inflation and the output gap." A caution in adjusting interest rates by central bankers under uncertainty is also advocated by Goodhart (1999), Al-Nowaihi and Stracca (2003) or Gerlach-Kristen (2005).

Thus, the present study confirms the usual findings of the research on monetary policy reactivity, though, under a quite different setup. The major distinctive feature of the present analysis is a joint analysis of the uncertainty over news (information precision depending on decision-makers' effort, r) and the acceptable level of general economic volatility (the width of the target range, ζ). The former contributes to more caution in monetary policy decisions - more uncertainty (less precision) lowers the probability of policy instrument adjustment while the latter decreases the frequency of necessary interest rates moves *ex ante*.

Expectations over the signal

As the *ex ante* probabilities of the respective decisions have been analysed, I turn now to the formation of expectations. The decision maker knows that she will opt for an interest

[82]See footnote 5 for an interpretation of the normally distributed state of economy as a shock to be anticipated.

rate change only if the signal (information) she obtains makes her believe the economy to be outside of the target. Hence, while evaluating the future losses occurring from the possible decisions (and effort spent for analysing information), she takes into consideration different expected distributions of the state of economy. In other words, she will opt for an interest rate change (cut or increase) *if and only if* her updated belief about the state of economy is beyond the target range.

Before exposing and computing the three expected loss functions, an important point of the Bayesian analysis has to be presented. This key element is conditionality. To give a better understanding of the problem, let us begin with the question: what is the expected value of a "decrease" signal? Or, in other words, if the signal is understood by the decision-maker as sufficiently low to cut interest rates, what is its value on average?

To answer that question all the necessary elements are already known: these are the cut-off value of the signal, the expected (marginal) probability distribution of the signal and the probability of the condition (obtaining the signal in favour of an interest rate cut), $P(a_1)$. Note that the distribution of a "decrease" signal (distribution of the signal conditional on the fact that it is in favour of an interest rate cut) is only a part of one tail of a normal distribution. One of its possible representations (for $\zeta=0.5$ and $r=2$) together with the analogical distributions of a "keep status quo" signal and "increase" signal are plotted on, respectively, the left, central and right panels of figure 2.8 below (remark that with these values of parameters, $\underline{M}=-0.75$ and $\bar{M}=0.75$).
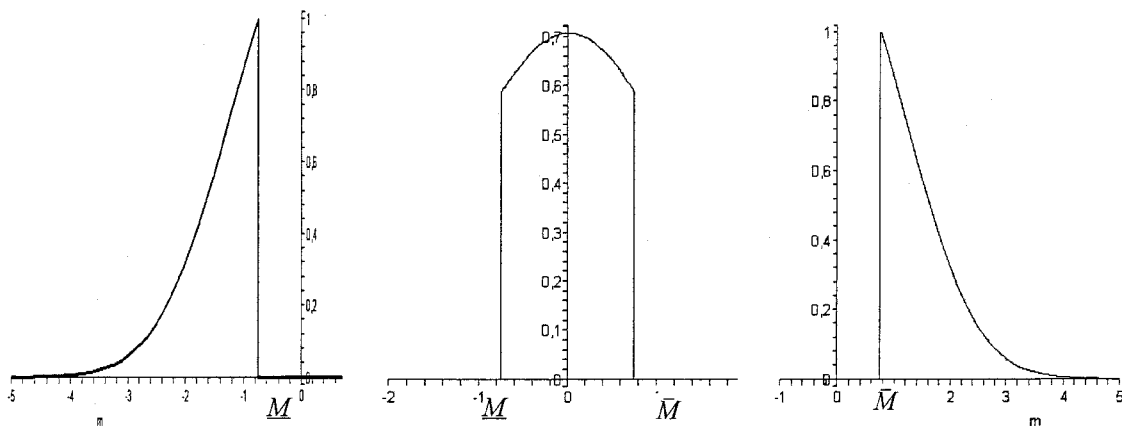
Figure 2.8: Distributions of signal conditional on its meaning - "cut", "status quo", "increase" ($\zeta=0.5$, $r=2$)

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Thus, the expected "decrease" signal is:

$$m_1^E = \int_{-\infty}^{\underline{M}} m \frac{\varphi(m\sqrt{H})}{P(a_1)} \, dm = \frac{-\varphi(\underline{M}\sqrt{H})}{\sqrt{H}\,P(a_1)} \qquad (2.12)^{83}$$

This value (which is a function of all the parameters of the model) has some interesting properties. First and obviously, it is always negative (H, $P(a_1)$ and $\varphi(x)$ being all positive) and second, by construction, it is smaller than $\underline{M}$, for all credible (real and positive) values of parameters. This is illustrated by figure 2.9 below.
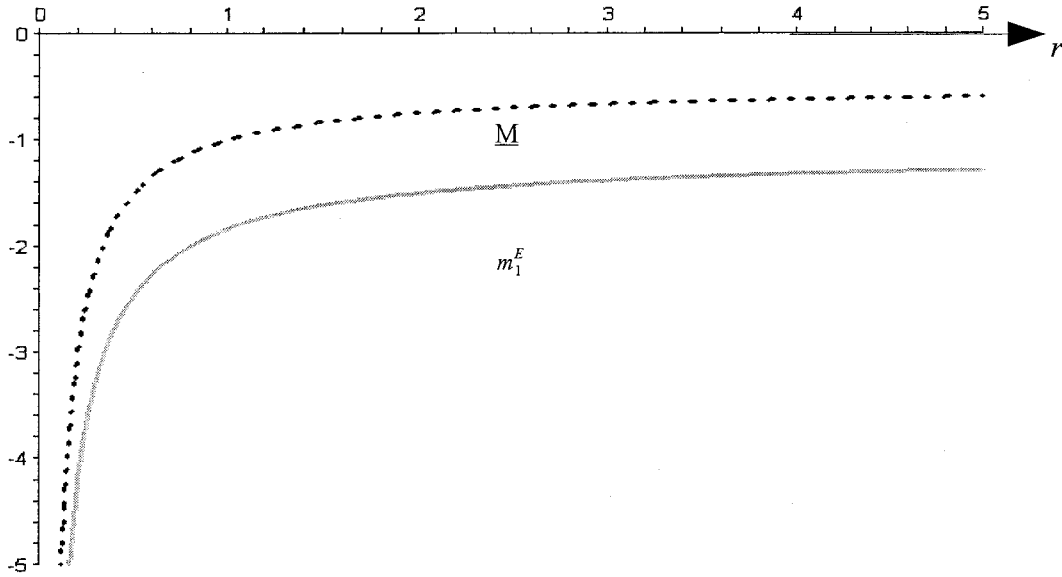
Figure 2.9:Expected value of the signal in favor of an interest rate cut (m_1^E) and the respective cut-off value ($\underline{M}$) as functions of the signal precision, r ($\zeta=0.5$).

Third, its partial derivative with respect to the effort, r, is:

$$\frac{\partial m_1^E}{\partial r} = \frac{m_1^E}{2\,r^2(1+r)}(m_1^E \zeta\, r + \zeta^2 r + \zeta^2 - r) > 0 \qquad (2.13)$$

This means that m_1^E is increasing in the effort r (decreasing in absolute value) but it probably might be decreasing only for some r if the target range were too large (however, no such a range was find in the simulations I run[84]). As r tends to infinity, the expected

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[83] For relative simplicity of the following formulas, define: $\Phi_1 \equiv \Phi(\underline{M}\sqrt{H}) = P(a_1)$ and $\varphi_1 \equiv \varphi(\underline{M}\sqrt{H})$

[84] It seems that the plausible parameters' values should be somewhat commensurate. Thus, the target width, ζ, should probably not exceed 2 standard deviations of the prior (otherwise interest rate movements would be very rare compared to decisions of keeping *status quo*). Also signal precisions are probably not very high, as the of MPC members often talk about a seizable uncertainty about economic conditions. Thus, the variance of the posterior distribution is probably also commensurate with the variance of the prior, which means that r probably does not exceed values like 5-7 (which, according to formula (4), would already mean that the posterior is 6-8 times more precise than the prior beliefs).

value of the signal in favor of an interest rate cut is approaching 0, but not asymptotically, the limit depending on the target width, ζ. [85]

As the model is symmetrical, the expected value of the monitoring conditional on the signal "increase" is exactly opposite to expected value of monitoring conditional on its "decrease" meaning, m_1^E :

$$m_3^E = \int_{\bar{M}}^{\infty} m \frac{\varphi(m\sqrt{H})}{P(a_1)} dm = \frac{\varphi(\bar{M}\sqrt{H})}{\sqrt{H} P(a_1)} = \frac{\varphi_1}{\sqrt{H} \Phi_1} \tag{2.14}$$

Thus, its properties are analogical to these of m_1^E : it is positive for all the plausible values of parameters, it is larger than $\bar{M}$, and, according to reckoned simulations, it is decreasing in effort, r. This also means that the greater the precision of the signal r (MPC member's effort), the lower in absolute terms, on average, the signal value in favour of an interest rates move.

The signal implying the status quo, is less interesting, because its expected value is 0.

$$m_2^E = \int_{\underline{M}}^{\bar{M}} m \frac{\varphi(m\sqrt{H})}{1-2P(a_1)} dm = \frac{\varphi(\bar{M}\sqrt{H}) - \varphi(\underline{M}\sqrt{H})}{1-2P(a_1)} = 0 \tag{2.15}$$

The expected <u>values</u> of the signal conditional on its meaning (decrease: m_1^E , *status quo*: m_2^E , increase: m_3^E) have no clear economic meaning (beside being an average value of signal for each respective decision). Nevertheless, taking into account the fact (implied by the rational expectations of MPC members) that expected *posterior* functions will differ according to the undertaken action (itself implied by an *unknown yet* signal) is the main distinctive feature of this analysis, compared to Hermalin (2005).

2.1.3. Expected loss functions

After having presented the basic properties of the model, I turn now to the analysis of the expected loss function. The focus will be on the expected value of the loss if interest rates will have been lowered (and a "decrease" signal will have been obtained) – L_1[86]. After the decision has been taken the loss depends only on the true state of economy, y. Nevertheless, this is conditional on obtaining a "decrease" signal and, hence, the expectation of the signal is expressed by (12), which is inserted into (5). Thus, the expected value of L_1 is:

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[85] The precise expression, without, however, any clear economic meaning (in the sense of interpretable), may be found in appendix (formula A6).
[86] Because of symmetry of the model (same *ex ante* probabilities of increase as well as decrease), the expected value of losses L_1 and L_3 are identical *ex ante*.

$$L_1^E = \int_{-\infty}^{\infty} max\{0, y+\zeta\} \sqrt{\frac{1+r}{2\pi}} e^{-(1+r)\frac{(y-\frac{m_1^E r}{1+r})^2}{2}} dy = \int_{-\zeta}^{\infty} (y+\zeta) \sqrt{\frac{1+r}{2\pi}} e^{-(1+r)\frac{(y-\frac{m_1^E r}{1+r})^2}{2}} \qquad (2.16)$$

which, making the change of variables $x=\sqrt{1+r}(y-\frac{m_1^E r}{1+r})$ and denoting for a relative simplicity of the following formulas $\varphi_2 \equiv \varphi((-\zeta-\frac{m_1^E r}{1+r})\sqrt{1+r})$ and

$\Phi_2 \equiv \Phi((-\zeta-\frac{m_1^E r}{1+r})\sqrt{1+r})$, can be written:

$$L_1^E = \frac{1}{\sqrt{1+r}} \varphi_2 + (\frac{m_1^E r}{1+r}+\zeta)(1-\Phi_2) \qquad (2.17)$$

Obviously, the expected value of L_1 is positive for all the plausible (real and positive) values of the parameters. This is implied by the way it is computed (the integral of a product of a non-negative function by a positive one). Moreover, it can be shown in this way: while the limit of L_1 when r tends to infinity is positive, the partial derivative of (2.17) with respect to r is negative for all r:

$$\frac{\partial L_1^E}{\partial r} = \frac{-\varphi_2}{2(1+r)^2} + \frac{m_1^E(1-\Phi_2)(m_1^E\zeta r+\zeta^2 r+\zeta^2+r)}{2r(1+r)^2} < 0 \qquad (2.18)$$

The expression (18) means that better information will lead to higher social welfare (smaller social loss), *ceteris paribus*, if the signal turns to be in favour of an interest rate cut. This is clear from a mathematical[87] as well as an economic point of view: if a signal is more precise and falls below the lower *status quo* band, the probability of policy error decreases and the society is better-off.

The ex ante expected loss L_2, if the committee takes no action (status quo *will be* kept), can be expressed as:[88]

$$L_2^E = \int_{-\infty}^{\infty} max\{0, |y|-\zeta\} \sqrt{\frac{1+r}{2\pi}} e^{\frac{-(1+r)y^2}{2}} dy = 2(\frac{\varphi(\zeta\sqrt{1+r})}{\sqrt{1+r}} - \zeta\Phi(-\zeta\sqrt{1+r})) \qquad (2.19)^{[89]}$$

L_2 is, similarly to L_1, always positive and decreasing in r. Its partial derivative with respect to r is:

$$\frac{\partial L_2^E}{\partial r} = \frac{-\varphi_3}{\sqrt{(1+r)^3}} < 0 \qquad (2.20)$$

Figure 2.10 presents a simulation of L_1 and L_2 as functions of r for $\zeta=0.5$

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[87]The expression $m_1^E\zeta r+\zeta^2 r+\zeta^2+r$ is positive for all (real and positive) values of parameters, while, as one may recall from (2.12), m_1^E is always negative.

[88]Recall that the expected value of signal "do not change interest rates" is null.

[89] For relative simplicity of the following formulas, define: $\Phi_3 \equiv \Phi(-\zeta\sqrt{1+r})$ and $\varphi_3 \equiv \varphi(\zeta\sqrt{1+r})$
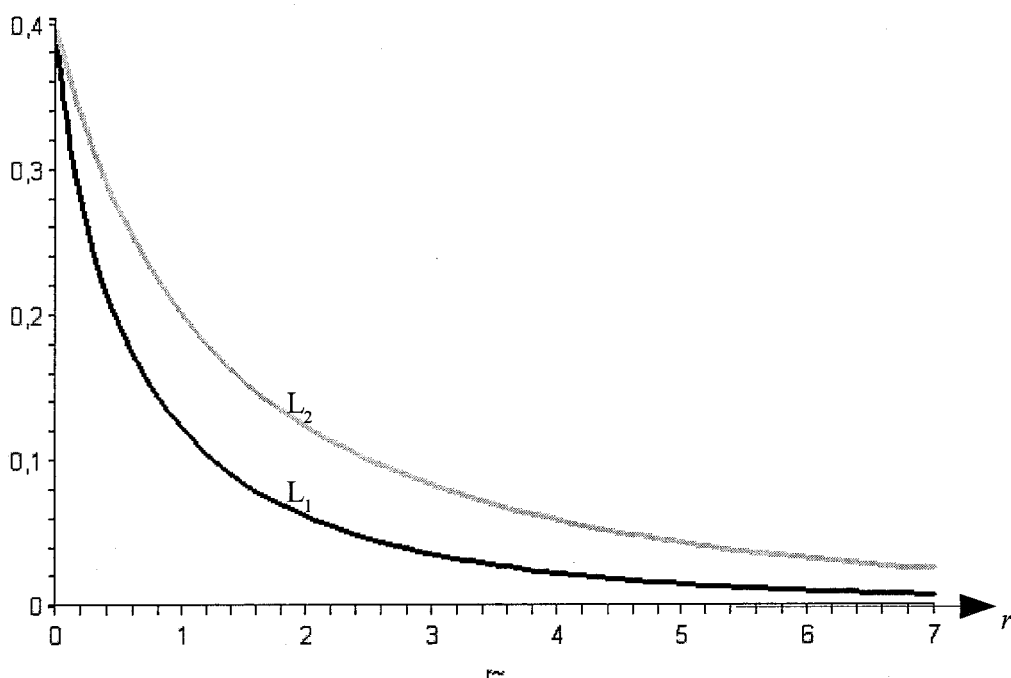
Figure 2.10: Expected losses L_1 and L_2 as functions of the signal precision, r ($\zeta = 0.5$)

However, before the signal is obtained, it is impossible to know which of the decisions will be taken and thus which of the two social loss functions will be incurred. Thus, in order to compute the expected value of the social loss function it is necessary to weight the above-presented losses L_1 and L_2 by the probabilities that they will be applied (*ex ante* probabilities of respective decisions). The total expected loss function is thus[90]:

$$L_t^E = 2\,\Phi_1 L_1^E + (1 - 2\,\Phi_1)\,L_2^E \tag{2.21}$$

As for any given values of parameters L_t is a weighted average of L_1 and L_2, which have been proved to be negative in expressions (2.18) and (2.20), L_t is also decreasing in r. However, the precise expression of a partial derivative of L_t with respect to r may seem complicated, because the weighting parameters (the probabilities of respective decisions) depend themselves on signal precision, r. Expression (2.22) below is negative for all plausible values of parameters and which is shown by figures 2.11 and 2.12 as well as its developed form presented in the appendix (expression A.7). Figure 2.11 demonstrates that for the plausible range of parameters[91] the total expected social loss function is decreasing in information precision, r (while not being monotonic with respect to the target width, ζ)

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[90] Recall that, because of the symmetry of the model, expected loss associated to an interest rate cut, L_1, is identical to expected loss of an interest rate hike, L_3. Moreover, their *ex ante* probabilities are equal ($P(a_1)=P(a_3)=\Phi_1$).

[91] Compare footnote 25.

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while figure 2.12 illustrates the fact that, indeed, the expression (2.22) is negative. On both figures z-value of the pale grey plain is zero (and does not intersect with either of the functions).

$$\frac{\partial L_t^E}{\partial r}=2\frac{\partial \Phi_1}{\partial r}L_1^E+2\Phi_1\frac{\partial L_1^E}{\partial r}-2\frac{\partial \Phi_1}{\partial r}L_2^E+(1-2\Phi_1)\frac{\partial L_2^E}{\partial r} \tag{22}$$
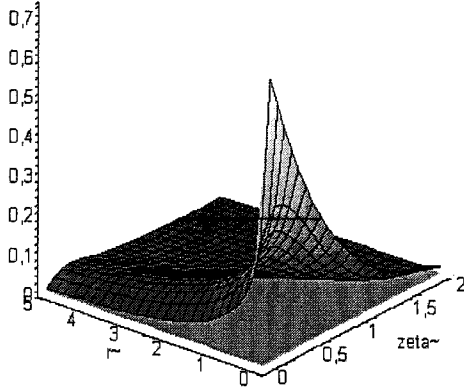
Figure2.11: Total expected social loss function
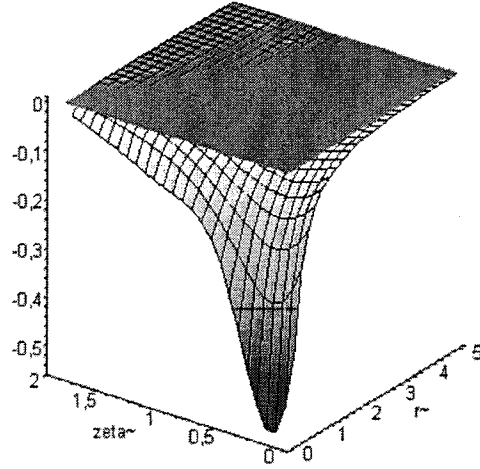
Figure 2.12: Partial derivative of social loss function with respect to signal precision, r

As one may also see on figure 2.11, for higher values of ζ (if the target range is too large), gains in precision of information do not lead to significant decreases of the social loss function. However, the social loss function is never increasing in effort of MPC members. All these means that if the implicit target is too large the incentives to get informed under costly information (precision) may be insufficient, which will be further developed in the following subsection[92].

2.2. Comparative statics

As the member's loss function, as proposed above in expression (1), is of the form $L_M = L_t + \alpha\,c(r)$, where $c(.)$ is a standard cost function (twice differentiable, increasing and convex) and α is the "degree of selfishness", or "information/effort aversion". As shown in the previous section, the expected social loss L_t^E is a decreasing function of the information precision (effort), r. This means, that for any given target range, ζ, there will exist an optimal level of information precision from the personal point of view of an MPC member. This is illustrated by figure 2.13.

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[92]The analogical case against an imprecise target is presented by Sibert (2005).

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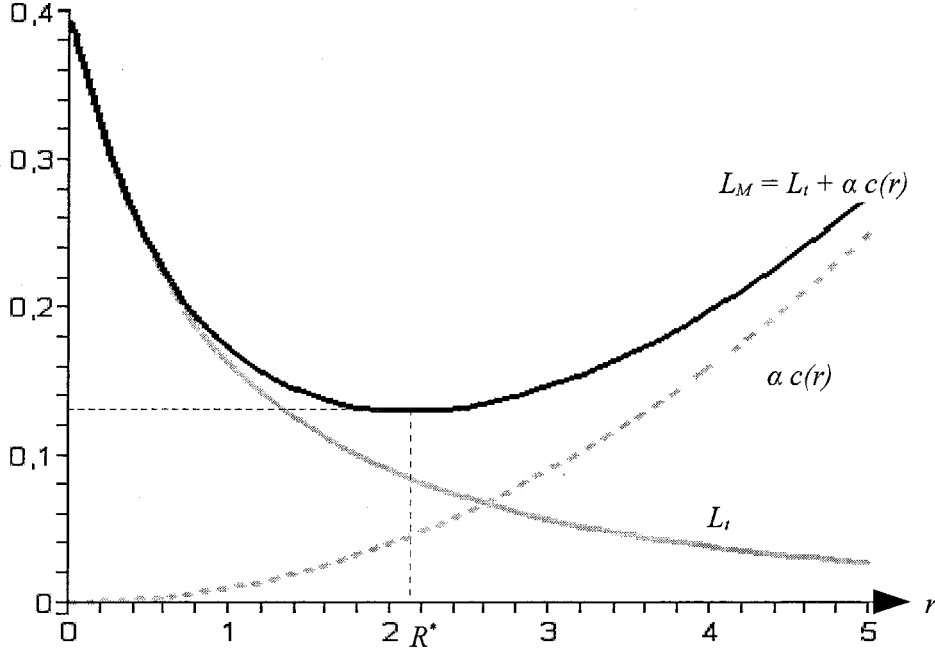
Figure 2.13: Optimal level of information precision ($\zeta = 0.5$, $c(r)=r^2$, $\alpha=0.01$)

The member's optimal effort R^* minimizing the loss satisfies

$$\frac{\partial L_M}{\partial r} = 0 \tag{2.23}$$

Proposition 2: *a higher "information aversion", α, leads to a lower effort from the MPC member*

Proof: Following standard comparative statics procedure, observe that

$$\frac{\partial^2 L_M}{\partial \alpha \partial r} = \frac{\partial^2 (L_t + \alpha c(r))}{\partial \alpha \partial r} = \frac{\partial c(r)}{\partial r} = c'(r) > 0 \tag{2.24}$$

As the MPC member *minimises* her personal loss function (combining social loss and her personal information acquisition cost), the positive sign of the mixed partial derivative means that the optimal level of information precision R^* will *decrease* if "information aversion", α, increases. This is illustrated by figure 14.
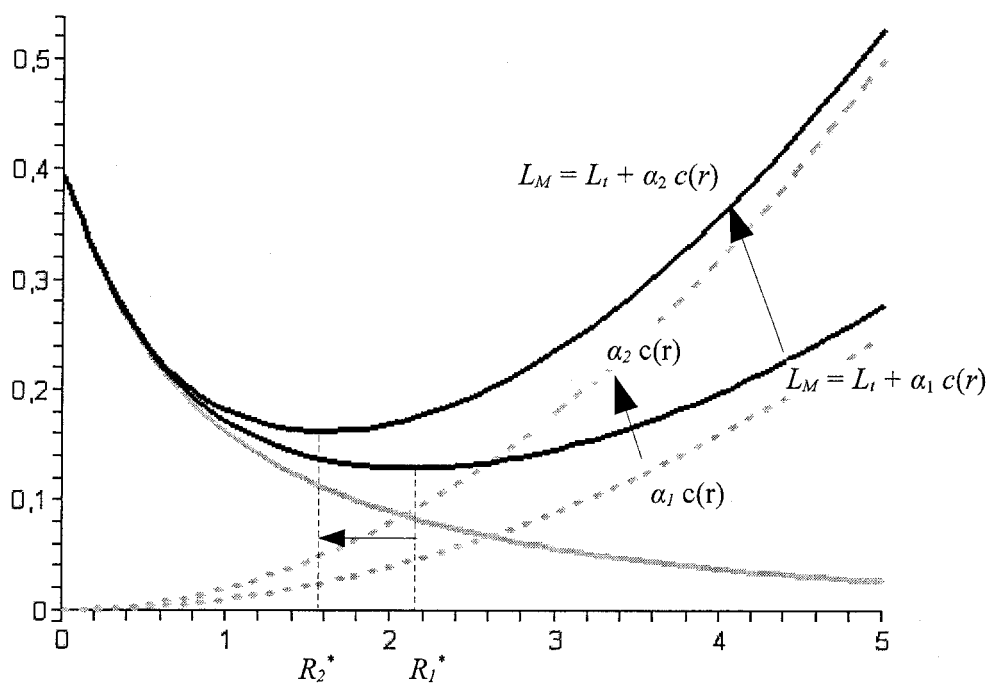
Figure 2.14: Reaction of the personal loss function and optimal effort on an increase in information aversion

This leads to the intuitive conclusion that if information acquisition is more costly to an individual MPC member, she will expend less effort, *ceteris paribus*. Consequently, she will vote for an interest rate change less frequently on average. Thus, MPCs where members are more "information adverse" will have a bigger "*status quo* bias". Empirically, this result could mean that MPCs with more economists and/or academics change interest rates more frequently than others. However, the most important point is that less "information averse" central bankers will become better informed and, consequently, will take better decisions. Thus, for a central bank which delegates the interest rates decisions in hands of the sole Governor, it seems important that he has an α as small as possible. A real-life example might be the Bank of Israel[93], which has been governed since may 2005 by Stanley Fischer, an outstanding American macroeconomist.

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[93]For a comparison of (inflation targeting) Central Banks' governance structures, including the Bank of Israel see Tuladhar (2005). However, the law determining its functioning (with a proposition of delegating monetary decisions to a committee is being discussed (see e.g. Fischer, 2006).

