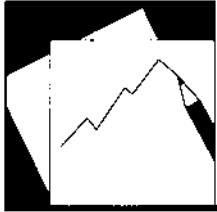


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Elements of Optimal Monetary Policy Committee Design

Jérôme Vandenbussche

IMF Working Paper

Monetary and Capital Markets Department

Elements of Optimal Monetary Policy Committee Design¹

Prepared by Jérôme Vandenbussche

Authorized for distribution by Peter Stella

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Abstract

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The move from individual decision making to committee decision making is widely seen as a major evolution in contemporary central banking. This paper reviews the relevant economics and social psychology literatures with a view to providing some insights into the question of optimal monetary policy committee design. While the preference aggregation literature points to the effect of committee structure on the extent of the time inconsistency problem and its associated costs, the belief aggregation literature analyzes how different committee structures affect the efficiency of information pooling, the process of social influence, and collective accuracy. In conclusion, we highlight the main tradeoffs that the analysis has brought to light and point to directions for future research.

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Author's E-Mail Address: jvandenbussche@imf.org

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| Contents | Page |
|--|--------------------|
| I. Introduction | 3 |
| II. A Large Diversity of Monetary Policy Committees | 6 |
| A. Size and Composition of MPCs | 6 |
| B. Decision-Making Process of MPCs | 8 |
| C. The Role of Staff in Gathering and Processing Information..... | 9 |
| III. Normative Issues in Monetary Policy Committee Design..... | 9 |
| IV. Preference Aggregation in Monetary Policy Committees | 11 |
| A. Theoretical Analyses..... | 11 |
| B. Empirical Evidence and Studies..... | 13 |
| V. Belief Aggregation In Monetary Policy Committees | 17 |
| A. The Theory of Information Aggregation in Committees | 18 |
| B. Social Influence During Group Decision Making: Experimental Evidence | 20 |
| C. Accuracy of Individual versus Group Judgment: Experimental Evidence on the Effects of Size and Composition | 23 |
| D. Effects of the Decision-Making Procedure: Experimental Evidence | 26 |
| VI. Summary and Conclusions | 28 |
| VII. References | 31 |
| Figures | |
| 1. Size and Composition of Selected MPCs (end-2003)..... | 6 |
| 2. Representation of the One-Shot Monetary Policy Game..... | 10 |
| 3. Mean Score by Round in Blinder and Morgan’s (2005) Experiment..... | 24 |
| 4. Accuracy of Group Decision as a Function of Interaction Pattern. | 29 |
| Boxes | |
| 1. Composition of Selected MPCs | 7 |
| 2. Staggering Terms of Committee Members to Achieve Central Bank Credibility | 12 |
| 3. Is Time Inconsistency a Real Issue for Monetary Policymakers? | 17 |
| 4. Information Aggregation in Large Electorates and the Condorcet Jury Theorem..... | 19 |
| 5. Blinder and Morgan’s (2005) Monetary Policy Experiment | 24 |
| 6. Group Decision Rule and Quality of Decisions: Holloman and Hendrick’s (1972) Experiment..... | 29 |

“My experience as a member of the FOMC left me with a strong feeling that the theoretical fiction that monetary policy is made by a single individual maximizing a well-defined preference function misses something important. In my view, monetary theorists should start paying attention to the nature of decision-making by committee, which is rarely mentioned in the academic literature.”

Alan Blinder (1998, p. 22)

I. INTRODUCTION

Blinder (2004) as well as Blinder and Wyplosz (2004) point to the move from individual decision making to committee decision making as one major evolution in contemporary central banking. They concur with J.P. Morgan (2000), which notes that “one of the most notable developments of the past few years has been the shift of monetary decision making to meetings of central bank policy boards.” This trend has become particularly more noticeable when two of the most influential central banks, the Bank of England and the Bank of Japan, switched to committee decision making in the second half of the 1990s.