Proposition 3: *An optimal target width, ensuring the highest possible information precision, exists.*

Proof: First, observe that, in order to assess the impact of the target width, ζ, one needs to know the sign of the mixed partial derivative of the member's loss function with respect to r and ζ.

$$\frac{\partial^2 L_M}{\partial \zeta \partial r} = \frac{\partial^2 (L_t^E + \alpha c(r))}{\partial \zeta \partial r} = \frac{\partial^2 L_t^E}{\partial \zeta \partial r} + \frac{\alpha c(r)}{\partial \zeta \partial r} = \frac{\partial^2 L_t^E}{\partial \zeta \partial r} = \frac{\partial^2 L_t^E}{\partial r \partial \zeta} \tag{2.25}$$

In order to reckon this expression, it would be necessary to derive expression (2.22) with respect to ζ, which is somewhat complicated. Instead, a graphical representation will be shown (figure 2.15).
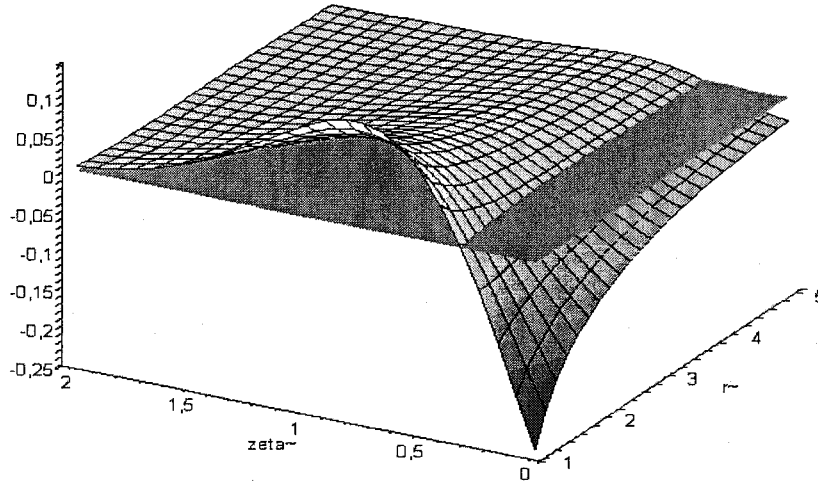
Figure 2.15 Second mixed derivative of the total expected social loss with respect to r and ζ

As on figures 11 and 12 the grey plain without grid signifies zero on figure 2.15. Clearly, it intersects the second mixed derivative $\frac{\partial^2 L_t^E}{\partial r \partial \zeta}$, which is negative for small target ranges, ζ, and positive for the larger ones. Interestingly, the solution of $\frac{\partial^2 L_t^E}{\partial r \partial \zeta} = 0$ with respect to ζ is relatively stable (reaction on changes in the effort, r, are minor, the solution for ζ is always somewhere between 0.4 and 0.5).

Comparative statics of the impact of changes in small and large target width for the optimal precision R^* are presented respectively on figures 2.16 and 2.17. The first one presents the effect of an increase in target range from $\zeta_1 = 0.01$ to $\zeta_2 = 0.35$ which results in an increase in the optimal level of information precision. The second shows that an

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increase in a (already large) target range: from $\zeta_3{=}0.7$ to $\zeta_4{=}1$ leads to a decrease in the optimal precision. The applied cost function is simply $c(r){=}r^2$ and the weighting parameter α (information aversion) is set to 0.01. Obviously, the applied values do not influence the interpretation of the analysis.
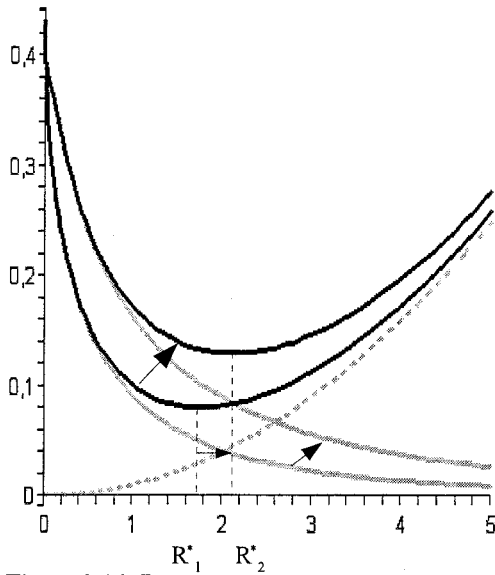
Figure 2.16: Reaction of the personal loss function and optimal effort on an increase in small target range, ζ.
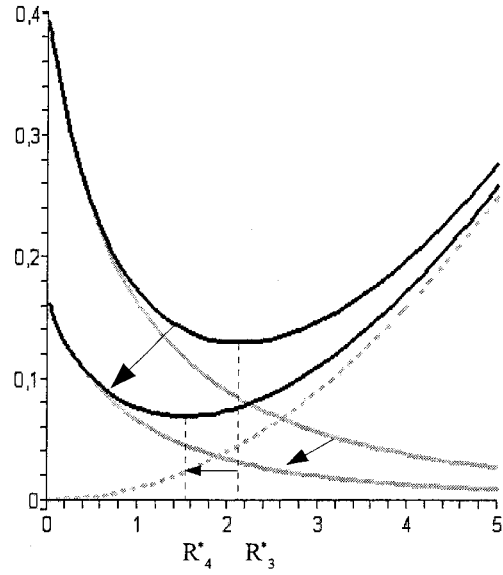
Figure 2.17: Reaction of the personal loss function and optimal effort on an increase in large target range, ζ.

It seems important to underline that the values of the different social loss functions for different R^* cannot be directly compared. In the opposite case, one could remark, that the value of the loss function for R^*_1 is smaller than the value of the corresponding loss function for R^*_2 and the value of the loss function corresponding to R^*_4 is smaller than the value of the respective loss for R^*_3 (one may compare only loss functions for a *given* ζ). It has been shown in section 2.1.3 that the society is better-off when the information precision of the decision maker increases (this is the meaning of the negative sign in expression (2.22)). However, the numerical value of any loss function does not have the precise meaning and thus, the ultimate goal of a potential mechanism designer is to provide incentives for the maximal information (precision) acquisition.

As may be seen on the figure 2.15, the value of target width for which these incentives are maximal are located somewhere between 0.4 and 0.5. Thus, an optimal width of the target range should be around half the standard deviation of the prior, which would lead to

approximately equal probabilities of each respective state of nature[94]. This result seem quite intuitive, at it means that the incentives for getting informed are the most pronounced when *ex ante* probabilities are equal.[95] This result, should be, however, treated with caution, as the model relies on some simplifying hypotheses. Moreover, it seems difficult to apply in practice, as it might be difficult to find such target ranges empirically and even more complicated to enshrine it into the legal basis for monetary policy.

3. The committee

This section will present the consequences for the collective monetary policy making which may be derived from individual decision-making model proposed in the first part of this chapter. The complications introduced by an increasing number of interacting committee members concern a number of fields.

First, it seems logical to suppose that the members may differ with respect to information acquisition costs (information aversion) which is not innocuous for the collective decision making. Moreover, one of the theoretical arguments for the delegation of monetary (or any other kind of) powers to committees is that such an organisation allows for sharing of knowledge ("two heads are better than one"). Second, another important question is how different people may interact during a committee meeting, *i.e.* to what extent and under which conditions they are able to pool different information sets they possess and thus increase the common committee information precision (compared to the individual one). Finally, the implications for collective decision making of the second important parameter of the model presented in section 1 - the target width - will be explored. Proposition 3 above proved that an optimal target width exists. This target width is, arguably, country-specific and thus of monetary integration between two countries of different implicit target ranges seem to be an important problem and will be analysed.

In order to approach these questions, recall the numerical example (subsection 1.2) considering that the two decision makers are no longer independent ones, but form a two-member MPC. In the example one member (endowed with information of poor quality) in

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[94]E.g. probabilities that the economy would require a decrease (increase) for these values are given by:
$\Phi(-0.5)\approx0.309, \Phi(-0.45)\approx0.326, \Phi(-0.4)\approx0.345$. See expression (8).

[95]This may be understood as follows: if the precision of information is nil, in the case of equal probabilities of two (three) events, the probability of error is equal to 0.5 (0.66). If there are some differences in probabilities, the "bet" on the most probable event leads necessarily to a smaller probability of error. In an extreme case, if one faces an almost certain event, it is rational to not get informed at all and "bet" for it in order to not incur any effort cost, as the probability of error rests marginal. Thus, the decision-maker is more inclined to get informed (and thus reduce the probability of error) if the probabilities are equal ex ante.

spite of having received an important signal in favour of an interest rates' hike, opted for the *status quo*, while the second one, who received a weaker (in absolute value) but much more precise signal preferred an interest rate cut. Supposing that they form a two member committee, the decision would be ambiguous. In this example, the outcome would depend on the decision rule and possible weighing scheme as well as on their understanding of each other's position.

This reinterpretation of the numerical example presented above shows the relevance of our model for a monetary policy committee. This impact will be studied in the following two subsections. The first one will treat of a committee of a country composed of two members differing with respect to their "information aversion" under different decision rules and hypothesis on interaction between the voters. The second subsection will present a simple analysis of a committee, whose members represent two different countries, possibly divergent with respective to their stabilization preferences. Nevertheless, as the focus of the present chapter is the information acquisition, the center of attention of the analysis will be the informational consequences - the precision of the posterior state of the economy, as perceived by the committee.

3.1. One Committee, Two (or more) Members

Remember once again the numerical example as exposed in the above introduction to this section. If the two members were to take a common position on the state of the economy (and subsequently an interest rate decision in line with this assessment), this would depend in the first place on the decision rule (along with possible weighting votes) and also on the type of interactions between members.

In the case of unanimity rule none of the propositions would win and thus, unless one of the members would be able to convince the other, no decision would be taken (*status quo* would be probably kept). However, let us suppose for now that the members meet and vote without a true sharing of information - hence the precision of any member does not influence the perception of the economy of the other one. This assumption will be alleviated below.

In the analysed case, a simple majority rule would also not yield any conclusive decision in the first place (similarly to the unanimity). Nevertheless, under a simple majority scheme, usually a tie-breaking mechanism is provided - the most often it is the chairman's vote

which prevails. It seems logical that the function of the chairman's would be given to the person with the best abilities (or equivalently, that the chairman would be provided with the best information). We might then, as an example, suppose that an interest cut would be decided.

Other feasible (intermediate) decision rules in case of disagreement were analysed e.g. by Sibert (2003) or Farvaque et al. (2007). Nevertheless, as previously seen in chapter 1, from the social point of view, the optimal decision rule (as proved by Ben-Yashar & Nitzan (1997) and Persico (2004)) would require weighting votes according to abilities or information precision. Thus, the member A should be endowed with a more important voting power and a socially optimal interest rate cut would be decided.

This numerical example, however, focusing on a single decision, makes the value of monitoring important for the outcome (a rise, cut or *status quo* as regards interest rates). Taking a longer-term vision (even if the time is not explicitly taken into consideration in this model) requires rather to focus on information precision, because, as we have shown in the previous section, a more precise information leads to a socially preferable outcome as well as to a more reactive policy.

In order to analyze the decisions taken by a heterogeneous committee given members' preferences and available information, two important details should be fixed: the decision rule and the possibility of reciprocal influence. First, the situation where the decision-makers do not communicate will be analysed. Second, a possibility of interactions and reciprocal understanding will be introduced.

No interaction

If the committee members have no possibility to interact, the respective assessments of the state of economy depend only on their private signal, and the decisions they vote for are the same they would choose individually. Thus, the only way of aggregating information is by voting. Nevertheless, the best informed members would have to struggle against the *status quo* bias of the less informed members (as shown above, less information leads to less frequent interest rate moves). In case of the unanimity rule, this *status quo* bias might be even more important, as proved e.g. by Gerlach-Kristen (2005), and would be aggravated as the number of members increases. Thus, under these assumptions, the delegation of the monetary powers to an extremely skilful individual seems to be a good way to prevent it. However, the practical problem relies on the finding these most skilful

potential decision-makers. The observed trends of the increasing part of academics in monetary policy committees (mentioned in the introduction and developed in the following chapter) as well as nominations of such experts as Stanley Fisher, Athanasios Orphanides or Ben Bernanke at central bank's heads seem to reflect in practice the findings of our model.

The situation is somewhat more complicated under a simple majority rule. Here, according to the median voter theorem, the alternative chosen by the committee would be the one supported by the median committee member (with respect to the individually perceived posterior state of economy, or, equivalently, with respect to the preferred decision). In other words, the interest rate would be cut if the perceived state of the economy of the median voter would be below the inaction zone. However, there is no specific reason to suppose that the median voter would be the best informed. Thus, even if majority voting in a committee may be a good cushion against individual whims (see Méon, 2006), it does not necessarily leads to the optimal outcome.

Theoretically, (as mentioned above) the optimal decision rule would weight the votes according to information precision, something that would be, nevertheless difficult to precisely know *ex ante*. Further, even if it would turn to be possible *ex post*, such a scheme might require different weighting at each policy meeting, which is naturally infeasible, as well as unacceptable seems a higher weighting of more skilled members (which will have, on average, a higher information precision). However, appointing a relatively larger *number* of members, which are supposed to be highly skilled, seems a sound second-best solution.

Here, an important question arises: would it not be better to employ a committee consisted of similar, as best as possibly skilled individuals? It seems that similar (identical) members would receive similar (identical) signals, or at least their personal signals would be highly correlated. And the same signal received twice is still just one signal. On the other hand, two *different* signals of the same value are the support that the underlying state of the economy is truly the one suggested by the two signals. These *different vs. identical* signals may be thought as of signals with uncorrelated vs. correlated errors. Thus, it seems that if information sharing is not possible, the best way of aggregating information would though be the nomination of highly skilled but heterogeneous (e.g. issued from different professional environments) MPC members.

Nevertheless, the monetary policy committees are established in order to allow for sharing information and different visions of the economy and thus the most important and realistic case is the one where the members may interact.

Interactions

This subsection will discuss the implications of the possibility of interactions among the committee members on their incentives to become (more) informed as well as its further consequences for the social welfare. These interactions lead to an information aggregation process, which may be more or less perfect.

Consider a case where members reveal their information and are perfectly understood by the others. If the members are allowed to share the independent[96] information they possess, the joint density function of their observations and the commonly known *prior* will become more precise and its mean will be an average of all the members' observations weighted by their respective precisions (which is a simple extension of the joint density functions of the prior and one signal presented in section 1 - equations 2.4 and 2.5). Thus, the more members the committee includes, the more individual precisions of personal signals are added and the smaller is the probability of error (and thus the value of the expected social loss function).

However, as shown above, the marginal decrease in the social loss function is decreasing in the precision of information, which implies the existence of an individually optimal precision level (effort), analysed above in section 2.2. This convexity of the loss function in effort, r (visible also in the figures 2.11-2.17), implies that the incentives for information acquisition for the $n+1^{th}$ member of the committee are smaller than for the nth one. This also means that in larger committees the individual efforts are probably smaller than in the bigger ones which does not necessarily mean that bigger committees are worse, which was presented and formalized by Sibert (2005, p. 99-101) under a quite similar setup. Nevertheless, it implies that beyond a certain critical committee size its results may worsen.

Consider the following formalization of the two-member case. A two-member committee (denote members 1 and 2) takes a monetary policy decision as described by the section 1 of the present chapter. Let the precision of information be perfectly additive (they can

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[96] If the information errors were correlated, the precision of the joint distribution would be smaller.

perfectly understand each other's signal) and let each of the members be equally skilled, which means that their effort cost functions are identical. Each of them cares about the social loss (which depends now on the sum of the two precisions) and only about her own cost of effort. This means that each of them solves the following optimization problem:

$$\frac{\partial L_M(r_1+r_2)}{\partial r_i}=0 \quad, i=1,2 \qquad (2.26),$$

which can be developed for the member 1 (for the member 2 the formula is analogical) as:

$$\frac{\partial L_t^E(r_1+r_2)}{\partial r_1}+\frac{\partial c(r_1)}{\partial r_1}=0 \qquad (2.27)$$

The fact that the members are supposed equally skilled necessarily leads to their equal effort in equilibrium. Thus, in fact *any* of the two members solves the following problem:

$$\frac{\partial L_t^E(2r_i)}{\partial r_i}+\frac{\partial c(r_i)}{\partial r_i}=0 \qquad (2.28)$$

This allows to understand that the collective decision-making, by allowing to pool the information (precision) leads to a decrease of the average *cost* of effort (per member) and thus leads to a higher common level of information precision than in the one-member case. However, this does not mean that in equilibrium the total shared information precision is twice as big as one member would expend (the effort per member would be certainly smaller than in case of one member)[97]. All these is illustrated by the figure 2.18 below (which should be compared with figure 2.13 adopting the same parameters for the one member case).
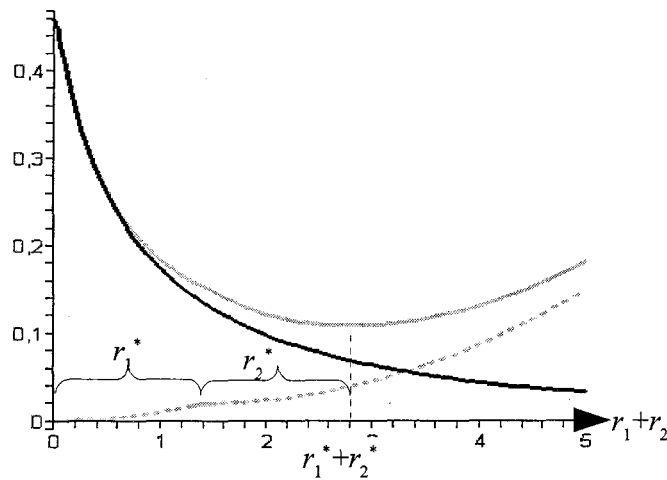
Figure 2.18: Equilibrium effort in a two-member committee

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[97]Which confirms the findings of Sibert (2005) and the empirical psychological evidence quoted therein.

Another important insight is implied by the alleviation of the hypothesis that the committee members can perfectly understand each other (as is assumed e.g. by Gerlach-Kristen, 2005). This would mean that the information aggregation would not be perfect and that the common precision of the observations of members 1 and 2 would be smaller than in the case presented on figure 2.18. Thus, the gains of creating a committee would be smaller and the optimal size of the committee would be reduced.

Next, assume that a committee is composed of two types of individuals, the highly skilled (whose information precision is on average greater) and less skilled ones. However, the correlation of errors is higher between two members belonging to the same category than between two different ones. Quite unsurprisingly, this will imply that at least in some cases, an optimal committee of a given size will be heterogeneous (composed of the two types of individuals). This simple reasoning indicates that a heterogeneous committee may be (jointly) endowed with more information than a homogeneous one.

This subsection presented some implications of collective decision making in monetary policy, under different assumptions about information structure and interactions between the committee members. Under more plausible assumptions (interacting is possible, information precision is not perfectly additive and correlation of errors depends on the type of the individual) it seems that committee is better than an individual, but the optimal committee would be of a limited size, and heterogeneous. Empirically, these could mean that heterogeneous committees will attain on average better results and/or will be more reactive, and that the performances will depend on the committee size and its members characteristics, hypotheses, which will be tested empirically in chapter 3. I turn now to implications for enlarging a monetary union of the unexplored until now parameter of the model presented in the previous sections, the target width, ζ.

3.2. One Committee in an Enlarging Monetary Union

In order to discuss the implications of the model presented above for a monetary union, let us assume that the monetary decisions are taken by a two-person committee, whose members are equally skilled, but have different (implicit) targets (which may reflect their countries' preferences).

This section focuses on the incentives for information acquisition for the two decision-makers that are implied by different possible configurations of the targets. It seems

important to underline that, in this model, a target should be understood relatively to the general economic volatility (which is not modeled, as the economy is supposed to follow a standard normal distribution)[98].

Consider country A - a big and stable economy (an existing monetary union) - and country B - a smaller and more volatile economy which considers entering to the monetary union. Assume that the implicit optimal target in the country A, ζ_A^*, is wider (which implies a smaller volatility of its interest rates) than in the country B, ζ_B^*, where interest rates are adjusted more often on average. The optimal target width for the monetary union will lie in-between these two targets (more precisely it will be a weighted average of the two)[99]. Thus the optimal target range for the enlarged union is $\zeta_U^* = (k\ \zeta_A^* + \zeta_B^*)/2$, $k>1$. This situation is illustrated by figure 19.
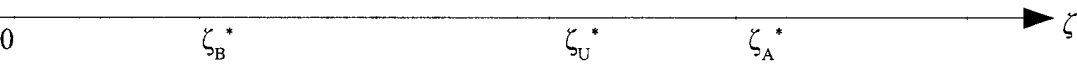
Figure 2.19: Optimal target widths in the countries A and B and after creating a monetary union

As stated above, the different possible configurations of the actual target and its optimal value in both countries will determine the consequences for the efficiency of monetary policy in each of the countries after the union will have been created. The underlying assumption is that the actual target widths are not the optimal ones for each country. Different possibilities will be presented graphically and commented below.

First, consider a situation where the actual target in the country A (ζ_A) is too large ($\zeta_A^*<\zeta_A$) while the actual target in the country B (ζ_B) is too small ($\zeta_B^*>\zeta_B$). Such a situation would mean that in country A the *status quo* area is too large: the interest rates are adjusted "too little, too late" (Gerlach-Kristen, 2005) and that the macroeconomic performance is also suboptimal (a too large target does not guarantee sufficient incentives for information acquisition and thus policy errors are more frequent than in the optimum - compare figure 17 and the corresponding comments above). On the other hand, the interest rates in the country B are too volatile (smaller target leads to more frequent interest rates adjustments) but the accuracy of these decisions is also suboptimal, which is illustrated by figure 16

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[98]Thus, if two countries have the same inflation target (say, 1-3 percent) and one of them used to be more volatile (its long-term inflation variance is greater), its implicit target as modeled here is smaller than in the more stable country.

[99]Weighing important parameters is commonly assumed in models of heterogeneous monetary unions - see e.g. Süppel and von Hagen (1994) or Berger (2002). Here, it means that, after creating the monetary union, interest rates will be adjusted more often in country A and less frequently in country B (compared to the situation before the monetary integration).

above. In such a situation, the enlargement of the monetary union would lead to an improvement in both countries, as the actual target (which also would be a weighted average of the actual targets in the two countries) would be move closer to the optimal width through averaging, no matter where precisely the actual union target would be situated relatively to the optimal one (on the left ζ_{U1} or on its right side ζ_{U2}). This is illustrated by figure 2.20. Here, one may think about a situation when an economy with relatively volatile rates (e.g. the Czech Republic) joins a monetary union accused of monetary policy inertia.
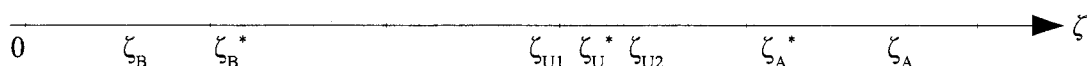
Figure 2.20:Illustration of a monetary union when the target width is overshoot in the big country and undershoot in the small one

Theoretically, an analogical situation would take place, if the target range in the union was too small compared to its optimal level (interest rates would be to volatile) while the target range in the accession country would be too large (the MPC of the country would accept too much volatility and consequently the interest rates would not be adjusted frequently enough). Similarly to the case exposed above, averaging the targets would move the actual widths towards an optimal value. On average the decisions would be more accurate in the union as well as in the accession country, while the (over)reactivity in the union would be reduces and (under)reactivity of the accession country would also be improved (increased). This second situation probably has not, however, any real-life example.

Next, consider a case, when the actual target width is overshoot in the union ($\zeta_A^* < \zeta_A$) as well as in the small one ($\zeta_B^* < \zeta_B$). This means that the monetary policies are not reactive enough in both countries. The most probable effect of their monetary integration would be a still inertial monetary union. For example, as such a situation reflects an accession to the monetary union of a small country whose interest rates were closely related to the rates prevailing in the big one (e.g. Malta or Estonia integrating the euro area). Thus, an enlarged union would still have a too wide target and consequently the incentives for information acquisition would remain lower than in the optimum. The *status quo* bias would then prevail and the social loss would not be minimized. None of the countries would significantly gain from this integration with respect to the efficiency of monetary policy making.

A symmetrical and fully analogous situation would exist if both countries (the union and the accession country) had too small targets and too high volatility of interest rates. The enlargement of the union would not yield any significant improvement of their monetary policy as the averaging of the target widths would not affect significantly the information acquisition incentives for any of the decision-makers. Thus, the interest rates in the enlarged monetary union would remain excessively volatile.

$$\xrightarrow{} \zeta$$
$$0 \qquad \zeta_B^* \quad \zeta_B \qquad\qquad \zeta_U^* \; \zeta_U \qquad \zeta_A^* \quad \zeta_A$$
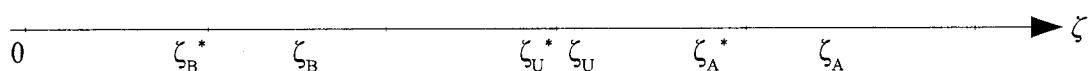
Figure 2.21: Illustration of a monetary union when the target width is overshoot both countries

In general, from the decision-making point of view as modeled in the present chapter, monetary integration improves the situation of both countries if their pre-integration target widths are different, i.e. if one of the countries has a suboptimally large target and the other's is too small. In the case if both actual targets are too small (the volatility of interest rates in both countries is excessive) or too large (both countries are have inertial MPCs), the monetary integration does not yield any significant improvements. It should be noted, however, that these recommendations stem from a purely decisional analysis with no pretense to a profound macroeconomic assessment.

CONCLUSIONS

The presented model aimed at an analysis of decisional aspects of monetary policy making. The obtained results may be summarized as follows. First, the precision (quality) of information plays a crucial role, namely, the better is the information at disposition of decision-makers, the better are the policy decisions (smaller social loss). Moreover, if the decision-maker is better informed, she will take the decisions more frequently, *ceteris paribus*. As Blinder (1997) "used to say that there are two basic ways to obtain quantitative information about the economy: you can study econometric evidence, or you can ask your uncle." Small effort (meaning small information precision), is thus "asking the uncle" and higher effort - "studying econometric evidence".

In order to ensure that the monetary policy makers will be endowed with better information, at least two conditions should be fulfilled. First, they should be the specialists within the field. The expertise makes the information (precision) acquisition less costly from their personal point of view and thus leads to a better information quality in the

equilibrium. Second, an appropriate definition of the target may provide better incentives for getting informed.

Finally, the model allows for some important insights for collective monetary policy making. Namely, the collective decision-making, by decreasing the individual average cost of effort, allows for the committee to be better informed that any individual decision-maker. However, under some plausible assumptions an optimal committee should be restrained and heterogeneous.

Turning to the possible model extensions, it seems that the most attainable way to develop it is to consider some different than standard normal distribution functions of the state of economy and, in the first place, to allow the variance of the prior to be different than 1. Another extension would be to consider an economy under disinflation, where inflation is more often above the target than below it or, equivalently a country whose MPC presented a non-neutral balance of risks or bias (one of the future movements is more probable than the other). These would mean that the mean of the prior distribution is different from zero.

It is also important to underline that the present model, focusing on decisional aspects of monetary policy making, is placed on a higher abstraction level than e.g. the underlying economic structure (interdependencies between economic variables such as inflation, unemployment, economic growth etc.) and thus, this structure has only indirect impact on the analysis and results presented above. Thus, introducing such interdependencies into the model would be a possible extension. Moreover this is a one-shot game in the sense that the state of the economy in period t does not depend on its value nor on the decision taken in t-1. Again, enshrining a more pronounced time dimension into the model would certainly make it richer.

The presented model is symmetric with respect to distribution of probabilities as well as preferences of central bankers. However, asymmetries of preferences in monetary policy making cannot be excluded (see e.g. Cukierman and Muscatelli, 2002), nevertheless, in the case of the present model their inclusion would lead to some important mathematical complications. Allowing for some skew of preferences (more aversion to interest rate hike than cut) seem, however, an interesting and possible model extension.

All in all, it seems that the model presented in this chapter contributes significantly to the existing literature, but also nourishes future research.

Appendix to chapter 2

Properties used in integration of functions in the model:

$$\int xe^{\frac{-x^2}{2}}\,dx = -xe^{\frac{-x^2}{2}} + C \qquad \text{(A1)}$$

$$\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{z} e^{\frac{-x^2}{2}}\,dx \equiv \Phi(z) \text{ , but } e^{\frac{-x^2}{2}} \text{ is a continuous function on } \mathbb{R} \text{ and thus it is integrable: there is a primitive function:}$$

$$\exists \Phi : \mathbb{R} \to \mathbb{R} \quad \text{so that } \Phi'(x) = \frac{1}{\sqrt{2\pi}}e^{\frac{-x^2}{2}} \text{ . So,}$$

$$\int_{a}^{b} \frac{1}{\sqrt{2\pi}}e^{\frac{-x^2}{2}}\,dx = [\Phi(x)]_{a}^{b} = \Phi(b) - \Phi(a) \qquad \text{(A2) and}$$

$$\int_{-\infty}^{b} \frac{1}{\sqrt{2\pi}}e^{\frac{-x^2}{2}}\,dx = [\Phi(x)]_{-\infty}^{b} = \Phi(b) - \lim_{x \to -\infty}\Phi(x) = \Phi(b) \qquad \text{(A3) , because } \lim_{x \to -\infty}\Phi(x) = 0$$

Basic properties used in derivation of functions in the model: $\Phi'(x) = \varphi(x)$ and $\Phi'(f(x)) = \varphi(f(x)) * f'(x)$ (A4)

$$\varphi'(x) = -x\varphi(x) \quad \text{and} \quad \varphi'(f(x)) = -f(x) * \varphi(f(x)) * f'(x) \qquad \text{(A5)}$$

$$\lim_{r \to \infty} m_1^e = \frac{-\phi(\zeta)}{(1 - \Phi(\zeta))} \qquad \text{(A6)}$$

The development of the expression (2.22) yields:

$$\frac{-m_1^E(\Phi_2 - 1)\left(\Phi_1\sqrt{r(1+r)}\left(m_1^E\zeta r + \zeta^2 r + \zeta^2 + r\right) + \varphi_1\zeta r(1+r) + \varphi_1\zeta(1+r)^{\frac{3}{2}}(\varphi_2 - 2\varphi_3) + (1+r)r^2(\varphi_3(2\Phi_1 - 1) - \Phi_1\varphi_2) - \Phi_2\varphi_1\zeta^2(1+r)r^2 + \varphi_1\zeta^2(1+r)^2(1+2\Phi_3)\right)}{\sqrt{r^3}\sqrt{1+r^5}} \qquad \text{(A7)}$$

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Chapter 3:

Central Banks' Performances and Reactivity:
Empirical Evidence and Lessons for the ECB

Introduction

This chapter aims at presenting empirical support of pervious chapter's findings as well as confronting other hypotheses offered by literature surveyed in chapter 1. This empirical exercise will serve also as the background for the assessment of the current and future decision-making scheme in the ECB, which will be the main focus of the analysis in chapter 4.

The preceding chapter offers two points for assessment of central banks policy: the first is the social loss or accuracy of decisions (which are both difficult to evaluate directly) and the second one is the frequency of *non-status-quo* decisions or interest rate volatility. In order to assess the major central banks in this light, this chapter presents their monetary policy committees in their most important (and often neglected) details: the decision makers. This presentation, indicating major trends in central bank's governance will be the substance of the first section.

Then, the two above-mentioned axis of MPC outcomes will be investigated, i.e. the inflation performance and reactivity. The macroeconomic performance will be assessed with respect to the main goal of monetary policy – price stability. Nevertheless, as the evaluation of MPCs will be based on individual members' profiles, which is quite common in corporate governance literature and not so much in macroeconomics (the recent notable exception being Göhlman and Vaubel, 2007), some relevant studies in the field will be revoked first. Further, an original assessment of MPC reactivity in panel data analysis will be presented. The reactivity will be measured in several ways: as number of interest rate moves by each MPC (on quarterly basis), as main interest rate "moving variance" and also as a "squared difference rule", which mimics a general Taylor rule but neglects the direction of an interest rate move in order to focus on "pure" reactivity.

Finally, special characteristics of monetary governance in selected new EU member countries will be presented and recommendations for them will be given on a basis of previous econometric exercise. Moreover, this will offer some advice for a decision-making scheme within the ECB after the enlargement of the euro area.

1. The dataset

The dataset covers the nine most important central banks (as in Eijfinger and Geraats, 2003): the European Central Bank (ECB), the Reserve Bank of Australia (RBA), the Bank of Canada (BC), the Bank of Japan (BJ), the Reserve Bank of New Zealand (RBNZ), the Swedish Riksbank (SR), the Swiss National Bank (SNB), the Bank of England (BE) and the Federal Reserve System of the USA (Fed). The sample is subsequently enlarged to four central banks of the new member countries of the European Union: the Czech National Bank (CNB), the Bank of Estonia (Eesti Pank – EP), the Bank of Malta (BM) and the National Bank of Poland (NBP). Out of these four, two (Estonia and Malta) participate already in the Exchange Rate Mechanism II (ERM II).

This sample covers major OECD countries: all G7 countries plus other countries of the euro area, New Zealand[102], as well as Swiss and Sweden, which both follow inflation targeting regimes in monetary policy.[103] Two of the selected accession countries are also members of the OECD. Nevertheless, in the rest of the chapter while comparing "OECD" and "enlargement" countries, Poland and Czech Republic are included in the latter subsample and not in the former one. The time span contains quarterly observations from 1999Q1 to 2006Q3. This time span is limited by the activity of the European Central Bank and data availability - e.g. BE publishes its annual reports on its website since 2000 (including financial report for 1999), BJ and SNB since 1999 only. However, this time span also ensures consistency and comparability. Moreover, as one may see on Figure 1 in the general introduction, in most countries and notably the Euro zone and the United States this period covers one full "interest rate cycle". Namely, interest rates moved generally upward approximately during the first two years (until the end of 2000) and then a remarkable tendency to cut them emerged and was reinforced by terrorist attacks in September 2001 and the general subsequent economic slowdown. Finally, after a relative

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[102] Which is interesting because of its unique decision-making system in the field of monetary policy. See Walsh (2005b).

[103] For an overview of inflation targeting regime see Bernanke et al. (1999). More specific aspects of this strategy under uncertainty (having and important impact on monetary policy making, as proved in chapter 2) see e.g. Bhattacharjee and Holly (2005), Orphanides and Williams (2006) or Svensson (2000). For a link between inflation targeting and governance structures see Tuladhar (2005).

stability in 2003 and 2004, an equally marked upward movement is easily perceivable. This last tendency moved interest rates in most countries to a level equal or comparable with the one in the beginning of the period.[104]

In order to assess the impact of central banks' elites on their outcomes, a databank including the CVs of MPCs' members, containing 188 entries was constituted, out of which 150 come from OECD countries and 38 from new EU member states. Most of the data have been retrieved from the websites and especially annual reports of the analyzed central banks. Nevertheless, some details of certain biographies come from other sources: *Who's who* website, *Central bankers in the news* (www.centralbanking.co.uk), *Forbes*, *Quid* and finally directly from press or personnel services of central banks.

First, the constituted database allows for taking into consideration some external factors (cf. chapter 1) such as: the number of members and measures of MPC dynamics (number of changes and turnover – i.e. the number of changes related to the size of the MPC). Nevertheless, it is focused on internal characteristics of MPCs. The features retained for the analysis, which may influence the preferences are suggested by the existing literature, surveyed in chapter 1. They include demographic characteristics (age and gender) as well as social ones: professional profile and educational background.

1.1. MPC size and dynamics in OECD countries

As the literature presented in chapter 1 clearly suggested, an important theoretical as well as empirical problem is the verification of the Condorcet theorem, i.e. if an increase in the number of members of a committee leads to better decisions. Thus, the committee size is a variable retained for the present analysis. However, one of the distinctive features of the database is to take into account the real number of appointed policy makers and not the statutory number of MPC members. For example, if the FOMC has normally twelve voting members, during the most part of 2005 two board positions were vacant. Here, we consider the number of members to be 10 and not 12 during that period.[105] This choice influences the further analysis (and especially the shares of different categories presented below) as the total number of members in the sample varied between 73, when all positions were filled (during 2003-2004) and 69 in the last observed quarter: 2006:Q3.

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[104] Creel and Fayolle (2002) justify their, much shorter, analysis period in a similar way. It seems, however, that in their case it was only "half a cycle".
[105] However, as the frequency adopted for the whole analysis is quarterly, it was decided to not to pay attention to members present and absent during any particular MPC meeting.

The second interesting external characteristic linked to the number of members is the turnover of MPC members. This feature seems to influence the work of any committee, but the research taking it into consideration was lead mainly in corporate governance field.[106] In the case of MPCs, turnover might be even more important for a number of reasons. On the one hand, the turnover is linked to the tenure of MPC members which is used as one of the factors influencing central bank independence, but this interaction has already been largely investigated.[107] Similarly, an excessive turnover might endanger the MPC credibility, which is probably equally important. On the other hand, on the grounds of agency theory (in corporate governance[108]) a risk of turnover may be an incentive to work harder, which in the case of the present dissertation (and more precisely chapter 2) would mean an additional effort in information acquisition, leading to better outcomes.

Within the whole sample there are two central banks where monetary policy is lead by a single decision-maker: these are the New Zealand Reserve Bank and the Bank of Malta (which is, however, taken into account only in the last part of this chapter, devoted to enlargement countries). The largest MPCs are in the ECB (18 members since 2001) and the FOMC (12 members). In most countries the number of members is absolutely stable, though, in some countries like the USA, Great Britain or Australia, some seats remained unfilled during sizeable periods.

In most of the analysed countries the replacement of MPC members is quite smooth because usually, conform to theoretical considerations[109], terms of office overlap and each year there are a few changes, which do not affect the overall composition of the committee. However, in countries with a single decision maker, one change signifies the "total turnover" of the committee. Moreover, in the FOMC, due to the rotation scheme considering Federal Reserve Banks' Presidents, each year in January at least 4 voting members change. In order to assess the impact of these MPC dynamics two variables are proposed: the number of changes and turnover. A replacement was counted as one change whereas a resignation without replacement or a nomination for an unfilled position were counted as "half a change"[110]. However, as the sizes of MPCs differ, to take account of the

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[106] See e.g. Coughlan and Schmidt (1985), Gispert (1998), Kang and Shivdasanil (1995), Weisbach (1988). Mechanisms making board's turnover difficult lower its market value – see Bebchuk et al. (2002) and Bebchuk and Cohen (2005).

[107] See e.g. the Cukierman's (1992) reference book or a survey of more recent research: Berger, de Haan and Eijfinger (2001).

[108] See e.g the seminal Fama and Jensen (1976) paper.

[109] See e.g. Cothren (1998) or Waller (1992 and 2000).

[110] Thus, e.g. the joining of the President of Bank of Greece to the Governing Council of the ECB in 2001 (related to the enlargement of the euro area) was counted as „half a change".

relative impact of the change on the committee size, the variable turnover is defined as the number of changes related to the effective number of members of the committee.

As the total number of MPC positions in analysed OECD countries equals 73 and the number of decision-makers who served during the analysed time span is 150, the average turnover in the sample slightly exceeds 1 for the whole period. This means that on average in all analysed MPCs each member was replaced once which offers additional argument in favour of the adopted time span.

1.2 MPCs' demography

The macroeconomic link between inflation and the age structure of the society can be derived from life-cycle saving behavior and implies that older nations (where more citizens are net savers) tend to have smaller inflation rates (Lindh and Malmberg, 1998 and 2000). As the MPC members are agents of the whole society and additionally, their behavior with regard to interest rate setting may also reflect their personal interests, the age structure of central banks' elites may influence their degree of conservatism. An other sociologically interesting demographic feature – gender – also potentially have an impact on MPC members' preferences: Chappell and McGregor (2000) remark that the preferences of the female members of the FOMC were among the most dovish.[111]

Among the 150 decision makers who were in charge of monetary policy in the 9 surveyed OECD central banks there were only 18 women (12 %). However, in the analyzed period their number increased from 7 (out of 70) in 1999:Q1 to 12 (out of 68) in 2006:Q3. The most feminized MPC was in Sweden where since 2003 the council is consisted in 50% of women. During some periods in the UK female members accounted for one third of the committee size (3 out of 9 committee members). On the other hand, in Switzerland as well as in the New Zealand there were no female members during the analyzed period, while in the ECB, the RBA, Bank of Canada as well as in the Bank of Japan one of the MPC members was female (not necessarily the same during the whole period, as usually female members are replaced by other female members[112]).

Considering age[113] the "average year of birth" of the surveyed central bankers was 1946. However, the average age varied only slightly for the whole sample (between 56.3 and

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[111] See also discussion in chapter 1 of the present dissertations.

[112] E.g. in the Board of the ECB Gertrude Tumpel-Gugerell replaced Sirkka Hamalainen in May 2003 and in Japan Miyako Suda replaced Eiko Shinotsuka in 2001.

[113] It was possible to find the years of birth of 148 out of 150 surveyed MPC members in OECD countries. It was due to the Bank's of Canada privacy policy, whose press service did not provide years of birth for two

58.6) during the analyzed time span, marginally decreasing from 57.1 in 1999:Q1 to 56.9 in 2006:Q3. These two evolutions are illustrated by figure 3.1.

Moreover, the frequency of years of birth of the 148 governors roughly followed normal distribution, which is illustrated by 3.2 below. Nevertheless, it seems important to remark that there were important differences between countries, with the oldest on average MPCs in Japan, United States and ECB and the youngest in and Sweden.

Figure 3.1. Demographic features of MPC members over time
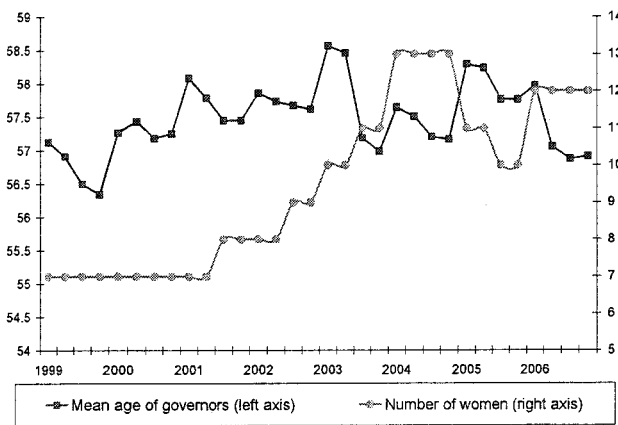
Source: author

Figure 3.2. Distribution of MPC members' age[114]
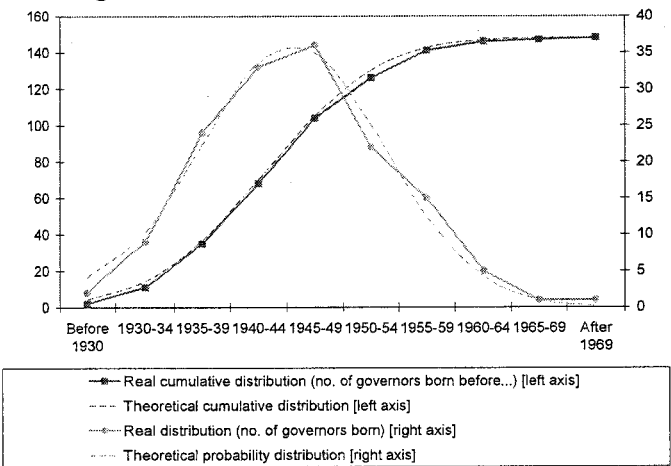
Source: author

Canadian governors. Hence, we assigned them the mean year of birth of all Canadian governors in our sample, an innocuous choice. The same problem in the "enlargement" subsample concerned a female member of the Polish Monetary Policy Council.

[114] Theoretical distributions were plotted using mean and variance computed from the sample: theoretical values follow N (1947, 82).

1.3. MPCs' social characteristics

Following Roland and Vaubel (2007) it is supposed that socialization processes undergone throughout the professional career of an MPC member influences the monetary policy. In order to assess this impact, the dominant type of professional experience[115] was classified into five categories: public economy meaning that the MPC member worked for the government (e.g. as the finance minister, treasurer or, very rarely, for a state-owned enterprise); private economy – if the MPC member worked mainly in the private sector; academic economy – assigned if the member followed an academic career; central banker – if the main part of the professional life the member spent within the central bank and, finally, other (mainly professional politicians, but also a few jurists and journalists). The structure of these categories assigned to the 150 surveyed MPC members is presented on figure 3.3 below.

Figure 3.3. Structure of MPC members' professional affiliations
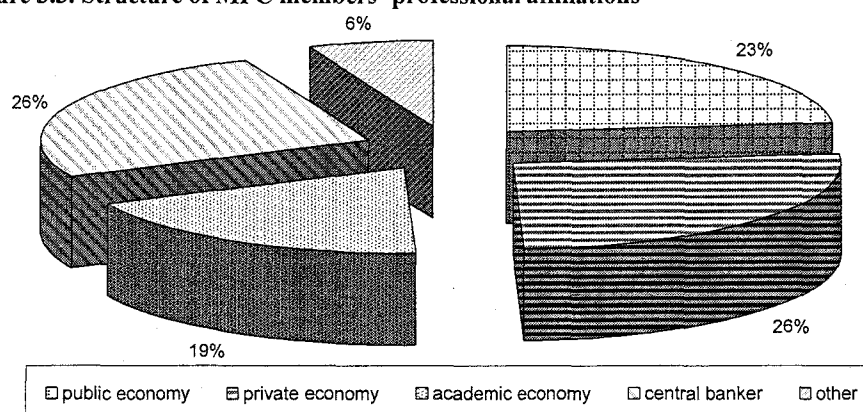
Source: author

This structure, however, is far from being stable even in the relatively short (31 quarters) time span of the present analysis. The part of public economists was very stable and varied between 24 and 26.5%. Remarkably, the part of academics increased[116] from about 16% in the beginning of the period (11 out of 70) to slightly more than 20% (14 out of 68), which happened mainly in expense of central bankers, whose share decreased from 30% in 1999 to slightly more than 25% in 2006. The participation of private economists in the beginning and in the end of the analysed period was very comparable (ca. 20%). Their

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[115] As in the further analysis the focus of attention will be given to heterogeneity of committees, it seemed inappropriate to allow for different types of career for individual members. I decided to consider the dominant and not the last type of occupation because the last job was in some cases very short-lasting and the socialization would be limited. This choice, however, required some arbitrary decisions when a member worked during similar periods in e.g. academia and government (in that case the last experience was chosen).
[116] This tendency was also remarked by Cohen (2005) and mentioned in the general introduction of the present dissertation.

share knew, however, a significant increase (up to 30% in 2005). The share of members classified as "others" was very restrained (3-6%) during the whole period. These evolutions are presented in figure 3.4.

Figure 3.4. Shares of different professional categories over time
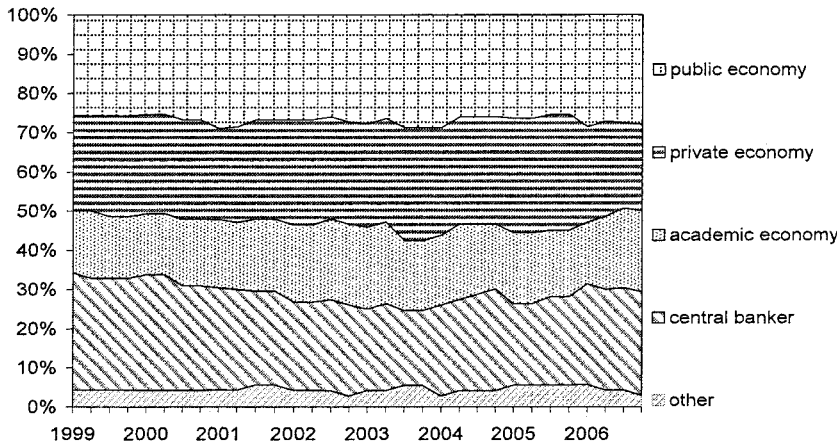
However, these proportions differ significantly between countries. Some of them have the obligation to include active professionals to their MPCs (e.g. Australia), some others interpret the general clause (present in virtually all central bank acts and statutes) that the MPC members must be recognized specialists as the quasi-obligation to appoint mainly professors of macroeconomics and finance (e.g. Poland).

Thus, the Governing Council of the ECB is dominated by "public economists" (their number varied between 10 and 13 on the total 17-18 members), in Australia "private economists" constitute systematically half of the Reserve Bank Board members (4 or 5 out of 9) while the Bank of Canada is governed mainly by "central bankers". Some others significantly evolved over the analysed period: in the beginning of the analysed period the British MPC was constituted mainly of central bankers (4) and academics (3), while in 2006:Q3 it was composed in equal numbers (2) of academics, central bankers and public economists, all these being completed by a private economist. Such heterogeneity is also a characteristic feature of the Swedish MPC.

The second social feature retained for the analysis is education. Its effects may be at least twofold. First, tertiary education is an imminent factor shaping the general outlook of

people and thus also their preferences[117]. Moreover, the highest education attainment may serve also as a proxy for the "information aversion" as defined in chapter 2.

Similarly to the professional background, educational attainments were dispatched into five categories: Bachelor (including LLBs), Master (both of science and arts), MBA, PhD and, finally Professors. A few comments on this categorization are important. First, it was decided to distinguish MBA as a separate category, even if it turns to be the smallest one, because such a specifically entrepreneurial formation may matter in shaping policy preferences. Second, even if professorship is not a diploma, this professional title proves an important capacity to analyse information and transmit knowledge to different kinds of public, which is important in monetary policy because of the need to precisely assess the true state of the economy and optimal level of interest rates as well as explain the decisions taken to the general public. The latter will increase the accountability of the monetary policy and thus increase its effectiveness.[118]

Among the 150 monetary policy makers approximately equal proportions (approaching 30%) of professors, doctors and masters (if MBA were also included in this category) were observed, all these completed by a significantly smaller participation of bachelors (25 - about 17%). Nevertheless, the important observed evolution during the analysed period relied on the constantly growing part of professors – mainly at the cost of PhD holders. Also, the participation of bachelors markedly decreased in the end of the analysed period (from 12 out of 70 in the 2005:Q4 to 8 out of 68 in 2006:Q3)[119]. This tendency is likely to persist, as the bachelors in MPCs are significantly older than other members and thus will probably retire sooner than others (mean age of all the registered in the database members the "average year of birth" is 1947 and 1940 for all the bachelors while for the members serving in 2006:Q3 these years are, respectively 1950 and 1944). Moreover, the general and already mentioned trend in monetary policy making is to rely more and more on academics. These evolutions are illustrated by figure 3.5 below.

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[117] Havrilesky and Gildea (1991) or Göhlman and Vaubel (2007) tested similar hypotheses and showed their relevance.
[118] See e.g. Briault, Haldane and King (1996).
[119] Moreover, five of the bachelors serving in 2006 were at the BJ, two in RBA and one in the British MPC. Another interesting and intuitive remark is that the majority of bachelors (14 out of 25) represented the private sector and thus were rather expected to bring into MPC meetings the private and not necessarily scientific point of view.

Figure 3.5 Shares of different education levels
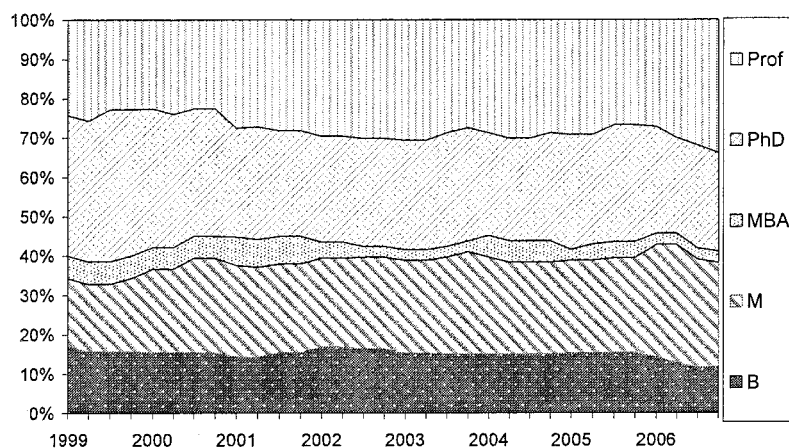
Source: author

Heterogeneity

Heterogeneity of MPC members may have an important influence on monetary policy making by a committee for a few reasons. First, in a very homogeneous committee a danger of groupthink is more likely to emerge, meaning that if all members of a committee are similar, they may also err in a similar way and reach an erroneous consensus.[120] Second, heterogeneous agents are more likely to provide a larger scope of information, which is, as shown in chapter 1, crucial for an effective monetary policy making. Thus, it seems that the heterogeneity of committee members might be to a certain extent substitutive to the size of a committee (three identical individuals have probably smaller cumulated knowledge than three heterogeneous ones). However, excessive homogeneity might endanger communication smoothness within an MPC and could possibly result in an excessive *status quo* bias or excessive volatility.

Heterogeneity of MPCs will be assessed on the basis of the shares of different social and demographic categories. A homogeneity indicator (the Herfindahl index) is computed for the three categories (education, profession and gender). The Herfindahl index of homogeneity is a sum of squared shares of each subset in the group. It is equal to one in case of perfect homogeneity (all members of the subset belong to the same group). That is, the more heterogeneous the MPC, the lower the value of the index.[121] An overall heterogeneity index, as a simple average of the three have been also computed.

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[120] Probably the most commonly cited example of group think is the Bay of Pigs Invasion in 1961 (the counselors of the American President was very homogeneous and thus had very similar visions of the world which lead to the erroneous decision to invade Cuba). See Janis (1983), especially chapter I, p. 14 and the following therein.

[121] As educational attainments (B, M, MBA, PhD, Prof.) as well as career backgrounds (academic, private or

The analysed countries substantially differ with respect to their MPC heterogeneity as well as its trends observed within the analysis' time span. Obviously, in countries where a single policy maker exists (in the OECD subsample this is New Zealand), all heterogeneity indicators are, by definition, equal to 1. Among the remaining countries the most heterogeneous is the Swedish MPC, where since 2003 among six members the gender parity is held and with respect to educational and professional categories a 1-1-2-2 pattern is usually followed[122]. The overall heterogeneity scores of the ECB are in the middle of the sample and were rather stable during the whole period (decreasing only marginally from 0.53 in 1999Q1 to 0.52 in 2006:Q3). However, it scores among the most heterogeneous with respect to education and is rather homogeneous (dominated by public economists) with respect to decision-makers' professional careers. The evolutions of all computed heterogeneity indicators[123], country by country[124] can be seen in figure 3.6.

The average for all OECD countries of the overall heterogeneity indicator decreased marginally from 0.57 in 1999:Q1 to 0.54 in 2006:Q3. It increased, however, only in two MPCs: Japan (from 0.49 to 0.54) and in Canada (from 0.52 to 0.54). Somewhat more interesting are the evolutions of the three elements which are put together to form the overall indicator. While on average MPC are more and more heterogeneous with respect to professions, the average MPC becomes slightly more homogeneous with respect to the educational background of its members. Finally, as might be expected, because of the increasing share of female MPC members, the trend in gender heterogeneity is increasing.

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public economy, central banker or other) are categorised in five subsets, heterogeneity indices for these features (PRO_HOM and EDU_HOM) may range from 0.2 to 1. Index of gender heterogeneity may take values between 0.5 and 1. Recall that a higher value of index means lower heterogeneity.

[122] E.g. in 2003:Q1 among the 6 members there were 3 women, which means that the gender heterogeneity indicator is equal to ½ - the minimal possible value. With respect to professional career there were 2 private economists, 1 public economist, 1 central banker, 1 academic economist and one "other", which makes the heterogeneity indicator equal to 0.22 (very close to the minimal value of 0.2). With respect to education there were 1 MA, 1 MBA, 2 PhD holders and one Professor, which makes the homogeneity indicator 0.28.

[123] The lower right panel of the figure 3.6 omits Switzerland, because Swiss MPC was composed of men only, which signifies that the Herfindahl index would stand at 1 during the whole period.

[124] Homogeneity, in contrast to the previously presented shares of different categories, cannot be presented for the whole sample, because homogeneity indicators cannot be aggregated between countries. Consider a simple example: two perfectly homogeneous MPCs: one consisted of female professors with academic profile, and the other with male central bankers MSc holders. The aggregation of member profiles would inform who is in charge of monetary policy in these countries, but a computation of Herfindahl index for the aggregated MPCs would certainly not yield the conclusion that they are both homogeneous. Thus, facing a choice between presenting only averages of homogeneity indices or rather the values for all the countries, the second option was chosen.

Figure 3.6 Heterogeneity indicators, by country (higher value signifies lower heterogeneity)
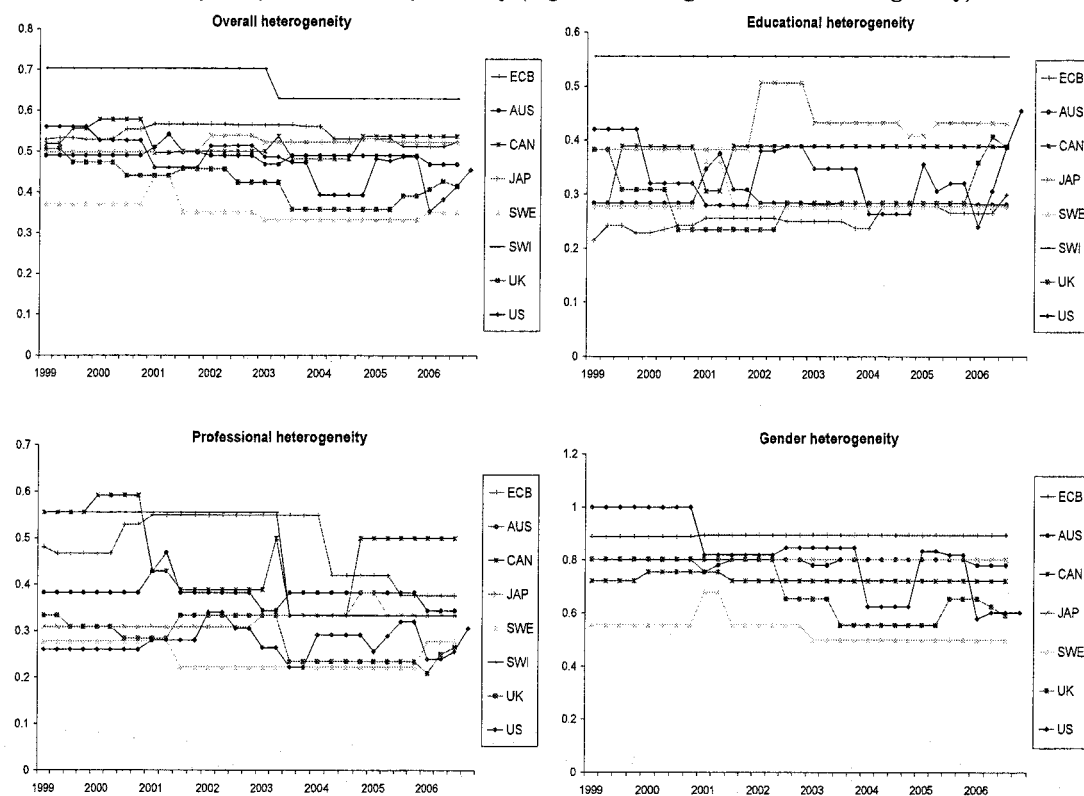
Source: author

Summing up, the most remarkable trends observed in OECD countries' central bank governance in recent years are an increase in the number of professors, at the cost of doctors and bachelors, as well as a significant increase in the proportion of academics at the expense of central bankers (insiders) and (to a limited extent) private economists. All these evolutions are completed by a slight increase in feminisation of MPCs, accompanied by a marginal decrease in average age. However, it seems difficult to globally assess the trend in homogeneity of MPCs. While main professional experience and gender tend to become more and more heterogeneous across most MPCs, the above-mentioned trend of increase in number of professors leads to a decrease in educational heterogeneity.

2. Outcomes of the monetary policy in selected countries

The empirical approach to assess MPCs' performance presented in this chapter has its theoretical underpinnings in different streams of economic literature. The first one and probably the most important is collective decision making and has been thoroughly reviewed in chapter 1. Second, the most common approach to monetary policy analysis is traditionally based on time inconsistency literature[125] but the central bank is treated usually as a homogeneous entity (or *the* central banker). However, the evaluation of monetary policy with a focus on the decision-making mechanisms and the decision-makers themselves is somewhat scarce.[126] Empirical research analyzing the collective decision making efficiency has been so far mainly focused on boards of directors in private firms. The main reason, beyond the importance of the subject, is probably the availability of data[127].

2.1. Lessons from the corporate governance literature

Two main streams of this research are the so-called agency theory and "upper echelon" theory. Agency theory focuses on the structural features of a committee (or board of directors). This theory is founded on Fama and Jensen's (1983) seminal paper. It argued that boards are a necessary instrument for the alignment of shareholders' and management's interests. Sources of this research can be traced back to Berle and Means' (1932) explanation of the separation of the property and control as a result of corporation growth and development of the markets. This separation of property and control may take the form of appointing independent (not linked to the firm's management) directors into the boards.

The hypothesis that independent directors «do a better job» as guardians of shareholders' interests has been tested empirically. The common examples are Rosenstein and Wyatt (1997), who find that the appointment of a new "outsider" increases the firm's value (measured as abnormal stock return) ceteris paribus, while the appointment of an "insider" may significantly lower the firm's value. Other features of the governance structure studied under the agency theory are the possibility of joining the mandates of CEO and chairman

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[125] Based on Kydland and Prescott (1977), Barro and Gordon (1983a and b) and Rogoff (1985)

[126] The work which is the closest to the present exercise is, obviously, Göhlman and Vaubel (2007). Other assessments of monetary policy performance are Cecchetti *et al.* (2006) and Cecchetti and Krause (2002), but these took into consideration such parameters as central bank independence, accountability, transparency and credibility and not decision making mechanisms as investigated in the present dissertation.

[127] For example, the sample size in meta-analysis by Dalton et al. (1998) was of over 40,000 observations.

of the Executive Board. The hypothesis that such an institutional arrangement influences the firm's results was tested by Dalton et al. (1998), but their meta-analysis found no correlation between the leadership structure and financial performance. They also tested the potential influence of a board's size on financial performance and again found no correlation.[128]

The impact of the board structure in terms of "outsiders to insiders" ratio has also been considered - see e.g. van Ees et al. (2003), but this study did not find any relationship between the ratio, size of the board nor the age of directors and financial performance for a sample of Dutch firms. Beiner et al. (2004) analyzed the size, outsiders ratio and board leadership and found that they are unrelated to performance (measured as return on assets – ROA - and Tobin's Q). They also argued that board's size and composition are independent corporate governance mechanisms.

Van Gils et al (2002) tried to explain the existence of inside or outside board. They found that the following variables were significant: firm size (bigger firms have outside boards), family firm (inside boards) and firm age (older firms have outside board). Organizational life cycle also plays a role (firms in a consolidation phase are less likely to adopt the outside board than in the growth phase).

Nevertheless, application of agency theory to the governance structure of central banks should be done with caution. One should remark that in Walsh's (1995a) seminal paper it is the central bank who is an agent of the society. This contrasts with the corporate governance literature, where the executive board is treated as representing the interests of shareholders and thus acts as (or at least on behalf on) the principal. Another problem with the application of agency theory is the emphasis put by some studies on pay incentives[129], something that, in the case of central banks, would also be interesting, but impossible to pursue due to the paucity of evidence on central bankers' salaries (that are mostly anecdotal, see, e.g. *The Economist*, August, 28th, 2003). Moreover, Drazen (2000, p.155)

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[128] This result may prove the lack of any liaison between boards' size and composition and financial effectiveness. Nevertheless, this inconclusiveness may also be induced by other features, such as: heterogeneity of the sample (governance mechanisms may be eg. sector-specific), existence of an optimal board size (for smaller boards the correlation may be positive and for bigger - negative which results in no-correlation in the whole sample), effect of firms' life cycle (cf. Lynall et al., 2003) and finally "equilibrium phenomena" as indicated by Hermalin and Weisbach (2001 and 2003), i.e. a situation where the firms' structure and its performance are influenced by a common exterior factor, which might mean that any relation between them is spurious.
[129] Cf. Adams and Ferreira (2003), Baker et al. (1988) or Jensen and Murphy (1990).

is skeptical with respect to the feasibility of the incentive contract as a solution to the time-consistency problem.

The second stream of research concerning boards of directors is the so-called "upper echelon". It is linked to the basic though fundamental remark that any committee is not a homogeneous entity but is consisted of its members. Consequently, the individual characteristics of committee members are crucial for their collective performance in the committee. "Upper echelon" theory tries to link such features of the board members as age, professional experience or education with the firm's effectiveness which is specifically inspiring for this research, aiming to test similar relations on MPCs.

An application of the methodology of upper echelon has been recently provided by Golden and Zajac (2001). The authors studied the impact of boards' size, tenure, occupational heterogeneity (measured by Herfindahl index) and age of their members on the probability of strategic change and documented significant relationships. In their survey, Hermalin and Weisbach (2003) presented findings showing that board composition in general is not related to the firm's performance while the board's size is (negatively). Jensen and Zajac (2004) recently highlight the importance of considering how both demography and position affect the relationship between corporate elites and corporate strategy. They find strong support for the hypothesis that corporate elites do in fact influence corporate strategies, «above and beyond economic factors such as prior performance, resource scarcity, and firm size». Firms' elites may also influence the communication strategy[130].

The influence of demographical factors has been hinted to, sometimes inadvertently, in the empirical literature on central banking, though in the context of monetary policy-making. For example, Chappell and McGregor (2000) remark that women could more often been qualified as doves, rather than hawks. Havrilesky (1993) notifies a «widely reported» division in the voting behavior of FOMC members between Federal Reserve Bank Presidents and Board of Governors. As a group, Federal Reserve Bank Presidents are more likely to vote for tighter monetary policy, and Governors for looser monetary policy, something which Havrilesky attributes to the average career experience (in private industry) and educational background (generally without PhD) of Fed Bank Presidents. Meade and Sheets (2002) remark that regional considerations also play a role in forming the preferred policy rate of a decision-maker. Moreover, they argue that this influence of economic situation in the home region may be important not only for regional FRB

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[130] See Arrow (1991).

Presidents, but also for the members of the *"hub"* – the Board of Governors of the Federal Reserve System. Thus, for federal-type central banks (like the Fed or the ECB) the regions of origin of decision makers is a potentially important variable.

A specific personal characteristic of central bankers were in the focus of Thies (2004), who put the stress on the fact "that different types of individuals (...) achieved different levels of success in attaining price stability during the Asian Crisis." As mentioned above in chapter 1, he studied seemingly subjective feature of "conceptual complexity" and found that central bankers who were ranked higher (whose speeches were "more intelligent") succeeded in achieving low inflation.

Finally Roland and Vaubel (2007), whose work is the closest one to the present exercise, lead a panel data analysis of 11 countries during 28 years (1973-2000) plus the ECB (1999-2003). They find that professional background (and, to somewhat lesser extent, also educational one) is important for the inflation performance – central bankers are the most hawkish members of monetary policy councils while trade unionists and politicians – the most dovish ones. However, as presented in the previous section, contemporary MPC members are extremely rarely from outside the economic world. Thus, an assessment focused on the most recent and truly independent MPCs seems of high interest. Such an attempt is presented in the following subsection.

2.2. Empirical panel data analysis

As mentioned above, in order to assess the performance of MPCs (and their members), the data presented in section 1 merged with some macroeconomic data will be explored through the panel data analysis. Thus, methodologically, the present analysis is similar to Göhlman and Vaubel (2007). However, some important differences should be underlined. First, in the present study the data frequency is higher, which allows not only for the assessment of inflation performance but also reactivity – also important from the point of view of decision-making efficiency[131] (as argued in introduction and proved in the previous chapter). Second, the adopted categorization is more compact, which is probably linked to the general trend of appointing rather "expert" than "non-expert" monetary policy

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[131] A survey of concepts of efficiency in monetary policy (but not necessarily decision making in monetary policy) and controversies surrounding it is presented by Wojtyna (2000).

makers[132]. Third, some technical elements differ, which will be exposed further, along with the detailed presentation of the adopted method.

In general, in order to evaluate inflation performance some basic short-term macroeconomic relations e.g. between inflation and unemployment will be augmented by MPC characteristics. This will allow us to assess the impact of MPC's composition on inflation and thus efficiency of monetary policy making. Similarly, in order to assess MPC reactivity, its measures (including the number of non-status-quo decisions taken or central bank interest rate variance) will be regressed on their macroeconomic determinants and MPCs characteristics. Moreover, a simple central bank reaction function will be also augmented by MPC features, which will provide an additional original assessment of central bank reactivity.

MPC characteristics and inflation performance

Low and stable inflation is the statutory goal of all the nine prominent central banks under scrutiny. Thus, inflation performance seem to be the most natural way of assessing MPC efficiency. The average inflation rates in the nine countries during 1999:Q1–2006:Q3 are presented in table 3.1.

Table 3.1. Average inflation rates in selected OECD countries (1999-2006)[133]

Country	Euro area	Australia	Canada	Japan	New Zealand	Sweden	Switzerland	UK	US
Inflation	2.06	3.08	2.29	-0.40	2.27	1.25	0.98	1.43	2.72

Source: own calculations, based on IMF International Financial Statistics CD ROM, February 2007

Inflation is obviously shaped by general macroeconomic situation (macroeconomic shocks) as well as by monetary policy. The general macroeconomic variables which are supposed to influence directly inflation level are unemployment (with respect to internal equilibrium) and nominal effective exchange rate (with respect to external equilibrium). The countries in the sample are relatively open ones and thus external pro- and anti-inflationary pressures might be important. These control variables performed best as inflation regressors among available indicators in the IFS database.

Moreover, the general macroeconomic conditions are easily transmitted between countries, especially in this time of globalized financial (and other) markets. A way to account for the general common trends is to include time dummies into the regressions. However, in order

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[132] In Göhlman and Vaubel (2007) central bankers and academic scholars were counted into "experts" category while politicians, trade unionists and (other) civil servants were included into "non-experts".
[133] The inflation averages concern the growth in the consumer price indices registered on quarterly basis in percentage points, annualized.

to locate the periods when inflation is mainly driven by these international developments while saving some degrees of freedom, a two subsequent regressions are run. First, a panel regression with cross section as well as time-specific fixed effects is run and second, only statistically significant time-specific fixed effects are kept. As inflation reacts with some lags to other economic variables as well as to monetary policy actions, the dependent variable is inflation one year ahead[134]. Thus the benchmark equation may be written as:

$$\pi_{jt+4} = \kappa_j + \tau_t + \lambda_u u_{jt} + \lambda_{NEER} NEER_{jt} + \varepsilon_{jt}, j=1..9, t=1..28 \qquad (3.1), \text{where:}$$

π_{jt+4} – inflation rate in country j in quarter $t+4$ computed as an increase in the price level compared to the analogous quarter one year earlier.

κ_j – country-specific fixed effects. As countries tend to differ with respect to their "culturally enshrined" inflation levels[135], these fixed effects are supposed to be statistically significant.

τ_t – time-specific fixed effects. Price levels depend among others on world prices of tradable goods (changing along the economic cycle) which make inflation rates covary across open economies. Thus the time specific time effects are supposed to be significant at least in *some* periods.

u_{jt-1} – unemployment rate in country j one year before the explained inflation rate

$NEER_{jt-1}$ – annual change in nominal effective exchange rate index for country j in one year before the realization of the explained inflation rate. An increase in NEER index means nominal effective appreciation, a decrease – depreciation.

λ_u, λ_{NEER} – estimated reaction coefficients of inflation on, respectively, unemployment rate and nominal effective exchange rate change (positive change means appreciation). The signs of both coefficients are expected to be negative.

ε_{jt} – is the error term.

The estimation of equation (3.1) delivers the results conform to expectations, with $R^2 = 0.93$, t-values in brackets:

$$\pi_{jt+4} = \kappa_j + \tau_t - 0.32 \, u_{jt-1} - 0.038 \, NEER_{jt-1} \qquad (3.2)$$
$$\quad\quad\quad\quad\quad (-4.88) \quad\quad (-5.60)$$

All estimated country-specific time effects are significant (all p-values equal all below 0.0001), which means that countries differ with respect to their "natural" inflation rates[136]. The estimation of time-specific fixed effects also yields the expected results: only some of them were significant at 5% confidence level. These significant ones are presented in table 3.2 below:

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[134] It seems important to underline that the introduction of a lag into the estimated equation reduces the number of available observations (one year lag in case of quarterly data reduces the number of time observations of 4 quarters which means 36 less observation less in the sample).

[135] See Hayo (1998).

[136] Precise determination of natural inflation rates as well as NAIRU would require, obviously, some more sophisticated methodology. These are, however, outside of the focus of the present dissertation. For an overview of the NAIRU concept see e.g. Ball and Mankiw (2002).

Table 3.2: Estimates of significant time-specific fixed effects in the control equation.

Quarter	1999:Q1	2001:Q1	2001:Q2	2001:Q3	2001:Q4	2002:Q4	2003:Q2
Estimate	-0.62082	-0.82892	-0.72398	-0.81899	-0.62303	-0.55816	-0.91573
p-value	0.0383	0.0041	0.0118	0.0045	0.0300	0.0528	0.0018

Source: Author's calculations. The software used: SAS System v.8.0.

In the following estimations, the equation (3.1) is modified to take account of only the significant time-specific fixed effects and is augmented with MPC-characteristic variables.

Thus, the estimated equation become:

$$\pi_{jt+4} = \kappa_j + d_t\,\tau_t + \lambda_u u_{jt} + \lambda_{NEER}NEER_{jt} + \alpha_l x_{ljt} + \varepsilon_{jt},\ j=1..9,\ t=1..28 \qquad (3.3),\ \text{where:}$$

d_t is a dummy operator, which is equal 1 for the following quarters: 1999Q1, 2001Q1, 2001Q2, 2001Q3, 2001Q4, 2003Q2 and 0 otherwise.

x_{ljt} are values of characteristic l of the committee j in quarter t. These features were presented in section 1 of this chapter and include such characteristics as homogeneity, shares of different educational or professional categories in the MPC, measures of MPC dynamics – turnover and number of changes etc.

α_l are coefficients describing the influence of characteristic l of the committee on the inflation rate one year later. Positive estimates would mean that this feature makes a committee more inflation-prone (dovish) while a negative estimated value means that the committee is more inflation averse (hawkish).

Estimates for the equation (3.3) are presented in table 3.3 below. The main results can be summarized as follows. First, professional experience of MPC members matter (which is illustrated by estimations a, b and c). Namely, shares of public economists (S_PUB) and "other" (S_OTR) – mainly politicians, lawyers and journalists in the MPC increases inflation rate. This result fully confirms the findings of Göhlman and Vaubel (2007) and is perfectly conform to expectations.

On the other hand, higher shares of academic economists (S_ACAD), central bankers (S_CB) and private economists (S_PRIV) are associated with lower inflation levels. This is also logical – specialists (academics and "insiders") are able to attain desirable inflation rates, moreover, in the case of insiders, the corporate culture of central bank may make its staff more hawkish. Private economists, potentially representing interests of their sector, which is particularly vulnerable to costs of higher inflation, are usually seen as hawks, which is also confirmed by the present study[137]. These results on "hawkish" professionals are only partially in line with Göhlman and Vaubel (2007) (GV hereinafter) – i.e. it confirms their results on private economists and central bankers (in both studies these are

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[137] A similar hypothesis was already posed by Posen (1995).

central bankers who are the most hawkish). The most striking difference between the two studies is the fact that GV find academics inflation-prone while the present study would rather qualify them on the hawkish side. The above-mentioned authors argue that their result testifies about Keynesian spirit reigning in academia. This, however, might have changed since the analysis periods differ (1973-2000 for GV and 1999-2006 in the present study).[138]

As percentage shares of different categories are explaining variables, it is impossible to put them all into one regression, because they would be linearly dependent. Thus a reference category has to be chosen[139], which may not be innocuous for the presentation of the results (but should not affect the results themselves). This can be seen in the results below: estimation (a) takes into account only "hawkish" categories (which are all significant at the one percent level) while "dovish" equation is estimated in column (b). When all categories are estimated jointly, only "dovish" categories remain significant. The results should be, however, interpreted relatively to each other as a rise in the share of a category must be reflected in a decrease in another one. This is also reflected in estimated fixed effects: they are higher when inflation averse categories are investigated (a) and lower when the dovish ones are under scrutiny (b).

Similarly to GV the mean age of the MPC members was not found significant. However, the other demographical feature – gender – seems to play a role in monetary policy. Namely, a higher share of female members (S_WOM) was found to be associated to lower inflation levels. This result, robust across different formulations (not necessarily reported in the table below) needs, however, some further investigation. The most straightforward interpretation, i.e. that female MPC members are more inflation averse needs not be the correct one (and is contrary to the findings of Chappell and McGregor, 2000). The other possible explanations may take into account the process of credibility gaining of dovish members (e.g. as modeled by Sibert, 2003).

Interestingly, the size of the committee (SIZE) proves to influence the inflation, however, not in the most straightforward formulation. Namely, while taking into consideration jointly the size and size squared, both are significant. Moreover, the coefficient on SIZE is negative (larger MPC obtain lower inflation) while $SIZE^2$ increases inflation (column e in the table below). This allows to compute the optimal size of the MPC, which is somewhere

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[138] Changes in central bankers' behavior are reported e.g. by Baldwin (1997).
[139] GV choose central bankers who have studied economics.

around 11 members[140]. This result was robust across different formulations, nevertheless, needs some caution, because its direct application would mean that "one size does fit all". Though, larger countries tend to have larger MPCs[141], which probably reflects the need for a larger scope of information which is supplied by a larger number of MPC members.

Finally, similarly to GV, none of the educational variables was significant and no convincing evidence was found with respect to the impact of MPC heterogeneity on inflation performance. However, in some regressions (not reported here) an increase in heterogeneity lead to a decrease in inflation rate, but the result was only significant at the 20% level.

Table 3.3 Estimations of impact of MPC characteristics on inflation performance

Variable		Equation 3.3 (a)		Equation 3.3 (b)		Equation 3.3 (c)		Equation 3.3 (d)		Equation 3.3 (e)	
		Estimate	Pr >|t|	Estimate	Pr >|t|	Estimate	Pr >|t|	Estimate	Pr>|t|	Estimate	Pr > |t|
Country fixed effects	ECB	5.9158	<.0001	3.0104	0.0007	3.1351	0.0014	2.7973	0.0026	8.5133	<.0001
	RBA	7.6399	<.0001	4.9534	<.0001	4.9986	<.0001	4.8547	<.0001	10.050	<.0001
	BC	6.9183	<.0001	4.0384	<.0001	4.2175	<.0001	4.1823	<.0001	8.9001	<.0001
	BJ	3.5747	<.0001	0.9435	0.0121	0.9786	0.0801	0.8790	0.0965	5.9701	0.0035
	RBNZ	4.4492	<.0001	1.7571	0.0542	1.8559	0.0638	1.3919	0.1445	5.4426	<.0001
	SR	4.6293	<.0001	1.9438	<.0001	2.0086	0.0020	2.4175	0.0002	6.8050	<.0001
	SNB	4.7150	<.0001	2.0607	<.0001	2.1538	<.0001	1.9535	<.0001	4.3922	<.0001
	BE	4.8492	<.0001	2.2163	<.0001	2.2829	<.0001	2.3998	<.0001	7.1427	0.0005
	Fed	6.4801	<.0001	3.8127	<.0001	3.8696	<.0001	3.7047	<.0001	9.2176	<.0001
S_ACAD		-2.4887	0.0053					0.0806	0.9046		
S_PRIV		-2.3729	0.0093			0.0836	0.9088	0.6406	0.5409		
S_CB		-2.6848	0.0017			-0.1978	0.7709				
S_PUB				2.6640	0.0008	2.5954	0.0040	2.9617	0.0005		
S_OTR				2.4099	0.0026	2.3460	0.0095	2.7466	0.0014		
S_WOM								-1.9256	0.0139		
SIZE										-0.8116	0.0217
SIZE^2										0.0360	0.0212
UNEMP		-0.3204	<.0001	-0.2881	<.0001	-0.2944	<.0001	-0.2773	<.0001	-0.3581	<.0001
NEER		-0.0379	<.0001	-0.0382	<.0001	-0.0385	<.0001	-0.0384	<.0001	-0.0439	<.0001
Time fixed effects	Q1_1999	-0.5203	0.0201	-0.5558	0.0114	-0.5361	0.0170	-0.6109	0.0065	-0.5016	0.0248
	Q1_2001	-0.7739	0.0004	-0.7690	0.0004	-0.7651	0.0004	-0.8263	0.0001	-0.8614	0.0001
	Q2_2001	-0.6656	0.0022	-0.6528	0.0026	-0.6517	0.0028	-0.7137	0.0010	-0.7352	0.0009
	Q3_2001	-0.7698	0.0004	-0.7514	0.0005	-0.7526	0.0006	-0.7848	0.0003	-0.7935	0.0003
	Q4_2001	-0.5737	0.0077	-0.5560	0.0095	-0.5566	0.0100	-0.5895	0.0060	-0.5894	0.0066
	Q4_2002	-0.4776	0.0261	-0.4882	0.0215	-0.4888	0.0230	-0.4947	0.0201	-0.4979	0.0210
	Q2_2003	-0.7941	0.0003	-0.8102	0.0002	-0.8106	0.0002	-0.7821	0.0003	-0.8612	<.0001
F Value (test for no fixed effects)		78.45	<.0001	80.13	<.0001	60.47	<.0001	75.43	<.0001	78.63	<.0001
R-Square		0.9298		0.9300		0.9301		0.9319		0.9282	

Source: Author's computations. The software used: SAS System v.8.0. The characters of estimations which are significant at 5% level are bolded. Hausman test rejected random-effects hypothesis in estimation (a) at 1% and in estimation (e) at the 10% level. In other cases the results did not qualitatively differ.

[140] In the quadratic function $y=ax^2+bx+c$ the extreme value is attained for $x^*=-b/2a$, which is a minimum if $a>0$. In the case of the estimates presented in the column (e) of table 3.3., the minimal inflation will be attained for SIZE=0.81/(2*0.036)=11.25

[141] Among the (surveyed here) OECD countries the correlation coefficient between the country's population and its (statutory) MPC size is as large as 0.82.

Committee features and policy responsiveness

Though, the assessment of inflation performance is an important aspect of the monetary decision making, the responsiveness seems to be the most coherent assessment of the MPC performance with the theoretical model presented in chapter 2. Moreover, the responsiveness of the MPC as well as the decisions taken by them are the very result of their work. Thus, it seems that in order to evaluate the efficiency of monetary policy making it is necessary not only to assess the macroeconomic performance but also the reactivity of the MPC.

Table 1 below allows for a first and rough approach of reactivity of central banks. As one may easily remark, among the analyzed 9 central banks only two (the US Fed and the Bank of Canada) changed interest rates over 30 times. It thus seems that these two are the most reactive central banks. On the other end the Bank of Japan would be situated with only four interest rate decisions followed by the Swiss National Bank with 12 moves. The reactivity of the ECB together with these of the Reserve Bank of Australia and the Swedish Riksbank would be situated close to the middle of the sample. Such a conclusion might be, however, premature. That is so because, as modeled in chapter 2 and proved by a vast economic literature, central banks change interest rates in response to the current (or forecasted, but these forecasts are based on currently available information) economic situation.[142] Thus, naturally, the number of interest rates changes (and the variance of interest rates) will be higher in the countries where economic fluctuations are greater.

Table 3.4 Summary of interest rate decisions in selected central banks between 1999Q1 and 2006Q3

Central Bank	Number of interest rate changes of which:			Total IR increases	Total IR Cuts	Average IR Increase	Average IR cut
		Rises	Cuts				
ECB	19	11	8	3.25	-3.25	0.30	-0.41
RBA	18	12	6	3.25	-0.75	0.27	-0.33
BC	35	18	17	4.75	-5.50	0.26	-0.32
BJ	4	1	3	0.30	-0.40	0.30	-0.13
RBNZ	26	18	8	5.25	-2.50	0.29	-0.31
SR	21	9	12	2.60	-3.50	0.29	-0.29
SNB	17	9	8	3.13	-3.63	0.35	-0.45
BE	24	10	14	2.50	-4.00	0.25	-0.29
FED	35	22	13	5.75	-5.50	0.26	-0.42

Source: author, based on annual reports of selected central banks

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[142] Central banks' reactions to economic situation are usually modeled as rules. The probably most widely analyzed are Taylor rules (based on Taylor, 1993), where the interest rate depends (positively) on the "natural" rate of interest, current inflation and its deviation from the inflation target as well as (negatively) on output gap. See also e.g. Gerlach-Kristen (2003), Verdelhan (1999), or a recent survey by Orphanides (2007).

The responsiveness of a committee will be explored in the three following ways. First, it will be approximated by the number of decisions of changing interest rates in a quarter. This straightforward measure has the disadvantage of discontinuity and very restrained interval (in the sample the number of decisions per quarter assumed only values 0, 1, 2 or 3). Nevertheless, the results of these regressions give some important insights on the determinants of monetary policy responsiveness, which will be investigated more deeply further.

Second, the responsiveness of the committees will be assessed on the basis of the variance of the main interest rate. Finally, two consecutive regressions will be run: in the first step a simple "difference" monetary decision rule[143] is estimated in panel data and augmented by some MPC characteristics, which allows for a simple and approximate assessment of preferences of differently composed MPCs. In the second step, the arguments as well as the instrument (interest rate change) of this difference Wicksellian rule are squared in order to assess monetary policy responsiveness. This approach, while keeping relative simplicity, better takes into consideration prevailing economic conditions and is immune to the critiques of discontinuity and restrained interval.

A. Number of interest rate moves

The number of non-status-quo interest rate decisions seems to be the simplest measure of MPC reactivity. In order to explore the panel structure of the data, the following equation is estimated:

$$n_{jt} = \kappa_j + d_t \tau_t + \alpha_x x_{ljt} + \beta_c c_{jt} + \varepsilon_{jt}, j=1..9, t=1..31 \qquad (3.4), \text{ where:}$$

n_{jt} signifies the number of interest rate moves in country j in quarter t

κ_j signifies the country-specific fixed effects[144],

d_t is equal to 1 only for 2000Q1, 2000Q3, 2000Q4, 2001Q3 and 2001Q4

c_{jt} stand for the values of control variables for country j in quarter t

β_c are the estimated coefficients for control variables

Other variables and parameters are defined analogically to previous equations.

Among plausible control variables only the level of inflation[145] (INFL) was significant while no measure of unemployment nor any other macroeconomic variables significantly

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[143] Such Wicksellian monetary policy rule was found to be the best approximation of optimal control in inflation targeting under imperfect knowledge by Orphanides and Williams (2006).

[144] These estimated country fixed effects could be themselves a measure of MPC reactivity, nevertheless they are not usable unless the cross-sectional dimension is sufficiently large

[145] And not the other tested: change, squared change or variance.

explained the number of interest rate moves. Selected estimations of equation (3.4) are presented in table 3.5 below.

Table 3.5: Estimations of reactivity measured by the number of interest rate moves

Variable		equation 3.4 (a)		equation 3.4 (b)		Equation 3.4 (c)		Equation 3.4 (d)	
		Estimate	Pr >|t|	Estimate	Pr >|t|	Estimate	Pr >|t|	Estimate	Pr>|t|
Country fixed effects	ECB	0.1858	0.2626	0.9467	0.0095	0.2042	0.2129	0.8949	0.0126
	RBA	-0.0315	0.8780	0.8576	0.0411	-0.0067	0.9733	0.7620	0.0617
	BC	0.6591	0.0002	1.8404	0.0004	0.5602	0.0016	1.6236	0.0019
	BJ	0.1477	0.2487	1.7195	0.0052	0.1507	0.2330	1.4579	0.0181
	RBNZ	0.3734	0.0319	3.8490	0.0034	0.3931	0.0223	3.1783	0.0143
	SR	0.3978	0.0052	1.2607	0.0015	0.1385	0.4069	1.0068	0.0204
	SNB	0.3180	0.0195	2.1536	0.0036	0.3296	0.0143	1.8856	0.0100
	BE	0.4621	0.0017	1.4416	0.0003	0.1130	0.5512	1.0273	0.0263
	Fed	0.5821	0.0025	1.6295	0.0005	0.3841	0.0564	1.3461	0.0058
INFL		0.1816	0.0007	0.2208	<.0001	0.1753	0.0010	0.1937	0.0003
HOM_E				-3.4374	0.0086			-2.8194	0.0302
S_MBA						2.4143	0.0050	1.6569	0.0713
Time fixed effects	Q1_2000	0.9137	0.0001	0.8792	0.0002	0.8911	0.0002	0.8604	0.0002
	Q3_2000	-0.5302	0.0261	-0.6116	0.0098	-0.5489	0.0197	-0.6098	0.0097
	Q4_2000	-0.5608	0.0193	-0.6488	0.0065	-0.5784	0.0146	-0.6424	0.0068
	Q3_2001	1.0920	<.0001	1.0249	<.0001	1.0377	<.0001	0.9940	<.0001
	Q4_2001	0.7329	0.0021	0.6843	0.0035	0.6757	0.0041	0.6406	0.0063
F Value (test for no fixed effects)		4.81	<.0001	3.94	0.0001	2.82	0.0035	2.21	0.0220
R-Square		0.6080		0.6282		0.6196		0.6263	

Source: as in table 3.3. Hausman test did not reject the hypothesis of random-effect model in model (c) and (d), nevertheless, the results did not qualitatively differ.

The most important finding is that educational heterogeneity leads to higher reactivity: the coefficient on the variable HOM_E is negative. This means that MPCs where the Herfindahl heterogeneity index computed for educational categories are higher (more homogeneous committees) were less reactive. Moreover, the share of "entrepreneurial" MBA education (S_MBA) also increases reactivity (this kind of education is quite rare in MPCs – see section 1). Similarly, professors seem to be more reactive while PhD holders seem less reactive, but these results are significant only at about 15% and depended on the controls (inclusion of time-specific dummies). Nevertheless, due to somewhat uncertain robustness, these results are not reported here.

Significant time-specific fixed effects are robust and stable across different formulations. On the other hand, the country-specific fixed effects were not stable and depended on other tested regressors. Moreover, depending on the explanatory variables used, the ranks of fixed effects changed. As remarked above, these fixed effects could be (in the case of a larger cross-section dimension) a measure of reactivity themselves, but the most plausible measure would be the fixed effects from the model including only macroeconomic variables and time dummies (it seems that the inclusion of MPC characteristics leads to

biased estimation of fixed effects understood as a measure of reactivity, because a part of this reactivity is already explained by MPC variables).

B. Moving variance of central bank interest rates

However, the simple number of non-status-quo decisions does not seem the most appropriate measure of reactivity, because each country differ in number of meetings.[146] Thus, the second proposed measure of MPC reactivity is also very intuitive: as volatility is measured in general by the variance of the variable, the "moving variance" of the main interest rate for four quarters forward is computed. The underlying hypothesis is that the MPC composition in quarter t influences its future decisions. It may be so, because new members take usually some time before the first dissent vote and thus it may be argued that the characteristics of the MPC in time t also have future consequences. Moreover, with the above-mentioned tendency to smooth interest rates it seems even more pertinent.

The method remains roughly the same (finding important time dummies and estimation of the fixed effect model), nevertheless the regressors change. As the explained variable is a variance, the main macroeconomic regressors (inflation and unemployment) were also tested in four-quarter ahead variance (which means that future interest rate changes react to future developments and the present composition of the committee). Nevertheless, some other control variables (exchange rates, inflation and unemployment levels, as well as their squared differences) were also tested. Among time-specific fixed effects the significant ones were 1999Q4, 2001Q1, 2001Q2 and 2001Q3. Thus, the estimated equation was:

$$V(i_{jt}...i_{jt+4}) = \kappa_j + d_t \tau_t + \alpha_l x_{ljt} + \beta_c c_{jt} + \varepsilon_{jt}, j=1..9, t=1..28, \qquad (3.5), \text{ where}$$

$V(i_{jt}...i_{jt+4})$ is a four-period-forward moving variance of main interest rate – a reactivity measure

κ_j are country-specific fixed effects

τ_t are time-specific fixed effects

d_t is a dummy operator equal 1 for the following quarters: 1999Q4, 2001Q1, 2001Q2 and 2001Q3 and 0 otherwise

Other variables and parameters are defined analogically to previous equations.

Interestingly, this measure is more sensitive to the MPC characteristics than the raw number of interest rate decisions. Thus, it confirms the previous remarks but gives also some additional insights. The confirmations concern smaller a reactivity of homogeneous

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[146] E.g. the ECB GC met fortnightly until November 2001 (which makes 72 meetings only for period Q1:1999-Q4:2001), while in USA FOMC meets twice a quarter and sometimes they take intermeeting decisions (by teleconferencing).

MPCs as well as higher reactivity of MBA holders. However, these estimations shed more light on the reactivity of the other educational categories. The detailed results of these estimations are summarized in table 3.6 and summarized below.

Table 3.6 Estimations of MPC reactivity measured by the moving variance of main interest rates

Variable		equation 3.5 (a)		equation 3.5 (b)		Equation 3.5 (c)		Equation 3.5 (d)	
		Estimate	Pr >|t|	Estimate	Pr >|t|	Estimate	Pr >|t|	Estimate	Pr>|t|
Country fixed effects	ECB	0.4091	0.0735	0.6151	0.0136	0.3600	0.0680	1.0321	0.0016
	RBA	0.0458	0.8058	0.3018	0.1777	-0.2304	0.3572	0.5611	0.0439
	BC	0.2523	0.2098	0.5897	0.0235	0.1204	0.4916	0.9200	0.0160
	BJ	0.1983	0.1006	0.6134	0.0097	-0.3166	0.3349	0.4722	0.0021
	RBNZ	0.2197	0.1469	1.1417	0.0169	0.4659	0.1505	1.2533	0.0020
	SR	0.0712	0.6019	0.3296	0.0763	0.1213	0.6057	0.9140	0.0095
	SNB	0.2235	0.0158	0.7399	0.0062	0.7369	0.0168	1.5235	0.0001
	BE	0.1341	0.1884	0.3851	0.0161	-0.0362	0.8739	0.7576	0.0105
	Fed	0.3722	0.0188	0.6712	0.0019	0.3627	0.1875	1.1510	0.0005
INFL		0.05096	0.0208	0.0544	0.0132	0.0544	0.0074	0.0554	0.0064
UNEMP		-0.0549	0.0208	-0.0513	0.0300				
UNEMP_V		1.0865	<.0001	1.0065	<.0001	0.8725	<.0001	0.8732	<.0001
HOM_E				-0.9410	0.0416				
S_PROF						-0.8367	0.0122	-1.6217	0.0001
S_PHD						-0.5203	0.0945	-1.3096	0.0010
S_MBA						1.2015	0.0009	0.3975	0.3381
S_MAST								-0.8158	0.0545
S_BACH						0.7865	0.0712		
Time fixed effects	Q4_1999	0.3886	<.0001	0.3906	<.0001	0.3874	<.0001	0.3846	<.0001
	Q1_2001	0.4533	<.0001	0.4348	<.0001	0.4406	<.0001	0.4387	<.0001
	Q2_2001	0.3750	<.0001	0.3683	<.0001	0.4045	<.0001	0.4020	<.0001
	Q3_2001	0.2534	0.0021	0.2402	0.0035	0.2617	0.0011	0.2600	0.0012
F Value (test for no fixed effects)		5.58	<.0001	5.86	<.0001	7.87	<.0001	6.87	<.0001
R-Square		0.5839		0.5913		0.6165		0.6173	

Source: As in table 3.3. Random effects models were not significantly rejected by Hausman test but yielded the same qualitatively results

Clearly, different educational categories affect the reactivity of the MPCs measured by the variance of main interest rates. At least two results are worth to be underlined. First, more educational heterogeneity leads to more reactivity (again, the coefficient on HOM_E is negative), which confirms the intuitions from the chapter 1 as well as the results from the previous subsection. The estimated negative coefficient (robust for all control variables and formulations) means that more homogeneous MPCs are less reactive, *ceteris paribus*. Such a negative relation between homogeneity and reactivity was also suggested by the analysis in chapter 2. This probably comes from the fact that the total information available for a homogeneous committee tend to be more restrained than the one provided by heterogeneous members. Thus, a committee which is better informed (heterogeneous one) will adjust interest rates more frequently.

Second, shares of different educational categories influence themselves the reactivity of the MPC. The most reactive are the MPC members with entrepreneurial (MBA) education. It is interesting to compare the columns (c) and (d) of table 3.6 above, which estimate the impact of shares of different educational categories under two different reference groups[147]. In (c) the reference group is master level which yields the following result: share of professors decreases reactivity while share of MBA holders increases it (at about 1% significance level) similarly, the share of PhD holders decreases reactivity while the share of Bachelors increases reactivity (these, however, only at about 10% confidence level). Under bachelors as the reference category (column d), shares of professors and PhD holders decrease committee's reactivity at less than 1% level, share of masters also negatively influences the reactivity (but only at somewhat more than 5% level) while the share of MBA holders has no significant effect. This shows that the MPCs with higher shares of MBA holders are *relatively* more reactive under both formulations.

These results are thus an extension of Göhlman and Vaubel (2007) who found that education does not influence the performance of MPCs (which was confirmed in the previous subsection), but they did not looked for any reactivity nor smoothing measures.

C. Reactivity measure based on a difference reaction function

Finally, in order to assess the central bank reactivity, two consecutive regressions are run. First, simple estimations of reaction functions of the central banks in the sample will be performed. Further research on MPCs reactivity will be built on this estimation. As mentioned above, let the MPC reaction function be of the form

$$\Delta i_{jt} = \kappa_j + \tau_t + \theta_\pi \Delta \pi_{jt} + \theta_u \Delta u_{jt} + \varepsilon_{jt}, j=1..9, t=1..31 \qquad (3.5), \text{where:}$$

Δi_{jt} stands for the change in central bank interest rate in country j and in quarter t

κ_j are country-specific fixed effects which should capture potential country differences, but as the whole estimated equation is in first difference, however, any significant results are not expected since all countries in the sample seem relatively homogeneous.

τ_t are time-specific fixed effects - constants which mark periods of all-over-the-world increases or decreases in interest rates. This captures interdependencies between monetary policy decisions in different countries.[148]

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[147] It is impossible to test all categories at the same time, because one of the categories would be a linear combination of all the other which would make the estimations unfeasible.

[148] E.g. Clarida, et al. (1998) while studying German monetary policy rule found that the Bundesbank reacted to American interest rate moves. In case of multi-country analysis finding the leader and the followers (and possibly the followers of the followers) would be extremely difficult. Thus it seems that simplification by fixed time effects is an efficient way to cope with the problem.

$\Delta\pi_{jt}$ and Δu_{jt} are, respectively, changes in inflation and unemployment rate in country i and in quarter t (compared to the previous year[149]).

θ_π and θ_u are, respectively, reaction coefficients to inflation and unemployment changes, which are supposed to be constant across the countries.

ε_{jt} is the error term.

Obviously, according to standard economic considerations one would expect a positive θ_π and negative θ_u. Moreover, the reader should take into account that the objective of this estimation is not to estimate a precise monetary decision rule for each country (these would probably differ and would also necessitate longer time series) but to provide a benchmark for reactivity assessment.

The results of the estimation of equation (3.4) confirm all the intuitions (t statistics in brackets) and the R^2 is satisfactory (over 0.61). However, the inflation coefficient is significant only at about 3% level:

$$\Delta i_{jt} = \kappa_j + \tau_t + 0.0368\ \Delta\pi_{jt} - 0.1898\ \Delta u_{jt} \qquad (3.6)$$
$$ (2.23) (-5.71)$$

In this formulation none of the country-specific fixed effects is significant at 10% confidence level (however, Japan and the US approach it). More importantly, numerous time-specific fixed effects, τ_t, turn out to be significant with p-values well below 0.01. These τ_t which were significant at 5% level are presented in table 3.5 below. The trend of decreasing interest rates throughout the world in 2001 (connected to the downturn after internet bubble and strengthened by the terrorist attacks of September 11th) is the most visible and long lasting.

Table 3.7 Estimations of significant time-specific fixed effects in MPC reaction function

Δi_t	1999Q1	1999Q2	2000Q1	2001Q1	2001Q2	2001Q3	2001Q4	2002Q4	2003Q2
Estimate	-0.3676	-0.38	0.2784	-0.6357	-0.55	-0.6550	-0.5869	-0.2883	-0.2380
t-statistics	-3.16	-3.28	2.38	-5.50	-4.73	-5.64	-4.98	-2.48	-2.04
p-values	0.0018	0.0012	0.0179	<.0001	<.0001	<.0001	<.0001	0.0138	0.0422

Source: as in table 3.2

Even if estimated coefficients on unemployment and especially inflation are quantitatively somewhat surprising (as mentioned above, their signs are conform to what could be expected), their relative weakness can be explained by the panel nature of the analysis and particularly by large time specific fixed effects, which prove a high level of monetary

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[149] Estimations with differences with respect to the previous quarter did not differ qualitatively, but have smaller significance and explaining power. This may be linked to the real-time data problem (i.e. the data available now are not necessarily the same which were available at the time of decision making), which is not taken into consideration in this dissertation. For a discussion of this issue see e.g. Orphanides (2001).

policy interdependence among countries. Nevertheless, the aim of the study is not a precise assessment of the reaction function but to focus on reactivity. Besides, the estimated reaction function is not significantly and robustly affected by any MPC characteristics.

As explained above, in order to assess reactivity, each element of this reaction function is squared. This transformation ignores the sign of MPC reaction (hike or cut) but allows to assess its magnitude. Thus, the measure of the reactivity is the square interest rate change which is explained by squared changes in inflation and unemployment augmented by MPC characteristics. The analysis procedure will be analogical to the estimation in subsections A and B above: first the significant time fixed effects are found in order to save degrees of freedom. These are (at 5% confidence level): 2000Q1, 2001Q1 2001Q2 2001Q3 and 2001Q4. The estimated equation is thus of the following form:

$$(\Delta i_{jt})^2 = \kappa_j + d_t \tau_t + \theta_\pi (\Delta \pi_{jt})^2 + \theta_u (\Delta u_{jt})^2 + \alpha_l x_{ljt} + \beta_c c_{jt} + \varepsilon_{jt}, j=1..9, t=1..31 \quad (3.6) \text{ where}$$

d_t is a dummy operator assuming value 1 for 2000Q1, 2001Q1 2001Q2 2001Q3 and 2001Q4 and 0 otherwise

Other variables and parameters are defined analogically to the previous equations.

The most interesting estimations of equation (3.6) are summarized in table 3.8

Table 3.8. Estimations of MPCs' reactivity measured by squared change in the main interest rates

Variable		Equation 3.6 (a) Estimate	Pr > |t|	equation 3.6 (b) Estimate	Pr > |t|	equation 3.6 (c) Estimate	Pr > |t|	equation 3.6 (d) Estimate	Pr > |t|	equation 3.6 (e) Estimate	Pr > |t|
Country-specific fixed effects	ECB	1.5684	0.0127	1.9175	0.0027	0.2022	0.2431	1.1896	0.0001	2.9816	<.0001
	RBA	0.6967	0.0286	0.8092	0.0110	-0.2781	0.1998	0.9031	0.0005	1.7432	<.0001
	BC	0.5576	0.0153	0.5782	0.0110	0.1264	0.3958	1.2980	0.0004	1.8533	<.0001
	BJ	0.7064	0.0283	0.8222	0.0106	-0.7234	0.0204	0.4688	0.0013	1.3132	0.0002
	RBNZ	0.1273	0.0279	0.1476	0.0107	0.3369	0.2522	1.5044	0.0001	1.4587	0.0002
	SR	0.4453	0.0406	0.2869	0.1981	-0.0271	0.8990	1.1424	0.0007	1.4396	0.0004
	SNB	0.3075	0.0086	0.3724	0.0017	0.3489	0.2173	1.5119	<.0001	1.6523	<.0001
	BE	0.8164	0.0113	0.8679	0.0066	-0.2324	0.2698	0.9442	0.0008	1.7312	<.0001
	Fed	1.1082	0.0044	1.2831	0.0010	0.1435	0.5554	1.3158	<.0001	2.3177	<.0001
UNEMP_V		0.5789	0.0004	0.5585	0.0006	0.4450	0.0078	0.4476	0.0074	0.3898	0.0181
SIZE		-0.087	0.0138	-0.1091	0.0025					-0.1079	0.0026
S_WOM				0.7332	0.0101					0.6321	0.0731
S_PROF						-0.2990	0.3372	-1.4563	0.0002	-1.2318	0.0018
S_PHD						-0.2894	0.3192	-1.4565	0.0001	-1.2994	0.0009
S_MBA						1.0870	0.0018	-0.0977	0.8029	-0.1661	0.6829
S_MAST								-1.1774	0.0033	-1.2981	0.0016
S_BACH						1.2093	0.0036				
Time fixed effects	Q1_2000	0.2995	0.0001	0.3233	<.0001	0.3112	<.0001	0.3079	<.0001	0.3219	<.0001
	Q1_2001	0.3400	<.0001	0.3572	<.0001	0.3570	<.0001	0.3545	<.0001	0.3400	<.0001
	Q2_2001	0.1682	0.0311	0.1918	0.0136	0.1989	0.0096	0.1958	0.0106	0.1999	0.0093
	Q3_2001	0.3211	<.0001	0.3350	<.0001	0.3208	<.0001	0.3181	<.0001	0.3244	<.0001
	Q4_2001	0.4426	<.0001	0.4558	<.0001	0.4377	<.0001	0.4351	<.0001	0.4394	<.0001
F Value test for no fixed effects		3.65	0.0003	4.32	<.0001	4.29	<.0001	4.34	<.0001	5.09	<.0001
R-Square		0.4860		0.5003		0.5144		0.5146		0.5365	

Source: As in table 3.3. The hypothesis of random effects was rejected by Hausman test in all presented regressions at 1% level except for estimation (a), where it was rejected at 10% level.

First, it should be mentioned that macroeconomic variables do not seem to influence the MPCs' reactivity measured by squared change in interest rate, particularly no measure of inflation was found to have a significant impact. The second argument of the above-presented difference reaction rule – the unemployment rate – was found to have a significant influence but only as a four-quarter forward variance (UNEMP_V). This would testify for a forward-looking behavior of monetary policy makers. It seems that in such a homogeneous sample (the main OECD countries) with important interdependencies between the individual monetary policies, an important part of underlying macroeconomic relations is captured by the fixed effects.

Even if the control variables do not explain well the reactivity measured as a squared changes of the main interest rate, some insights are provided by MPC characteristics. First, one of important theoretical hypothesis is confirmed (e.g. Gerlach-Kristen, 2005), namely, that bigger committees tend to be more inertial. The previous findings of the present exercise are also confirmed. Again, among MPC characteristics mainly educational background (although measured in several ways) seem to influence reactivity of monetary policy. Interestingly, also the MPCs with higher feminization rates (S_WOM) tend to be more reactive.

Similarly to the results presented in paragraph **B.**, the MPC members with an MBA or Bachelor degree tend to be more reactive relatively to Professors, PhD holders and masters. It seems that an entrepreneurial education (MBA) induces people to be more active in general, a feature which might be also reflected in their behavior in monetary policy making.

The negative influence of the share of professors and PhD holders probably requires some further investigation. There are at least three possible explanations. First, academic duties are in some countries the only compatible with exercising the mandate of MPC member (e.g. Poland, and de facto the ECB Governing Council[150]). This may increase the individual alternative cost of information acquisition for the members exercising their extra MPC duties (even academic ones). Second, highly educated members may have a more

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[150] Point 3.4. of the Code of Conduct for the Members of the ECB Governing Council states that "Members of the Governing Council shall ensure that non-ESCB activities, if any, whether remunerated or not, have no negative impact on their obligations and will not damage the image of the ECB. In scientific or academic contributions, members of the Governing Council shall make clear that the contribution is made in a personal capacity and does not represent the views of the Governing Council or the ECB. When making public statements on ESCB-related matters, members of the Governing Council shall have due regard to their role and duties in the Governing Council." which suggests that academic duties are accepted.

pronounced consciousness of underlying uncertainty which, in turn, leads them to be more cautious in decision-making (see chapter 2 or e.g. Orphanides, 2003). This may be also linked to more inclination towards interest rate smoothing[151], which means that the changes from one period to another are small (and thus their squares also). Finally, but it seems impossible to check this hypothesis, academics in MPCs (or their important part) may lean towards an economic school advising against important monetary interventions[152].

All in all, the characteristics of the MPCs which were scrutinized in section 1 of the present chapter play an important role in monetary policy making. It was shown (similarly to Göhlman and Vaubel, 2007) that professional experience of MPC members affects the inflation performance. Namely, higher shares of private and academic economists as well as central bankers relatively to public economists and other members in the MPC lead to lower inflation, *ceteris paribus*. Also some preliminary evidence supporting the existence of an optimal MPC size of about 11 members was presented. With respect to the second important factor of the MPC efficiency – its reactivity – all proposed measured show that MPCs with higher share of MBA holders are more reactive. The other educational category leading to a higher degree of MPC reactivity is the bachelor diploma while the other categories, including the highly educated (Professors and PhD holders) proved to be relatively less reactive ones. Also higher levels of educational heterogeneity were associated with more reactive policy. Interestingly, higher feminization ratios lead to lower inflation rates through a more reactive policy. Finally, the average age nor measures of MPC dynamics (turnover and the number of changes) was not significant in any of the regressions.

3. Characteristics of monetary governance in accession countries

The comparison of MPCs in accession countries to those from the "old" OECD or EU members reveals some important differences. They seem to be quite persistent and, at least to a certain extent, may be explained by their "cultural" differences[153] or transformation heritage. However, one needs to be somewhat cautious as the subsample of enlargement

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[151] For an analysis of different possible explanations of interest rate smoothing in case of British MPC see Cobham (2003). A more theoretical point of view, indicating the collective decision making as a *reason* of smoothing is presented by Farvaque, Meon and Matsueda (2007).

[152] Compare e.g. Blinder (1997) and his comments on the commandment "Thou Shalt Not Fine-Tune" (p. 12).

[153] Cultural differences cannot be excluded in this context, as even inflation performance may be explained to a certain extent in this way – see Hayo (1998).

MPCs is significantly smaller (4 countries, 22 available positions in MPCs and the total number of monetary policy makers during 1999-2006 was equal to 38) than the OECD countries (9 central banks, 73 available positions and 150 monetary decision makers in the sample time span). In the following paragraphs the distinctive features of MPCs in enlargement countries are exposed.

MPC size and dynamics in enlargement countries

On the first sight MPCs in new EU members tend to be smaller than in the other countries (the average statutory number of members in NMCs is equal to 5.5 while in OECD countries it amounts to 10.5). Such a comparison is, however, problematic for at least a few reasons. First, the surveyed enlargement countries are on average smaller than other countries in the sample and the size of an MPC is highly correlated to the population (as well as to other measures of the country size, such as GDP). Second, the monetary policy committee at the Eesti Pank works only since February[154] 2001 and it takes no decisions concerning interest rates, as these are "imported" from the ECB due to the unilateral currency board arrangement. The weaker legal basis (in other countries MPCs are usually established by laws or even constitutions) and vaguer prerogatives make the position of the Estonian MPC weaker than its counterparts in other countries.

Considering the turnover in enlargement MPCs, it is generally comparable to the turnover in other countries of the sample: on average the MPCs composition was once fully exchanged (one complete rotation or so took place). However, two exceptions need to be noticed. First, the FOMC is an outlier with respect to this feature: due to the rotation scheme the composition of its voting members changed almost four times. Second, in Malta, Governor Bonello served during the whole time span (thus no change nor turnover took place). Additionally, contrary to some "old" OECD countries, in the enlargement subsample no vacant positions were observed during 1999-2006.

An interesting, influencing the turnover as well as the distribution of number of changes over time (and probably suboptimal) MPC design exists in NBP. Namely, except the President of the National Bank of Poland, all members of the Monetary Policy Council have the same term of office, which means that in its end 90% of the MPC are replaced every six years (which recently happened in early 2004).

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[154] The Governor Vahur Kraft established the Monetary Policy Committee composed of nine members by a decree on 27th February 2001. Its main tasks include the monitoring of the economic environment, "general management of the foreign currency reserves", coordination of the EP works in the area of financial supervision, its positions and estimations with regard to the Estonian economy and financial system as well as strategic developments at the EP (*EP Bulletin* No 3, 2001, p. 5).

3.1. MPCs' demography in enlargement countries

A remarkable difference between enlargement and "old" OECD countries is the age structure. More precisely, the MPCs members in enlargement countries are on average significantly younger then their counterparts in developed economies: for all the surveyed monetary policy members the mean age of birth was, respectively, 1952 in enlargement countries and 1945 in OECD countries. However, during the analysis period this age gap significantly decreased from slightly over 10 years in 1999Q1 to less than 6 years in 2006:Q3. The number of female monetary policy makers in enlargement countries stood at 2.[155] In the same period the number of women at MPCs in other surveyed countries increased, driving the tendency described in section 1.1. These demographic evolutions in enlargement as well as OECD countries are presented on figure 3. 7.

Figure 3.7 MPCs' demographic evolutions in OECD and enlargement countries
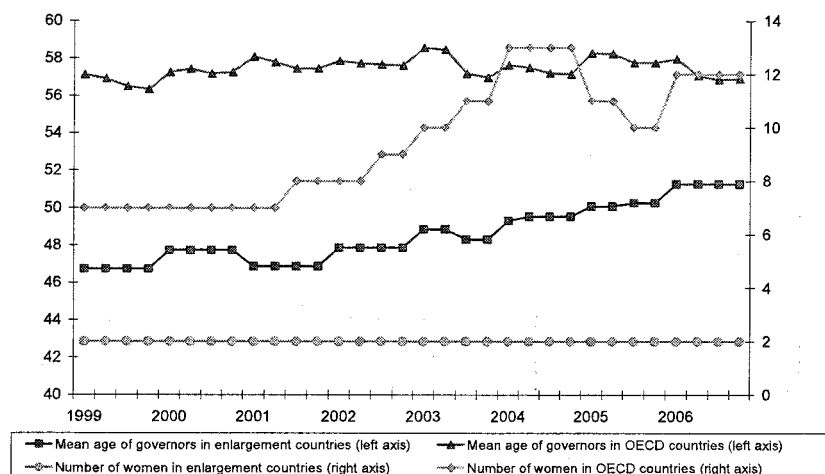
Source: author

Additionally, the distribution of years of birth of MPC members in OECD countries follows quite closely a normal distribution, which is much less the case in enlargement countries. This phenomenon might be, however, at least partially explained by the larger number of observations in OECD countries. The age distribution in the group of enlargement countries is presented on figure 3. 8 and may be compared to the one plotted for OECD countries, presented above on figure 3. 2.

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[155] However, they were not the same during the whole analysis period. In 2001:Q1 the President of the NBP Ms Hanna Gronkiewicz Waltz was replaced by Mr Leszek Balcerowicz and at the same time Ms Michaela Erbenová was appointed to the Czech MPC. At the Polish MPC changeover in 2004 Ms Ziółkowska ended her term of office and Ms Wasilewska-Trenkner started hers.

Figure 3.8 Distribution of MPC members' years of birth in enlargement countries

	Before 1930	1930-34	1935-39	1940-44	1945-49	1950-54	1955-59	1960-64	1965-69	After 1969

— Real cumulative distribution (no. of governors born before...) [left axis]
--- Theoretical cumulative distribution [left axis]
--- Real distribution (no. of governors born) [right axis]
--- Theoretical probability distribution [right axis]
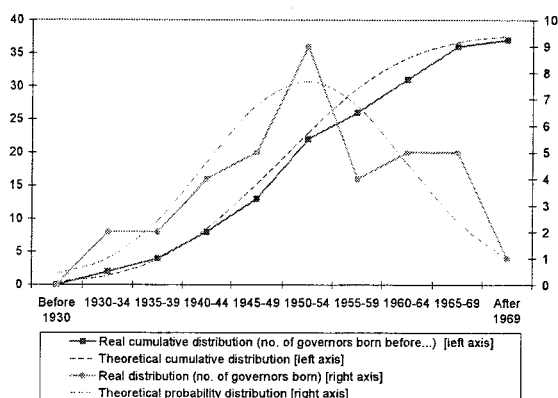
Source: author

There is at least one possible explanation for these differences. Namely, all enlargement countries in the sample (except Malta) are transition economies and nomination of on average younger MPC members than in "old" OECD countries might be driven by the aversion to the "old regime" (this is particularly visible in Estonia). However, this remark is not valid for academics (which were on average three years older than other MPC members in enlargement countries) – the social group seen as immune to political-historical heritage and whose competences increase during the whole career. These remarks as concerning a vast group of people are, obviously, quite general, and some counterexamples could be probably found.

3.2. MPCs' social characteristics in enlargement countries

While comparing social features of monetary policy makers in OECD and enlargement countries, a few points are easily remarkable. First, almost half of MPC members in enlargement countries are academics, which makes this group even more influential than in other countries. However, the general tendency of increasing the participation of this type is common to both subsamples. MPCs in accession countries were composed in about 20% of central banks' staff in the beginning of the analysed period. This share significantly subsequently decreased, which benefited to above-mentioned academics but also to private economists, who were absent on enlargement MPCs until 2001. Similarities of the MPCs in both groups of countries include the relatively stable number of public economists and marginal participation of the members classified as others. These evolutions are illustrated by figure 3.9.

Figure 3.9. Shares of different professional categories at MPCs in enlargement countries
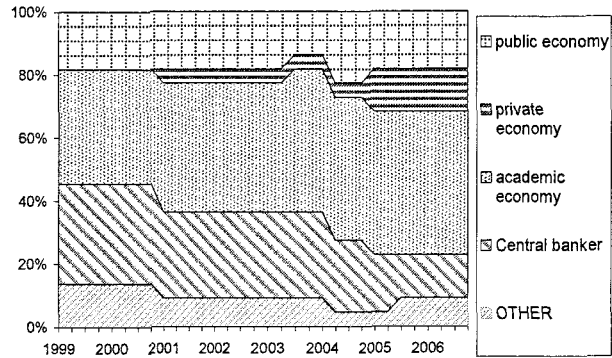
Source: author

The education structure of MPCs in enlargement countries is significantly different from that in other OECD members. In fact, only three out of the five categories distinguished for educational backgrounds are observed in accession countries. The educational attainments absent are bachelor level and MBA. This can be expected due to the educational systems prevailing until recently, where these formations were simply inexistent. Interestingly, in the other three categories the trend of replacing doctors by professors observed in the whole sample was present in both groups of countries. Moreover, in enlargement countries the part of master diploma holders slightly decreased, whereas in OECD countries their part increased at the cost of bachelors. Figure 3.10 presents these evolutions graphically.

Figure 3.10 Shares of MPC members with different educational backgrounds in enlargement countries
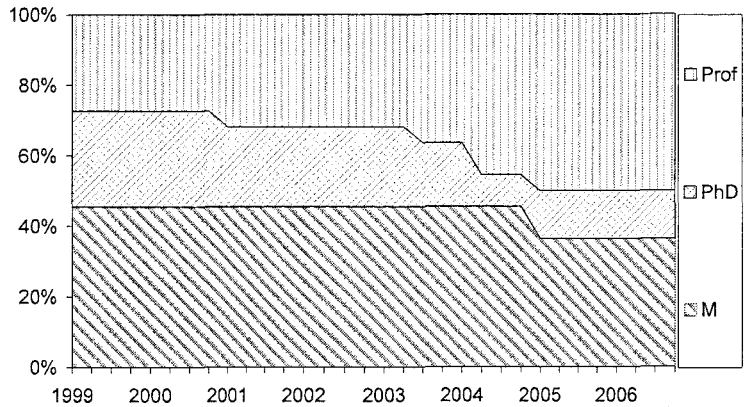
Source: author

3.3. Heterogeneity of MPCs in enlargement countries

Among the three enlargement countries, two (Estonia an Poland) have very homogeneous MPCs. Obviously, Malta is not even taken into consideration in this comparison, because with single decision-maker by definition it is perfectly homogeneous. Moreover, as already mentioned, the most homogeneous Executive Board of the Bank of Estonia has no real

monetary powers. What seems important, however, is that the Polish MPC was the only one whose homogeneity increased with respect to all its components. In contrast, the Czech MPC was among the most homogeneous in the beginning of the analysed period and became the fourth most heterogeneous (within the whole sample) in 2006. The heterogeneity indicators computed for the three enlargement countries are illustrated by figure 3. 11.

Figure 3.11. Heterogeneity indicators in enlargement countries
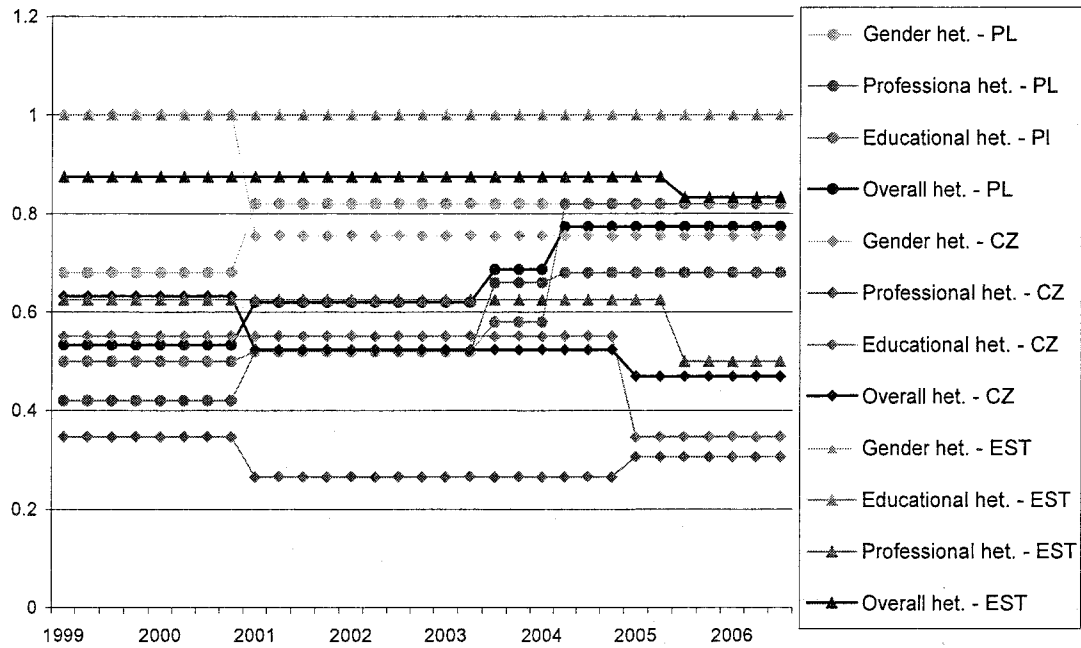
All in all, it seems that MPCs in enlargement countries have some specific features, like younger, in general, policy makers, even greater than in OECD countries part of academics and higher homogeneity. Nevertheless, as they generally follow the same trends remarked for the whole analysed sample, they are likely to become quite similar to their OECD counterparts in a foreseeable future.

Conclusions

The aim of this chapter was to present an international perspective for an assessment of the decision making in the European Central Bank. In order to do so, the first section scrutinized the decision-making bodies in major OECD countries and presented general trends in composition of MPCs. The second section presented the results of the empirical research aiming at finding significant relationships between the composition of these MPCs and their macroeconomic performance as well as reactivity. Finally, the third

section presented specificities of monetary governance in selected new EU member countries, which will sooner or later adopt the euro (Malta and Estonia sooner, Poland and Czech Republic later) and the Presidents of their central banks will enlarge the ECB Governing Council[156].

The Governing Council of the ECB (GC) is the biggest among MPCs in the world. Considering the professional structure of its members, it is dominated by the public economists, who account for over a half of its members (which is somewhat unusual taking into consideration the average structure of MPCs in OECD countries). With respect to educational background, it is in equal parts composed of Professors, PhD and Master degree holders (which is quite conform with the general trends). During all the analyzed period, there one female member sited in the GC and the average age of its members varied between 56.5 and 60.2 years.

According to the evidence presented in section 2, such a structure has some important consequences for the functioning of the MPCs. A smaller than average feminization along with a high share of public economists should lead to higher inflation levels. Actually, the average inflation rate of the euro area is only slightly above the (onweighed) average for all the analyzed countries and it would be difficult to argue that the average inflation of 2.06 percent over an almost eight-year period is a poor performance. However, a dominant position of highly educated members (and no Bachelors nor MBA holders) makes the GC not very reactive. This is probably aggravated by the size and consensual mode of the decision-making (see Gerlach-Kristen, 2005). Thus the composition of the GC may be treated as an explanation for its potentially insufficient reactivity as argued by many of its critics[157].

Beside the economic impact (which is not discussed here), the entry of the new EU member countries into the euro area will influence the composition of the GC. However, the presidents of the central banks in the analyzed new EU member states are not very representative for their MPCs (e.g. none of the incumbent Presidents is from the academia, even if academic scholars account for almost the half of their MPCs). Thus, beside the mean age (they are younger than the GC members on average), which was not found significant for monetary policy making in the present study, the impact of the enlargement will be significant mainly for the size of the GC (which is already deemed suboptimal). This problem will be extensively discussed in the following chapter.

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[156] The enlargement reform of the Governing Council of the ECB is in the focus of the following chapter.
[157] Compare e.g. Creel and Fayolle (2002 a and b).

Chapter 4

Impact of the enlargement of the euro area on the ECB[158]

Introduction

The Maastricht Treaty adopted in February 1992 (came into force on November 1st 1993) created a basis for the functioning of the European Central Bank (ECB) and European System of Central Banks (ESCB) as a monetary authority for the Economic and Monetary Union (EMU). The rules adopted were implicitly designed to work properly with 12 - 15 members of the then European Union (EU).[159]

The eastern enlargement of the EU necessitated reform of the ESCB. There was a well-established consensus in the literature that the initial decision-making structure of the ECB was completely inadequate in ensuring good policy-making in the EMU of 20 or more members[160]. A highly politically-influenced reform of the ECB's decision-making process was presented and ratified shortly before the 1st of May 2004, in spite of many criticisms.

On the theoretical ground this problem concerns the optimal decision-making model for a federal-type central bank with an important number of regions/countries. Nevertheless, a political economy approach, taking into consideration divergent preferences of different countries is also necessary.

This chapter is thus mostly focused on the functioning of the Governing Council as the most powerful body within the ESCB. Additionally, its composition and structure is not fixed and depended (before the reform) on the number of countries adopting the euro. To evaluate the reform proposals we use a three criteria set: economic efficiency, political acceptability and public perception.

The main objective of this chapter is to clarify the debate on ECB reform, to sum up the discussions on the enlarged ECB, to propose a more complex point of view - not only

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[158] This chapter draws heavily on Stanek (2004a)

[159] On the economic foundations of the EMU and related controversies see e.g. Alesina and Grilli (1992), Wojtyna (1998) or the seminal De Grauwe (2003) book.

[160] See e.g. Baldwin et al. (2002), Fitoussi and Creel (2002).

concerning the technical matters of the voting system, but also a more general view on the Statute of the ESCB and ECB. It is the author's intention that matters such as independence, accountability, credibility, transparency, strategy and finally the voting system should not be considered as separate but as a kind of package deal. Thus, this chapter will not only complete the theoretical aspects of collective monetary policy making presented in chapter 1 by a special focus on a federal-type central bank, but also will employ the results obtained by the analysis contained in chapters 2 and 3 in order to draw some lessons for the future of the ECB.

The chapter is organised as follows: section 1 provides an overview of the reform scenarios in the literature. Section 2 presents the reform proposed by the ECB and the critics that followed. Section 3 includes criteria set we recommend for the assessment of the ECB enlargement reform. Section 4 describes an alternative reform proposal. Section 5 attempts to objectively evaluate the different reform scenarios. Concluding remarks close the chapter.

1. Some proposals for reform

The Intergovernmental Conference (IGC) in Nice in December 2000 opened the way for reforming the EU institutions in the perspective of the entry of 12 new members. One of the institutions not reshaped at that time was the European Central Bank. Nevertheless, the Nice Treaty included the so called "enabling clause" which provided the possibility to reform the voting system in the Governing Council without a new IGC. Such a reform should be adopted by the Council (at the level of the heads of states or governments) by unanimous voting on recommendation of the European Commission (after consultation of the European Parliament and ECB) or on the recommendation of the ECB (unanimity in the Governing Council) after consultation by Parliament and the Commission (consultation procedure).

The most important monetary policy decisions in the euro area are taken by the Governing Council of the ESCB, initially composed of six members of the Executive Board of ECB (including its President) and all presidents of the national central banks from countries which have adopted the euro. Each governor has one vote. Formally, decisions are taken

by a simple majority vote with the President's vote breaking a tie[161] except in the case of "shareholder matters", where votes are weighted.

The importance of a reform of the decision-making framework in the enlarging ECB was highlighted by Baldwin et al. (2001) who argue that the enlargement of the EMU will pose some serious problems if the initial decision-making system remained unchanged[162]. They have underlined that increasing heterogeneity within the enlarged EMU will cause difficulties in adopting the optimal euro-wide monetary policy[163]. They argue that when the relative power of the Executive Board (which they suppose representing the purely euro-wide view) decreases monetary policy decisions might be taken by a coalition of smaller and poorer countries, with a higher growth rate and higher inflation (at least partially due to Balassa-Samuelson[164] effect). And even if they are not able to change policy their own way, the enlarged Governing Council would suffer from the increased 'status quo bias', which they define as a situation where the Governing Council hardly changes interest rates in response to economic evolutions or shocks, a hypothesis which is also supported by the chapter 2 and Gerlach-Kristen (2005). They argue also that voting rules matter even if, according to some statements of the former President of the ECB, they are rarely applied and decisions are consensual. This is because such a consensus is reached as dissenting governors are conscious of the potential vote record and thus win nothing by voting against a proposition which would be decided anyway.

Baldwin et al. (2001) also presented three reform options: rotation, representation[165] (grouping of countries) and "executive decision"[166]. All these solutions are based on rules reducing the number of national central bank governors who have voting rights.

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[161] Article 10.2 of the Statute of the European System of Central Banks and of the European Central Bank in its first version (in force until . For an analysis and comments see e.g. ECB (1999).

[162] The monetary policy framework of the ECB has been criticized even without enlargement in mind, see e.g. Creel and Fayolle (2002) or Fitoussi and Creel (2002). In the latter enlargement is taken into consideration but the first three years of ECB's monetary policy are also critically analyzed.

[163] However, the pace of enlarging the euro area is not as big as Baldwin et al. were afraid of: as of June 30th 2007 out of new EU member countries only Slovenia joined the EMU while Cyprus and Malta will join on January 1st 2008. For some other countries strategies see e.g. Rostowski (2003) or Smidkova (2003).

[164] For theory as well as some recent estimations of the Balassa-Samuelson effect in accession countries see Egert (2001 and 2003) and Klau and Mihaljek (2004). Other asymmetries influencing the efficacy of European monetary policy were analyzed by Aksoy et al. (2002). Other economic aspects of accession of the new EU member countries into EMU were tackled by e.g. Ca'Zorzi and De Santis (2003).

[165] Further in the text the term 'grouping' will be applied to this kind of reform, as 'representation' is one component in the proposed set of criteria.

[166] This section only sketches the existing options. Their more formal assessment according to the criteria set (proposed in section 3) is presented in section 5.

Rotation[167] means that governors of national central banks participate in votes with a certain frequency and consequently are not allowed to vote during some periods. Thus, the main questions to ask are the following: How numerous should the voting national central bank governors be? How long should be the voting periods? It is worth mentioning that in the case where changes are too frequent (when the vote-casting period is short) this may lead to some credibility problems. On the other hand, when the tenure as vote-casters is too long, some countries would have to stay without a vote for a long time, which might reduce the political acceptability of the solution. Rotation might be applied to a committee in a symmetric way (equal voting periods for every member) but asymmetric solutions are more flexible.[168]

Representation[169] relies on pooling national central banks in a few constituencies and on allocating a certain number of votes to each group. It may take numerous forms depending on the grouping criteria adopted[170] and decision-making schemes within the groups[171]. These two questions are of high political sensitivity and may pose problems at every enlargement stage (realistically supposing that the EMU enlargement will not occur in one wave of 10 countries but will be "spread" over time and that in the further future some other countries may wish to join the euro area).

"Executive decision"[172] means that the monetary power would be delegated to a monetary policy council- a group of independent experts (as currently is the Executive Board). This decision-making framework is applied in the majority of modern central banks. The main parameters at the core of "executive decision" are the number of decision-makers, the length of their tenure and the means of accountability. This solution is the one preferred by Baldwin et al. (2001) and takes the form of the current Executive Board enlarged by five independent experts ("outsiders").

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[167] The Federal Open Market Committee is an example of a monetary policy body where rotation applies.
[168] Several asymmetric rotation possibilities are analyzed by Berger, de Haan and Inklaar (2003).
[169] Grouping is applied in the decision-making system of the IMF; see e.g. Van Houtven (2002) for a deeper analysis.
[170] Such as size (GDP or population), inflation homogeneity, business cycle synchronization or geographic proximity. Different grouping possibilities (although in the context of asymmetric rotation analysis) are presented by Berger, de Haan and Inklaar (2003).
[171] For instance, the constituencies' representatives might rotate or be nominated by a group decision.
[172] In this chapter the term 'centralization' will apply to proposals where independent experts (e.g. the Executive Board) are the only decision-makers. As Berger (2002) remarks, any solution which gives more power to the centre (the Executive Board) and decreases the power of national central banks governors might be classified as 'centralization'.

Centralization is also found to be the first best solution in the framework of Berger's (2002) model, based on the standard time-inconsistency approach[173]. He distinguishes three types of decision-makers: board, governors representing the 'in' region (with bigger economic weight) and governors representing 'out' countries (new adherents with an above-natural output target and some structural inflation). The features of the "out" region imply an increased inflation bias, which is more accentuated as output considerations increase (the two regions are considered as having identical output-inflation preferences). However, structural inflation is compensated by lower tradables inflation target in the "out" region.

Berger (2002) assumes that the members of the board takes the euro-wide perspective (inflation and output targets of "in" and "out" regions are weighted by their respective economic size), and governors coming from both regions consider situations in their countries of origin. Consequently, the governors apply to their loss and reaction functions parameters (inflation and output targets) characterizing their respective countries.

Berger (2002) also analyses the weighting of votes (not mentioned by Baldwin *et al.*, 2001) and finds it to be the second best solution, which implies, however, some decision-making costs (due to higher number of decision-makers). The third best solution is then to fit political weights with the economic ones less precisely but try to avoid a large number of decision-makers (for example by an asymmetric rotation scheme). This article is the most formal one among those quoted herein concerning ECB enlargement reform. Nevertheless, it seems to forget any political questions, which would certainly dominate a sensitive area like common European central banking.

Political and juridical questions are present in Artus and Wyplosz (2002).[174] Their three propositions are very similar to those mentioned above, though their "centralisation" scenario is a simple delegation to the Executive Board. They also propose numerous criteria for the design of the enlargement reform of ECB decision-making system, among which:

— number of voters, which should be restrained;

— stability– constant number of voters and no need for adaptations to future enlargements;

— communication smoothness– all committee members should work in headquarters;

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[173] Based on Kydland and Prescott (1977), Barro and Gordon (1983), and Rogoff's (1985) works. For a survey see Cukierman (1992) or Bofinger (2001).
[174] Judicial feasibility of potential reform scenarios is analyzed in the appendix to this work, by Louis (2002).

— national bias[175]– e.g. incentives to choose monetary policy from the country-specific, and not purely European point of view should be avoided;

— problem of big and small countries– solution should be acceptable for all;

— accountability[176] - the reformed ECB should be somehow controlled by a democratic institution. Authors acknowledge difficulties in the European context as the most democratic institution- the European Parliament - has only limited powers and they propose instead to increase ECB transparency[177] e.g. by more frequent communications and policy explanations.

Some criteria, mainly concerning socio-political issues, are also proposed by Heisenberg (2003). Four criteria are mentioned:

— efficient decision making, which is fulfilled when the reformed Governing Council is able to take "consistent" decisions (which should be understood as leading to stable and predictable monetary policy in general);

— problem of human resources, which is solved when all countries are satisfied with 'diplomatic' and 'prestige' issues;

— building a sense of common European identity, which is met when a solution does not use a Member State as a unit of analysis (it reflects the lack of national bias mentioned above);

— democratic legitimacy (treated together with accountability and transparency).

Using these criteria, Heisenberg chooses grouping as the best reform proposal. According to this author, this solution "rejects the Member State metric and begins grouping geographical areas together to solve the problem of both human resource and that of efficient decision making". Nevertheless, this proposal is not free from some important

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[175] For some discussion of this phenomenon in the existing ECB as well as a weak (but existing) evidence see Heinemann and Huefner (2004) and for the support from American experience see Meade and Sheets (2002).
[176] The debate on central banks' accountability is highly present in economic literature; see e.g. Banque de France (2000), Randzio-Plath and Padoa-Schioppa (2000), Schürz (1997), Briault and Haldane (1996). Very interesting and important discussion between Buiter (1999) and Issing (1999) took place in the columns of the Journal of Common Market Studies. Pollard (2003) analyzed these features while comparing the ECB and the American Fed.
[177] Transparency is obviously not the same as accountability. Nevertheless, means of transparency and accountability may be sometimes alike, but the addressees are different: in case of accountability these are political bodies, in transparency it is the general public and financial markets. Transparency and accountability are analyzed somewhat deeper in section 3, as they are important components of criteria proposed for the assessment of reform proposals.

flaws. One of them was mentioned earlier by Fitoussi and Creel (2002): this scenario would complicate the (even now relatively complex) system of territorial units in the EU.

Among the different reform possibilities Fitoussi and Creel (2002) indicated another one: direct nomination. This means that the current Executive Board should be completed by a fixed number (nine) of national central bank governors. This nomination would take place in two steps: two committees would propose members to the Executive Board and candidates (among the national central bank's governors) to sit in the Governing Council, and the final decision would be taken unanimously by the European Council. Optimism concerning feasibility of such a nomination process is based on experience of political negotiations on the nomination of the first ECB President- Wim Duisenberg and his successor- Jean-Claude Trichet. Their second-best solution would have been to adopt a rotation process with two seats permanently reserved for the (four) larger member states.

2. The new decision making framework of the ESCB

The solution, agreed by the Council[178] before national ratifications, was firstly proposed by the ECB Governing Council on February 3rd 2003.[179] The proposal consisted in dividing countries into three groups on the basis of a "composed indicator". This ranking takes into consideration the GDP shares (with a weight of 5/6 for the ranking) and the importance of the national financial sector (total assets, with a weight of 1/6). The first group would be composed of five countries with the highest ratings, the second group would include half of the national central bank's governors with the next rating positions and the third would comprise the remainder. There would only be 15 voting national central bank governors in the Governing Council: four coming from the first group, eight from the second and three from the third group. Such a reform would enter into force as soon as the euro area would be extended to 22 members.

The proposition includes two intermediate phases: no change before the monetary union exceeds 15 members, and two groups when the number of member countries is comprised between 16 and 21. In this case, the first would be composed of five countries and the latter of the remainder, with 4 votes for the bigger countries and 11 votes for the second group. The five biggest countries would vote with a frequency of 80%, and the "intertemporal voting power" of intermediate countries would depend on the total number

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[178] Published on March 21st and in the Official Journal on April 1st 2003
[179] It was made public in a press release on December 22nd 2002, but officially proposed two days after the Nice Treaty entered into force– see ECB (2002) and (2003).

of member countries. The voting frequency of the second group of countries in this intermediate stage would gradually diminish to attain 68.75% in the case of 21 members. This intermediate stage might be postponed until the number of EMU members attains 18, if such decision were taken by a two-thirds majority of members of the Governing Council. Such decision would mean a temporary enlargement of the Governing Council up to 24 members.

In the final reform stage, second group countries would vote with a frequency varying from 72.3% in case of 22 members to 57% in case of 28 members (15 "old" EU countries + 12 new EU member states + Turkey). In the latter case a third group country would vote with a frequency of 33.3%. This means that for the first two groups the vote-casting periods are longer than the non-voting ones and that the time the smallest countries will wait for their votes is twice as long as the voting period.

The ECB's proposal was largely criticised by economists[180]. Their critics concerned numerous flaws of the proposed reform, which included:

Limited capacity of improving the existing decision-making, because the number of decision-makers is still too large (Gros, 2003, Wyplosz, 2003). A 21-person monetary policy body would be the biggest among the OECD countries and, for example, the Bundesbank was reformed especially to avoid the over-twenty-participant Bundesbankrat. Furthermore, the number of discussion participants is not limited at all, which may lead to long-lasting meetings and consequently weaker responsiveness to economic evolutions and finally problematic efficiency in taking decisions (Bofinger, 2003). Although the weaker responsiveness of the larger committees was not empirically proved in the previous chapter, a negative impact on inflation performance was shown for the committees exceeding 11 members (see table 3.3 and comments above).

Lack of transparency implied by the level of complication in the rotation mechanism (Gros, 2003), which could "undermine the trust of Europe's citizens in the ECB and in Europe's institutions in general" (Bofinger, 2003).

Violation of rules of "one member one vote" and "ad personam participation" (Bofinger, 2003) and the renunciation of the principle of member states' equality (Gros, 2003, Bofinger 2003) by creation of a three-class membership. These features would reinforce

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[180] See Bofinger (2003), Gros (2003) and Wyplosz (2003), briefing papers for the European Parliament as well as Horn (2003), who presented an arbitrary proposition for the allocation of votes.

national considerations in monetary decision-making processes and eventually threaten ECB independence. Moreover, the third group would solely consist of new entrants (as a place in the second group was guaranteed for the smallest current member in terms of GDP- Luxembourg by including the total assets of financial system in the "composed indicator"; Gros, 2003; Bofinger, 2003).

A decreased national central bank governors' accountability for general monetary policy, because their personal responsibility would be diluted by the rotation scheme (Bofinger, 2003).

The lack of sufficient degree of precision, and notably lack of precise definition of the rotation mechanism within groups and possibility to postpone the rotational system unless the euro area reaches 18 members, makes the proposal unclear (Gros, 2003).

Wyplosz (2003) also remarked that, in general, the proposal is internally inconsistent. If the national central bank governors do not represent their own countries but act as independent experts (which is systematically argued by the ECB officials and a priori guarantees the credibility of the ECB), then the proposed rotation scheme is problematic and useless. It is difficult to show logically any relationship between the size of the country and personal capacities of its national central bank governor. In other words, the weighting of votes (also by asymmetrical rotation) means that national considerations matter, which has been denied by the ECB since its inception.

The three above-mentioned authors rather advised a more centralized approach. Though their counter-propositions differ in details, all of them recommend an increase in the policy-making powers of the Executive Board (possibly enlarged to 8, 9 or even 10 members).

The European Parliament (2003), in line with these criticisms, published a report and rejected the ECB's reform proposal. In addition to the afore-mentioned arguments, the report remarks that in a 25-country EMU, it would become theoretically possible that a coalition of small countries, representing only 10% of the Euro area GDP, decides the European monetary policy despite the opposition of the four largest countries and the Executive Board (the latter would count for 10 votes and would be outweighed by the other 11 voting governors). Consequently, under this reform proposal, the Governing Council is far from being representative of the euro area. Moreover, the transparency of the

ECB proposal is doubtful, because the adopted rotation system is too complicated to be made clear to the public.

As an alternative for the ECB reform project, the Committee for Economic and Monetary Affairs of the European Parliament proposed a double-majority voting system (simple majority + qualified majority of 60% of euro area population). It mentioned, however, that in a longer perspective, a delegation of monetary power to a supranational enlarged Executive Board would be in line with a genuinely European approach.

The Council's decision to adopt this reform proposal, despite the will of the most democratic European Institution and in contradiction with the opinions of the Commission's amendments[181], appears to be sub-optimal. Before it entered into force, ratification by all member countries according to their constitutional requirements was necessary, which might have allowed to reject it and to adopt a better solution. Nevertheless, "old" member countries ratified the amendment and the proposed reform entered into force shortly before the EU enlargement on May 1st 2004.

3. Defining a new set of reform criteria

Before turning to the assessment of the different reform scenarios, designing the proper organization of the Governing Council of an enlarged Euroland is necessary. Conceptually, a central bank is established in a political process to ensure economic stability and consequently the welfare of the citizens. This statement, either too general or too naive, is at the origin of the proposed criteria set. These criteria will touch three previously mentioned spheres: economics, politics and citizens (their rights and need for democracy).

We propose to name these three criteria as follows: economic efficiency, political acceptability and public perception. They are comprehensive and may be taken as criteria groups, of which more precise components are given later. It is worth underlining that all components have already been indicated (in one or another formulation) in the literature. The novelty of our approach is the crucial link established between the three distinguished spheres. It implies that enlargement reform of the ECB should not be seen as pure reshaping of the decision-making structure but should rather be considered as a package

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[181] Commission's opinion, dated 19.02.2003 was positive, but recommended limiting the number of voting Governors, including countries' populations in the composed indicator and asked for more precision in rotation schemes within groups.

deal, which will establish a new quality in the functioning of the ECB. Thus, it would require an upheaval in the Statutes of ESCB and ECB.

3.1. Economic efficiency

The economic efficiency criterion examines whether the reform proposals improve the satisfaction of the central bank's objectives[182]. In the case of the ECB, the main objective is to guarantee price stability in the whole Euro area, which was (re)defined in May 2003 as maintaining inflation rates below but "close to 2%" over the medium term. The efficiency of the monetary policy body is thus connected with its potential to attain its objective(s)[183]. In the case of the ECB, we take the position that it will mainly depend on its credibility[184] and independence[185]. Efficiency also depends on the Council's potential to make accurate decisions just at the right time and, in this perspective, the number of members (to avoid the never ending deliberations and above-mentioned "status quo bias") and their possible motivations– national or euro-wide point of view[186]– are crucial.

Credibility of the monetary policy body is difficult to establish *ex ante* and normally follows well-managed policy experience. Nevertheless, some institutional arrangements may undermine the ability to achieve it. Notably, when the personal configuration of a policy-making institution changes too often (in the most extreme case, at each meeting a different group of people decides the monetary policy), it may be difficult for the public and financial markets to believe that it will lead a continuous, time consistent and eventually appropriate monetary policy. Thus, arrangements which may dilute the responsibility (such as rotation) will be considered here as endangering the credibility[187].

Independence is another feature of a modern central bank closely related to its efficiency. It reflects the level of autonomy of a central bank (economic, goal setting and legal). According to many economic publications the ECB is the most independent central bank in

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[182] For some new theoretical underpinnings of the monetary policy framework in a monetary union, see Matsen and Røisland (2005) and the comment by Méon (2007) as well as Dixit and Jensen (2000 and 2003).
[183] For a discussion of possible monetary policy goals in context of its efficacy see Wojtyna (2000).
[184] Credibility as a mean to attain the price stability objective was introduced by time-inconsistency literature. For an assessment of the credibility in new EU member countries see Arestis and Mouratidis (2005).
[185] See e.g. Alesina and Summers (2003) or Bassoni and Cartapanis (1995). A critical view is presented e.g. by Posen (1993 and 1998)
[186] Berben et al. (2003) and also Berk and Bierut (2003) indicated some theoretical advantages of including governors from different countries as 'experts' on regional economic situations. Nevertheless, recall that in Berger's (2002) model, national preferences make decisions adopted by the Governing Council sub-optimal.
[187] It may be also argued that working together for the common monetary policy may build up a sense of co-responsibility. However, in this article, we retain the existing argumentation of e.g. Baldwin et al. (2001, p. 23) and Bofinger (2003, p. 5) that rotation solutions decrease credibility. A discussion of credibility and reputation issues in a newly created central bank is provided e.g. by Rotondi and Vaciago (2003).

the world (as its governors practically cannot be revoked, enjoy a long term of office, quantify their objectives themselves, etc.)[188]. Nevertheless, if a reform tends to diminish the level of ECB independence, it obviously may lose this leading position[189]

Size problems should be understood as an excessive number of members, which may make difficult good and timely decision-making. It may be problematic to have either too many decision-makers or discussion participants.

Finally, assuring the decision-makers' euro-wide point of view can be regarded as the best means to attain the interest rate which would be optimal for the euro area as a whole.

3.2. Political acceptability

Political acceptability is related to today's (indirect) democracy and for the goals of this article will be composed of 'adoptability', accountability and precision of formulation.

In a political system, where citizens delegate a part of their freedom to their states' institutions and, further, countries delegate a share of their sovereignty to international organisations, control on the use of these delegated powers is necessary. The European Union is an example of international organisation whose supranational powers are very strong, especially in the areas of competition, external trade and monetary policy.

Therefore, when establishing rules for these supranational authorities, the Member States tend to be extremely cautious, especially as all amendments of international treaties (which regulate the functioning of supranational institutions) will need unanimity. The mechanism which plays an important role here is the trade-off between the gains of efficiency attained by delegating responsibilities and the costs incurred by a loss of sovereignty. Additionally, unlike in strictly political areas, where (theoretically) all countries are of equal weight, in the economic field, bigger countries wish to exercise more power since even a small relative loss may be huge to them in terms of real effects.

Thus, on the one hand, we have the theoretical rule (i.e. all countries' votes are equal) and, on the other hand, we may observe discrepancies relied on different economic weights. To find a political-economic solution, some kind of compromise is needed. This compromise, satisfying all countries and increasing the probability for a reform to be accepted, will here be labeled "adoptability". "Adoptability" is to be understood as a division of votes in the Governing Council that matches the economic strength of the respective countries. These considerations are highly important when

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[188] For an index of central banks' independence, see e.g. Cukierman *et al.* (1992) or, more recently, Gutiérrez (2003)
[189] This does not mean an automatic policy worse-off. Nevertheless, most economists believe that there is a clear link between a high degree of independence and low inflation. For a survey of the issue see Berger, de Haan and Eijfinger (2001).

governors tend to be considered as their countries' representatives. A more precise proposition of the measure for adoptability is presented in box 2.

Box 2 Under-representation indicator

Let us assume that countries wish to exercise at least as much voting power in the Governing Council as is their respective GDP share in the euro area. By voting power we understand the weight (share) of a country's vote in the whole Governing Council.

In other words the problem of adoptability of a solution is supposed to come from the GDP, which is not fully recomputed into the voting power. To explain the sense of the proposed "under-representation indicator", a few simple examples are needed.

Consider a Governing Council which will be dominated by the big countries, let us say representing 80% of total euro area GDP. It means that the GDP not represented in such a Council is 20%. But this solution will not be acceptable (adoptable in the term of this article), because the majority of European countries (small countries) will not be represented. On the other hand we may have a Council dominated by a coalition of small countries. Such a Council certainly will not be adoptable because the big (underrepresented) countries will object.

This (extremely sketchy) analysis implies the construction of a simple under-representation indicator. Let us firstly compute the total GDP which is underrepresented in voting powers. It is the sum of positive differences between the GDP and voting shares (if a country is underrepresented, the difference is added up, if it is not underrepresented, the underrepresented GDP equals 0). Secondly, one should compute the share of number of under-represented countries (if there are 10 underrepresented countries among 25, this share equals 40%). Finally, the mean of this two values gives the "under-representation indicator".

Arbitrarily, we set the limit values (for the assessment of reform adoptability) to 25% (if it is lower, the reform is considered as fully adoptable and 50% (if it exceeds 50%, the reform is unacceptable). The first interval (0-25%) means that less than a fourth of power (economico-political) is redistributed, the second (25%-50%), that less than a half of this power is reallocated and the last one (over 50%) means that there is more than 50% unsatisfied (in terms of countries and/or GDP).

The calculations of the under-representation indicator are presented in appendix. Countries are ranked by decreasing value of "composed indicator" used in classification of countries in the ECB reform proposal[1].

Voting powers are calculated as follows: frequency (or number or share - depending on the reform adopted) of votes divided by the total number of votes. The obvious flaw of this approach is in ignoring possible coalitions (voting powers in the enlarged EMU measured by Banzhaf indices thus taking into account "winning coalition capacity" was performed by Fahrholz and Mohl, 2003).

Among reform possibilities weighting votes and constituencies were ignored. In the case of direct GDP weighting, the value of the indicator should probably be very close to 0.[2] In the case of constituencies the results should not differ significantly from those computed for rotation schemes.

1. See Horn (2003, p.6).

2. A potential problem might stem from slight differences between economic weights and voting powers. In such case, as much as a half of the total number of countries might be underrepresented (while others would be over-represented). This would finally lead to relatively high value of the underrepresentation index (approximately 25%).

Accountability means that decision-makers should be responsible for their decisions. In the special case of central banks, a trade-off between accountability and independence is necessary[190]. As mentioned above, the ECB is considered as a very independent institution and one could infer from this that some measures of ensuring accountability are needful.

Accountability is determined by the ECB's reporting obligations to the EU's and national institutions, as well as some control or supervision powers over the ECB, which these institutions may exercise. In contrast to national central bank, which may be somehow accountable also to their nations, we suppose that the ECB is only accountable to political institutions of the Union and member states. For this reason, as well as because it might be good substitute for 'adoptability', the accountability is part of political acceptability criterion and is not taken into consideration in public perception.

A precisely formulated reform proposal leaves no doubt about the composition of the interest rate setting body at any point in time; i.e. one should know not only the frequencies of voting (in case of a rotation-type scheme) but also the schedule. It might be important to know who after whom is going to have the right to vote (in order to analyze potential coalitions) and consequently at least the rules for this order should be fixed. The minimum might be considered as stipulating in the Statute of the ESCB and the ECB (or other act enforcing the reform) who, when, and under which conditions will decide about this schedule. This high degree of precision in the definition of the scheme is needed to avoid any future misunderstandings.

3.3. Public perception

Public perception is our third proposed criterion, which includes transparency simplicity, durability as well as representation[191].

Transparency means that mechanisms and decisions should be made understandable to the public, including financial markets[192]. Obviously the communications to the general public and those addressed to financial agents will be different, but these problems are not of our direct concern. Obligations such as publication of minutes, voting records and motivations are the most relevant to enhance the central bank's transparency. Increased transparency

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[190] See e.g. Artus and Wyplosz (2002, p. 57).
[191] For a measurement of public support in the case of the ECB and its implications see Maier (2002); Maier and Bezoen (2002); Maier and Hendrikx (2002). The latter analyses also the probable support for the ECB after EMU enlargement.
[192] For theory as well as an excellent new index of central banks' transparency see Eijffinger and Geraats (2003). For more information and other concepts see Geraats (2001) and Winkler (2000).

will probably increase the public support for monetary decisions taken by the reformed ECB.

Simplicity means that the functioning of the Governing Council should also be made understandable in order to generate public support for the reform (and the ECB).

Durability is connected with adaptability to different enlargement scenarios (with potentially numerous stages) without any need for further negotiations. Citizens may be tired of seeing repeated quarrels about the ECB. In the case of a durable solution, public understanding and eventually the support for the ECB will probably be enhanced. Durability as well as simplicity are directly related to the design of decision-making structure and depend solely on rules constituting the Governing Council.

Representation, understood as a certain decision-making power in the hands of every country, is also in the interests of the general public, and for example, a Council dominated by nationals of one country (even if they were the highest class specialists) would not enjoy the enormous euro-wide public support. On this point, representation is

close to 'adoptability', but it mimics the point of view of a citizen of a certain country (*Is my country's interest represented in the Governing Council?*). As some reforms proposed would need the Statutes of the ESCB and the ECB to be amended, they would thus need to be ratified (at least in some countries) by a referendum. Henceforth, exclusion of any country from the decision-making process might endanger public perception in this country and question *de facto* feasibility of the reform.

These criteria take into consideration three main aspects of monetary policy: politicians (governments) establish rules for the ECB, which, by the (macro) economic mechanisms should ensure the welfare and stability for the general public. The criteria and their components are summed-up in table 4.1. For an attempt at numerization of these criteria, see section 5.

Table 4.1 Reform criteria and their components

Economic efficiency	Political acceptability	Public perception
Independence	Adoptability	Transparency
Credibility	Accountability	Simplicity
Size problems	Precision of formulation	Durability
Euro-wide view		Representation

Source: Author

4. Alternative reform proposal

Following the proposed three-criterion set, the solution we would like to present for the enlarged ECB will consist in three spheres. First, and foremost, the decision-making structure must be reformed to ensure the economic efficiency of the Council. Second, the political dimension should be taken into consideration, and in this matter the proposition consists in some additional accountability measures to be adopted. Finally, the transparency of the ECB should be enhanced, for the comprehension of the general public and better information for financial markets.

The present approach distinguishes among the existing propositions because it argues that there is no possibility to successfully prepare the ECB for the enlargement by reforming only the decision-making structure. Thus, the reform proposed would require a substantial reshaping of the Statute of the ESCB and the ECB. Consequently, the whole decisional process applicable to the treaties (an IGC, the signature of amendments to the Treaty and finally the ratification process) would be necessary. This may be complicated and time-consuming but the ESCB and the ECB need a good framework for their functioning indeed.

4.1. Reforming the decision-making framework

The solution we would like to propose for a new European monetary framework follows the centralization scenario. This choice is the one preferred by a majority of the above-quoted authors and seems to be optimal from the economic point of view. It may suffer, however, some criticisms from political and democratic points of view. These questions are addressed in the two following subsections.

The proposed solution relies on delegation of the operational decisions, including interest-setting power as well as exchange rate powers (foreign reserves operations), to an enlarged, nine-person Executive Board[193]. These three additional members should ensure a larger political representation. However, they would represent solely the interests of the euro-area as a whole, which should be, in our opinion, enshrined as a principle into the treaties[194].

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[193] An Executive Board composed of up to 11 members seems also possible and would not pose any number problems (such and Executive Board would be still smaller then the FOMC) and, according to the evidence presented in chapter 3 this size is, *ceteris paribus*, close to the optimal one.

[194] Members of some other bodies of the EU: the Commission, the Court of Auditors (both supranational), as well as the Economic and Social Committee and the Committee of Regions, should act "in general interest of

Nevertheless, any strategic decision, requiring no urgent action (which interest rate or exchange rate policy may need) would stay in the hands of the Governing Council in its present composition (the Executive Board and national central bank governors from countries which have adopted the euro).

These strategic decisions would, in particular, comprise such actions as adopting legislative acts and broad policy guidelines, defining medium-term targets and fixing the procedures for the ECB. Other important tasks like decisions concerning international co-operation (art. 6 of the present Statute) or advisory powers (art. 4) to any European institutions in fields of competence of the ECB or fixing minimum reserve requirements would be also in the hands of the Governing Council. Thus, the Governing Council would keep some control over the new Executive Board.

The distinction between strategic and operational decisions comes from Bofinger (2003). However, his proposal includes a veto power in the hands of the Governing Council. It might be, nevertheless, difficult to implement it in practice: if the operational decisions are delegated to the Board, it is because the Governing Council is considered as acting too slowly. Consequently, a veto power in the hands of a large body does not make much sense. Instead, accountability should be enhanced (see below).

The new Executive Board members should be chosen in a procedure similar to the present rules[195]: they would be appointed by the Heads of States and Governments on a recommendation of the Council after consultation of the European Parliament and the Governing Council. To ensure a wider range of opinions[196], it may be useful to have a "distinguished personality" from the private sector as a member of the Executive Board. Nevertheless, it is not recommended to set too detailed requirements for the candidates for the Executive Board, as we believe (similarly to Fitoussi and Creel, 2002) that they may block some suitable candidatures. On the other hand, too loose characteristics complicate the appointment system and do not bring much added value. Such a political process would probably ensure that appropriate candidates are chosen and at the same time does not suffer from the democratic deficit.

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the Community" (art. 213.2, 247.4, 258 and 253 of the TEEC - numeration according to the Amsterdam Treaty). This statement is not present in the Statute of the ESCB and the ECB nor in related articles of the Treaty.

[195] Art. 11.2 of the Statute of the ESCB and the ECB.

[196] As shown in the preceding chapter, heterogeneity ensures a more reactive monetary policy.

This (political) reasoning and optimism concerning its outcomes are also based on Fitoussi and Creel (2002) and particularly their comments on the "direct nomination" proposal. Nevertheless it does not concern the co-optation of national central bank's governors to the Executive Board but the method of appointment of all its members.

It is worth recalling, that, beside Fitoussi and Creel (2002) and Bofinger (2003), centralization scenario was also the preferred solution of Baldwin *et al.* (2001), Artus and Wyplosz (2002), Berger (2002), and Wyplosz (2003). Hence, our debt towards their work.

4.2. Additional accountability measures

The accountability of this solution is, to a certain (nevertheless insufficient) extent, ensured by the political process of nomination of the Executive Board members, where the European Parliament (as the most democratic among the EU's institutions) plays a consultative role. This should be enhanced by involving the members of the European Parliament in the "preselection" process of candidates to the Executive Board, (*cf.* Fitoussi and Creel, 2002).

However, accountability also necessitates some supervision during realization of tasks and duties by the decision-making body. This is the reason for more frequent reporting obligations to the European Parliament. Regular explanations of policy decisions and strategies are even more important, due to the extremely high level of the ECB's independence. The present monetary dialogue, which is held on a quarterly basis, should be more frequent - in our opinion, the best solution is to organize monthly meetings, and in the case of special decisions taken by the ECB, *ad hoc* hearings.

In this reform proposal, we argue that some additional accountability measures (as described above) are necessary to balance the resistance of politicians to any steps towards centralization (or federalization).

4.3. Enhanced transparency

Taking into consideration a certain level of 'mistrust' of the public towards such an independent and relatively new institution as the ECB, it is advisable to make it as open and understandable (transparent) as possible.

Any special obligations need not to be enshrined in future treaties to make the ECB more transparent but would perpetuate its good practices in the area. Since its inception, the ECB has increased its transparency without any statutory changes- see Eijfinger and Geraats

(2003). Following their transparency index, we would like to recommend improving the ECB's communications especially in the procedural field, i.e. publication of voting records and minutes of the meetings.

These additional transparency measures might be undesirable in a decentralized Governing Council. The first argument against is the possibility of inciting public debates accusing 'others' of adopting a policy not optimal from some country's perspective. Such mediatic accusations are easier if the vote record is known when voters are clearly identified with their countries (governors of national central banks). Second, more accentuated political pressure on countries' governors would be possible, as the 'lobbyists' would be able to 'control' voters' behavior. Once again, in case of a centralized decisions, national (or any other) pressures on decision-makers would have less sense and voting records might even enhance the personal independence of the members of the Board.

Summing up, additional transparency requirements should probably generate public support and enhance comprehension and thus credibility in the case of a centralized European monetary policy body, without national connotations.

This solution, which restrains the size of monetary policy body, does not suffer from any national bias, and the Executive Board's credibility will not be endangered *ex ante*. These features together with guaranteed independence should allow price stability objectives to be met. The increased accountability should make this reform proposal politically acceptable for member states in spite of the lack of national representation. Its simplicity, durability and transparency will also probably generate public support. Obviously, political acceptability as well as public perception are very difficult to assess objectively, but to estimate the latter we could, for example, arrange opinion polls.

As mentioned above, this complex solution would require considerable amendments to Treaties (even if some proposed changes- e.g. transparency measures - need not to be written into them).

5. An assessment of major reform proposals

In the quest for objectivity of the criteria proposed in section three, we establish an assessment scheme, which allows for numerical (and thus potentially more objective) judgment (criteria coding is presented in table 2). A first numerical attempt to assess the reform proposals in view of the proposed three-criterion set is presented in table 3.

5.1. Criteria coding

All the adopted criteria assume a value on a range between 0 and 5. Criteria assessments depend on some simple features (also presented and defined in section 3), which were weighted in order to attain the value of 5 for each criterion. These weights are arbitrary, but reflect the importance of components, as argued below. Components whose weight equals to 1 are assumed to be discretionary variables.

Table 4.2 Criteria measurement

Economic efficiency 0-5	Political acceptability 0-5	Public perception 0-5
Independence 0-1	Adoptability 0-2	Transparency 0-2
Credibility 0-1	Accountability 0-2	Simplicity 0-1
Size problems 0-2	Precision of formulation 0-1	Durability 0-1
Euro-wide view 0-1		Representation 0-1

Source: author

Among components of the economic efficiency criterion, the higher rank (2) is accorded to size problems. This choice is justified by the fact that the size problem is the most directly related to enlargement of the ESCB. This component assumes value of 2, if the number of decision-makers does not exceed 15,[197] equals 1, if the number of decision-makers is comprised between 15 and 21, and 0 if it exceeds 21.[198] Independence is given 1, if the index of legal central bank independence (Cukierman et al., 1992) does not fall below 0.7,[199] and 0 instead. As remarked above, we only consider the credibility of the adopted decision-making structure of the monetary policy body and not credibility of its actions. The monetary policy body is assumed to be credible if at least 50% of its members are permanent ones[200]. In this case the component takes value 1, in the opposite- 0.

Within the criterion of political acceptability, the higher weight (of 2) is accorded to adoptability and accountability. These two features seem to be more important than the precision of formulation, which is only a formal (and relatively easy to meet) requirement. Adoptability equals 2 if the under-representation indicator (as defined in box) does not exceed 25%, amounts to 1 it the under-representation indicator is between 25% and 50% and 0, if it exceeds this value. As a proxy for accountability we have chosen the reporting obligations to the European Parliament. Consequently, the component equals 2 if reporting

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[197] Number equal to the number of Bundesbankrat members (after reform).

[198] Number to which the Governing Council will be limited after the adoption of the reform.

[199] Value accorded to the Bundesbank by Cukierman et al (1992) was equal to 0,69.

[200] As is the case in the Federal Open Market Committee, where only four members (out of 12) rotate.

obligations (or practices) to the European Parliament are at least on monthly basis; 1 if they are at least on annual basis, and 0 if they are less frequent or they do not exist. Precision of formulation is given 1 if reform proposal leaves no doubt about the precise mechanism of the decision-making nor its schedule and 0 instead.

Among public perception components, transparency is considered as the most important. It is proposed to accord 1 point, either for the publication of the minutes of meetings or voting records if they are published within a year from the meeting; 1 point for detailed explanations of every decision taken; 2 if both are fulfilled and 0 if none[201]. Simplicity is given 1 if there is no need to use any indicators (including GDP or arbitrary weights) in reform definition, 0 instead. Durability assumes 1 if there is no need for adaptation for further enlargement stages and 0 in the opposite case. Finally representation is given the value of 1 if every country representative has some voting power and 0 instead.

5.2. Assessment of reform proposals

The status quo, as argued in section one, is unacceptable. Nevertheless, it is interesting to assess it, according to our criteria, and use it as a benchmark. Its main disadvantage is the growing size problem- up to 31 decision-makers. Also problematic is the euro-wide view, because, in spite of official statements, NCB governors may be considered as their country representatives38. The under-representation indicator equals 42.4%[202]. Status quo is surely not a durable solution: even if there is no formal need for adaptation, it has to be changed precisely because of forthcoming enlargement. Of course, status quo enjoys a high degree of precision, simplicity and independence; existing transparency and accountability measures are kept; credibility is not directly endangered and finally every nation is represented. Overall assessment amounts to 8 and this high result shows that to improve significantly the existing framework, the simple reshaping of decision-making structure will probably not be sufficient.

The ECB proposal somehow solves size problems, but not very efficiently - up to 21 decision makers are involved. Asymmetric rotation ensures a small improvement in matching economic weights and voting powers (under-representation indicator equals 41.1%). As over 50% of decision makers rotate, and consequently the composition of the

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[201] Other important transparency requirements (with exception of policy inclination) are already present in the ECB practice- see Eijfinger and Geraats (2003).
[202] Supposing a euro area of 25: all "old" EU members + 10 new member countries of the first wave. Obviously, adding Bulgaria and Romania does not change qualitatively this result. See also box 1 and appendix.

body is not stable, its credibility might be considered as endangered. Similarly to the status quo, the euro-wide point of view is not assured and this argument is implicitly enhanced by an asymmetric rotation scheme. The proposition is not stipulated precisely enough (e.g. unknown schedule). The basis for the rotational system is far from being simple. However, this solution is durable and every nation is represented. The total of 7 consequently signifies a slight worse-off compared to the status quo.

Centralisation- the analysis concerns the simplest delegation of the interest-setting power to the Executive Board, but the assessment does not change much in other possible centralisation scenarios. Economically, the solution seems perfect: size problems are eliminated and the euro-wide view even if not embedded in the treaties, is implied by the nomination process. Credibility and independence are not endangered at any point. This scenario is equally simple, precise and durable. On the other hand the 'adoptability' of such a solution is null, because, supposing supranational character of technocrats, all countries (and consequently all euro-area GDP) are underrepresented. Thus, the proposed under-representation indicator would be equal 100%. Representation of citizens of all the countries would also be non-existent.

Simple rotation may take some diverse forms and consequently its assessment lacks precision. Unfortunately, there is a trade-off between credibility and adoptability: relatively stable composition of the Council would enhance credibility but adoptability would then be null (see appendix).

Grouping is the most vague solution and its assessment depends on many detailed arrangements adopted. Its durability would be doubtful, as probably the groups would change at every enlargement stage. Grouping countries would, in our opinion (and contrary to Heisenberg's, 2003), even raise suspicion about regional motivations of the governors.

Weighted votes' major inconvenience lies in the size of the Council and in the implicit confirmation of national preferences instead of euro-wide view. Its major advantage consists in matching economic and political weights.

The alternative proposal (section 4) in general follows the centralization scenario and, consequently, its economic efficiency is (in the light of adopted criteria) perfect; moreover, the euro-wide view would be guaranteed by an appropriate statement in the Statute. Likewise in the case of centralization, its adoptability would be null, but this would be offset by additional accountability measures and a more politically involved nomination

process. This reform would be also precise, simple and durable. The lack of national representation would be compensated by additional transparency measures. Summing up, its score is 12.

The alternative proposal has an outstanding result in comparison with the other analysed reform scenarios. One may argue that under this criteria set, this is natural, as our criteria have considered some questions (accountability, transparency) which were not of direct concern in the purely technical improvements of the ECB's decision-making framework. Nevertheless, it seems relevant to turn attention to the integrality of the different aspects of the ECB's preparations on the enlargement.

As a conclusion, evaluations reported in table 3 indicate that the ECB proposal is a slight worse-off compared to the status-quo. This should incite the main decision-making bodies in the EU to reconsider if the adopted reform will improve the functioning of the ECB.

Table 4.3 Numerical assessment of analyzed reform scenarios

Criterion /component	S C E N A R I O S						
	Status quo	ECB proposal	Centra- lization	Simple rotation	Consti- tuencies	Weighted votes	Alternative proposal
Economic efficiency	2	2	5	2-4	2-4	2	5
Independence	1	1	1	1	1	1	1
Credibility	1	0	1	$0\text{-}1^{*\blacktriangle}$	$0\text{-}1^{*}$	1	1
Lack of size problems	0	1	2	1-2*	$1\text{-}2^{*}$	0	2
Euro-wide view	0	0	1	0	0	0	1
Political acceptability	3	2	2	1-3	1-3	3-4	3
Adoptability	1	1	0	$0\text{-}1^{*\blacktriangle}$	$0\text{-}1^{*}$	$1\text{-}2^{*}$	0
Accountability	1	1	1	1	1	1	2
Precision	1	0	1	$0\text{-}1^{*}$	$0\text{-}1^{*}$	1	1
Public perception	3	2	3	4	2-3	3	4
Transparency	1	1	1	1	1	1	2
Simplicity	1	0	1	1	$0\text{-}1^{*}$	0	1
Durability	0	1	1	1	0	1	1
Representation	1	1	0	1	1	1	0
TOTAL	*8*	*7*	*10*	*8-10*	*5-10*	*8-9*	*12*

Source: author's assessment   * depends on precise arrangements adopted
▲ close trade-off, impossible to make both equal 1

Conclusions

The present chapter surveys economic literature concerning the necessity of reforming the European Central Bank in view of the recent enlargement of the EU and, sooner or later, of the EMU. We have thus tried to place the debate surrounding the necessity and possibilities of the reform of the ECB decision-making system in a larger context of a

contemporary central bank. In order to do so, we have devoted some space to highly discussed problems of transparency and accountability.

This analysis indicates the need for a more complex context while reshaping the existing Statute of the ESCB and the ECB in view of the further EMU enlargement. Such a need is linked to the necessity of a modern central bank law for the enlarged European (Monetary) Union.

The survey of the literature devoted to the enlargement of the euro area indicates the criticability of the reform adopted by the European Council for the enlarged ESCB. At the same time, this literature demonstrates some ways to formulate criteria for assessment of this reform. We propose a criteria set, addressing three main spheres of political economy (economics, politics and general public) and precisely define its components. We put forward an alternative scenario of the reform, which turns some attention to the importance of linkages between the decision-making framework, its political acceptability as well as public perception and other important matters in central banking such as accountability and transparency. Finally, the main reform scenarios are assessed numerically and thus more objectively.

The main conclusion of this assessment is that the adopted ECB reform slightly worsens the existing framework. It also indicates, that the basic reform proposals are not able to improve significantly the ECB's structure. Among them the centralization scenario is probably the best. Considering the reform as a more complex one (going beyond the pure reform of the decisional structure), should be more acceptable for the politicians as well as for the public.

Finally, we would like to point out some possible paper extensions. First of all, the attempt at numerization of reform performances in the light of criteria proposed seems to be too simplified and may be surely improved. Second, not all possible reform scenario (especially mixed ones) were sufficiently discussed and analyzed.

Appendix to chapter 4: Computations of under-representation indicator for some reform options

COUNTRY	GDP Share	ECB PROPOSAL				STATUS QUO				ROTATION 6				ROTATION 15			
		Voting power	Difference GDP-VP	%GDP underr.	%Countries underrep.	VP	GDP-VP	%GDP UR	%Ctrs UR	VP	GDP-VP	%GDP UR	%Ctrs UR	VP	GDP-VP	%GDP UR	%Ctrs UR
Germany	22,4	3,8	18,6	18,6	4,0	3,2	19,2	19,2	4,0	2,0	20,4	20,4	4,0	2,9	19,5	19,5	4,0
UK	17,2	3,8	13,4	13,4	4,0	3,2	14,0	14,0	4,0	2,0	15,2	15,2	4,0	2,9	14,3	14,3	4,0
France	15,8	3,8	12,0	12,0	4,0	3,2	12,6	12,6	4,0	2,0	13,8	13,8	4,0	2,9	12,9	12,9	4,0
Italy	13,2	3,8	9,4	9,4	4,0	3,2	10,0	10,0	4,0	2,0	11,2	11,2	4,0	2,9	10,3	10,3	4,0
Spain	7,0	3,8	3,2	3,2	4,0	3,2	3,8	3,8	4,0	2,0	5,0	5,0	4,0	2,9	4,1	4,1	4,0
Netherlands	4,6	2,9	1,7	1,7	4,0	3,2	1,4	1,4	4,0	2,0	2,6	2,6	4,0	2,9	1,7	1,7	4,0
Belgium	2,8	2,9	-0,1	0,0	0,0	3,2	-0,4	0,0	0,0	2,0	0,8	0,8	4,0	2,9	-0,1	0,0	0,0
Sweden	2,6	2,9	-0,3	0,0	0,0	3,2	-0,6	0,0	0,0	2,0	0,6	0,6	4,0	2,9	-0,3	0,0	0,0
Austria	2,3	2,9	-0,6	0,0	0,0	3,2	-0,9	0,0	0,0	2,0	0,3	0,3	4,0	2,9	-0,6	0,0	0,0
Denmark	2,0	2,9	-0,9	0,0	0,0	3,2	-1,2	0,0	0,0	2,0	0,0	0,0	0,0	2,9	-0,9	0,0	0,0
Poland	2,1	2,9	-0,8	0,0	0,0	3,2	-1,1	0,0	0,0	2,0	0,1	0,1	0,0	2,9	-0,8	0,0	0,0
Ireland	1,2	2,9	-1,7	0,0	0,0	3,2	-2,0	0,0	0,0	2,0	-0,8	0,0	0,0	2,9	-1,7	0,0	0,0
Portugal	1,3	2,9	-1,6	0,0	0,0	3,2	-1,9	0,0	0,0	2,0	-0,7	0,0	0,0	2,9	-1,6	0,0	0,0
Luxembourg	0,2	2,9	-2,7	0,0	0,0	3,2	-3,0	0,0	0,0	2,0	-1,8	0,0	0,0	2,9	-2,7	0,0	0,0
Greece	1,4	2,9	-1,5	0,0	0,0	3,2	-1,8	0,0	0,0	2,0	-1,2	0,0	0,0	2,9	-1,5	0,0	0,0
Finland	1,5	2,9	-1,4	0,0	0,0	3,2	-1,7	0,0	0,0	2,0	-0,5	0,0	0,0	2,9	-1,4	0,0	0,0
Czech Republic	0,7	2,9	-2,2	0,0	0,0	3,2	-2,5	0,0	0,0	2,0	-1,3	0,0	0,0	2,9	-2,2	0,0	0,0
Hungary	0,6	2,9	-2,3	0,0	0,0	3,2	-2,6	0,0	0,0	2,0	-1,4	0,0	0,0	2,9	-2,3	0,0	0,0
Slovakia	0,2	2,0	-1,8	0,0	0,0	3,2	-3,0	0,0	0,0	2,0	-1,8	0,0	0,0	2,9	-2,7	0,0	0,0
Slovenia	0,2	2,0	-1,8	0,0	0,0	3,2	-3,0	0,0	0,0	2,0	-1,8	0,0	0,0	2,9	-2,7	0,0	0,0
Lithuania	0,1	2,0	-1,9	0,0	0,0	3,2	-3,1	0,0	0,0	2,0	-1,9	0,0	0,0	2,9	-2,8	0,0	0,0
Cyprus	0,1	2,0	-1,9	0,0	0,0	3,2	-3,1	0,0	0,0	2,0	-1,9	0,0	0,0	2,9	-2,8	0,0	0,0
Latvia	0,1	2,0	-1,9	0,0	0,0	3,2	-3,1	0,0	0,0	2,0	-1,9	0,0	0,0	2,9	-2,8	0,0	0,0
Estonia	0,1	2,0	-1,9	0,0	0,0	3,2	-3,1	0,0	0,0	2,0	-1,9	0,0	0,0	2,9	-2,8	0,0	0,0
Malta	0,0	2,0	-2,0	0,0	0,0	3,2	-3,2	0,0	0,0	2,0	-2,0	0,0	0,0	2,9	-2,8	0,0	0,0
Executive Board		28,6	-28,6	0,0	0,0	19,4	-19,4	0,0	0,0	50,0	-50,0	0,0	0,0	28,6	-28,6	0,0	0,0
TOTAL		100		58,2	24,0	100		60,8	24,0	100		70,0	44,0		-0,26	63,06	24,00
INDICATOR				**41,1**				**42,4**				**57,0**				**43,5**	

Source: author, GDP and classification see Horn (2003)

General Conclusion

The principal concern of this dissertation was the collective decision-making in monetary policy, which is, since recently, a norm in the central banking. The analysis aimed at an evaluation of the decision-making system in the European Central Bank, and proposing potentially important improvements for the young institution, which have been relatively often criticized since its inception. However, such an assessment as well as a formulation of reform proposals required a few important steps, which constitute themselves potentially important contributions to the economic literature.

The first step, expressed through the first chapter, relied on the study of economic literature focused on the collective decision making in general and particularly on the implications of its application in monetary policy making. The principal results of this research, which hinted the directions of the further more creative investigations, may be summarized as follows.

First, committees outperform individuals in decision-making, which is even better documented in case of monetary policy making than in general theory. However, under the plausible assumption of the existence of costs of adding a decision-maker to a committee as well as costly information acquisition and aggregation, the size of the committee is limited. Second, concerning the decision rule, theoretical considerations shows the suboptimality of the most frequently applied simple majority and also relatively frequent unanimity requirement (or veto power given to all committee members). In particular, unanimity (as well as too strict majority requirements) leads to suboptimally high policy inertia, which is aggravated if the size of the committee is excessively large. However, the theoretically optimal rule weighing votes according to the skills seem politically infeasible and the simple majority rule, assures some policy smoothing which may be positive in monetary policy. Third, interactions between members positively influence the outcomes, especially because of their important learning effects and reducing conflicting interests. Finally, empirical studies on monetary policy committees prove that personal preferences matter for the decisions made and that they may be shaped by personal experience, political affiliations, education, age, gender etc.

In the second chapter a Bayesian model of monetary policy was developed, in order to give some additional insights of the decision-making to the arguments present in the existing literature. The first result is the positive effect of higher precision of information on the quality of decisions but also on reactivity of an individual decision maker. Moreover, an accurate definition of monetary policy target provides additional incentives for the information acquisition.

The consequences of the proposed model for the collective decision-making are also significant. First, collective decision making leads to socially preferable outcomes, because the average costs of information acquisition are smaller in committee thus leading to a higher common information precision, which seems to be a new argument. Second, under a plausible assumptions of imperfect information aggregation the size of the committee will be bounded and the committee members should be heterogeneous. This confirms the economic intuition that heterogeneity might be a reasonable and relatively costless substitute of the number of members. Finally entering a monetary union is especially appealing solution for the countries whose monetary policy has been overreactive relatively to led by the union.

Chapter three aimed at empirical testing of the results provided by the preceding one (especially the hypothesis of the positive impact of better skills on policy outcomes and reactivity) and more generally assessing the influence of the characteristics of the MPCs on monetary policy making. It was shown (similarly to Göhlman and Vaubel, 2007) that professional experience of MPC members affects the inflation performance. Namely, higher shares of private industry and academic economists as well as central bankers relatively to public economists and other MPC members lead to lower inflation, *ceteris paribus*. Also some preliminary evidence supporting the existence of an optimal MPC size of about 11 members was presented. With respect to the second important factor of the MPC efficiency it was shown that MPCs with higher share of MBA holders are more reactive. The other educational category leading to a higher degree of MPC reactivity is the bachelor diploma while the other categories, including the highly educated (Professors and PhD holders) proved to be relatively less reactive ones. Also higher levels of educational heterogeneity were associated with more reactive policy. Interestingly, higher feminization ratios lead to lower inflation rates accompanied by a more reactive policy.

Finally, chapter 4 attempted to evaluate the decision-making framework of the ECB in light of the results of the previous chapters as well as some additional political economy

literature focused on monetary policy in a federal-type central bank. These considerations may be summarized as follows.

The Governing Council of the ECB is the biggest among MPCs in the world. Moreover, it is (as presented in chapter 3) dominated by public economists and highly masculine. Thus, the composition of the GC may be treated as an additional explanation for its potentially insufficient reactivity as argued by many of its critics. The enlargement of the EMU, started by the accession of Slovenia to the euro area, would finally lead to an important increase in the number of GC members, exacerbating the existing problems. Thus, the conclusion of the existing literature on the necessity of the reform of decision-making system of the ECB is fully confirmed. Moreover, the adopted reform does not solve the existing problems. After formulating of a set of criteria which should be met by a successful reform, a proposal closely fitting this requirements is presented. The important argument worth to underline is that the reshaping of the decision-making system cannot be performed regardless other political economy considerations such as transparency or accountability of the central bank.

It thus seems that the present dissertation significantly contributes to the economy of the central banks on the scientific as well as on political grounds. The findings of both, the theoretical and empirical chapters, on the impact of the individual decision makers' characteristics on the outcomes of the monetary policy making should be taken into consideration by the appointing institutions as well as the designers of the appointment process. The need for the genuine experts, already visible in some countries through the trend of appointing highly educated and recognized specialists has now theoretical underpinnings.

Somewhat more specifically, the present thesis joins the (constructive) critics of the adopted ECB reform. In a related article (Farvaque and Stanek, 2007) we also argue that a subsequent occasion to reshape the decision-making structure of the ECB was missed when the European Convention presented "copy-paste" art while proposing the monetary provisions of the new EU treaty. After the Berlin Declaration, with no clear mandate for the monetary affairs, it seems that also the new IGC will not deliver a better solution.

Finally, a PhD dissertation is merely a stage of a scientific research within a field. Thus, the future research tracks opened by the present thesis seem quite numerous. First, it seems that the Bayesian model presented in chapter 2 is open to the possible extensions, such as considering some different than standard normal distribution functions of the state of

economy and, in the first place, to allow the variance of the prior to be different than 1. Another extension would be to consider an economy under disinflation, where inflation is more often above the target than below it or, equivalently a country whose MPC presented a non-neutral balance of risks or bias (one of the future movements is more probable than the other). These would mean that the mean of the prior distribution is different from zero. Another possible extension is introducing underlying economic structure and/or explicit time dimension into the model. Finally, allowing for some asymmetries between countries would make it even more suitable for the analysis of the EMU.

Also the empirical exercise, presented in chapter 3 can certainly be extended by application of additional econometric techniques, such as probit or logit modeling of the decisions of interest rate moves taken by central banks (and taking into consideration MPC characteristics). Similarly, taking into consideration other efficiency measures, including the distance from efficiency frontier, as e.g. proposed by Cecchetti et al. (2006) or Mester (2003) might possibly yields additional insights. All these points constitute a challenge for the research being the continuation of the present thesis.

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Efficiency of Decision Making in Central Banks: Lessons for the ECB

Abstract:
This thesis investigates the efficiency of decision-making mechanisms in central banks. The key variable influencing the efficiency of decisions made is information precision – the higher information precision, the better are monetary policy outcomes and the policy becomes more reactive. The information precision a decision maker is willing to acquire depends on her skills, on the policy target and on adopted institutional solutions. Empirically it was shown that professional experience of monetary committee members affects the inflation level while their education influences reactivity and existence of an optimal committee size is confirmed. Finally, the recent reform of the ECB is evaluated and criticized and an alternative reform proposal is specified, fitting a proposed criteria set.

Keywords: Collective decision making, European Central Bank, efficiency of decision-making, Bayesian analysis, information acquisition, information precision, central bank, monetary policy committees, EU enlargement, monetary policy

Efficacité de la prise de décision au sein des banques centrales : leçons pour la BCE

Resumé
Cette thèse s'attache á comprendre les facteurs influencant l'efficacité de la prise de décision au sein des banques centrales. La variable déterminante l'efficacité des décisions est la précision d'information : plus elle est élevé meilleurs sont les résultats de la politique monétaire et la politique devient plus réactive. La précision d'information acquise par le décideur dépend de son habilleté, de la cible de politique ainsi que des institutions de prise de décision. Empiriquement il a été montré que l'expérience professionnelle des membres de comité de politique monétaire influence le niveau d'inflation et leur niveau d'éducation influence la réactivité. L'existence d'une taille optimale du comité a aussi été confirmé. Finalement, la récente réforme du système de prise de décision au sein de la BCE a été évaluée et critiquée ainsi qu'une proposition alternative correspondante au critères proposés a été spécifiée.

Mots clés: prise de décisions collective, Banque centrale européenne, efficacité de prise de décision, analyse Bayesienne, acquisition d'information, précision d'information, banque centrale, comités de politique monétaire, elargissement de l'UE, politique monétaire.

Efektywność podejmowania decyzji w Europejskim Banku Centralnym

Streszczenie
Niniejsza praca bada efektywność podejmowania decyzji w bankach centralnych. Kluczową zmienną mającą wpływ na efektywność decyzji jest precyzja informacji – im jest ona wyższa tym lepsze rezultaty polityki pieniężnej a sama polityka jest bardziej reaktywna. Precyzja informacji, jaką osoba podejmująca decyzję skłonna jest nabyć zależy od jej umiejętności, od celu polityki jak również przyjętych rozwiązań instytucjonalnych. Empirycznie wykazano, że doświadczenie zawodowe członków rady polityki pieniężnej wpływa na poziom inflacji podczas gdy poziom ich edukacji wpływa na reaktywność polityki. Ponadto potwierdzono istnienie optymalnej wielkości rady. Ponadto niedawna reforma EBC została oceniona i poddana krytyce jak również zaproponowano rozwiązanie alternatywne, spełniające zaproponowane uprzednio kryteria oceny reformy.

Słowa kluczowe: kolektywne podejmowanie decyzji, Europejski Bank Centralny, efektywność podejmowania decyzji, analiza bayesowska, zdobywanie informacji, precyzja informacji, bank centralny, rady polityki pieniężnej, rozszerzenie UE, polityka pieniężna.