Decision making by committee is now the rule rather than the exception in central banks. For example, 29 out of the 34 central banks studied in J.P. Morgan (2000) explicitly delegated monetary policy decisions to committees, whose sizes ranged from three to eighteen members. Out of 101 central bank laws surveyed at end-2003 in Lybek and Morris (2004), 95 made provision for an implementation board, the median size of which was between seven and nine. The list of central banks relying on a monetary policy committee (henceforth MPC) keeps growing year after year as countries modernize their central bank laws.²

This trend seems to coincide with the emergence of a consensus among practitioners and academics around the idea that collective decision making is part of international best practice in monetary policy. In his review of the operation of monetary policy in New Zealand, Svensson (2001) recommended that a formal monetary policy committee be responsible for decisions related to monetary policy rather than the governor alone, as is currently the case. In March 2005, (IMF: 2005, Public Information Notice No. 05/44), the IMF recommended to the Israeli authorities an update of the Bank of Israel Law, which would include the establishment of a committee to set monetary policy.

Taking these contemporary developments as background and motivation, this paper’s objective is to review comprehensively the relevant theoretical and empirical literature on group decision making, in economics as well as social psychology, with a view to providing some insights into the question of optimal MPC design.³ We are primarily interested in three aspects of the

² For example, a new banking law in Mauritius in 2004 increased the central bank’s independence and included a provision to set up a MPC, and in 2005 a new banking law in Libya granted the central bank’s governor the authority to establish a MPC.

³ Recent, more focused surveys include Berger (2006), Fujiki (2005), and Gerling et al. (2003). The survey by Sibert (2006) is closer in spirit to our paper in that it also draws on social psychology studies.

committee structure: its size, its composition (including appointment procedures), and its decision rule. Rather than providing definitive answers on several aspects of optimal MPC structure, we aim at highlighting key considerations and trade-offs to be taken into account by national authorities contemplating a reform of their monetary policy decision-making body. Despite their importance, procedural aspects of MPC meetings as well as issues associated with post-decision communication with the public and financial markets are mostly ignored in the paper in order to preserve focus.

As described in Lybek and Morris (2004), while in some central banks the same board determines monetary policy and implements it, in others the two functions are split between a policy board, which determines the target, and an implementation board which adjusts policy instruments to achieve that target. We shall therefore be somewhat restrictive by considering mostly the case of a central bank where the same board—the MPC—chooses the monetary policy it deems appropriate to achieve a specified target and has some latitude to set this target.⁴ Therefore its decisions have both a technical and a political character. However, we are confident that many aspects of our discussion are also relevant for central banks with a two-tiered decision-making structure.

The designer of an optimal MPC structure needs to acknowledge the politically partisan pressures exerted during and after the appointment process of MPC members, hence the diversity of preferences of potential MPC members over conflicting policy objectives, as well as the limited amount of information and understanding of the economy available to any single decision maker, hence the diversity of beliefs and views of the world within the committee. To deal with these aspects, the modeling tools of economics are rather well suited. However, the designer would also have to take into account processes of social interaction and influence in the course of collective deliberations. It is less obvious that he would know exactly how to fully specify individual preferences and learning processes to capture those other aspects. Regarding MPC members' preferences, Yellen (2005) recently remarked that the behavioral assumptions underlying many economic models of committees missed important individual motives. In particular, she emphasized that many experts on MPCs are likely to be motivated by a sense of the public good and a spirit of cooperation, to be concerned by the quality of the atmosphere within the committee, and to respect the authority of the chairman. It is highly plausible that these considerations have a first-order influence on the elaboration of individual "strategies" in a real world MPC although they are typically omitted in game-theoretical models. Regarding the learning process and the evolution of individual beliefs, Issing et al. (2001, p.132) insist that "[monetary policy] decisions are the outcome of a *process of collective reasoning which is more than a mere exchange of views*. This collective process can shape the final outcome more than each single vote." These remarks from famous practitioners motivate our adopting an eclectic approach to analyze the determinants of MPC members' behavior and our devoting a large part of this paper to a discussion of the social sociology literature on group decision-making.

⁴ While the extent of a central bank's de jure and de facto target autonomy varies from country to country, none is ever insignificant in our view. Indeed even in the strictest inflation targeting regime, where monetary policy decisions could be merely technical in principle, the central bank has some freedom to decide how fast to return to target following a shock.

A first dimension of heterogeneity across potential policymakers is their relative preference for different policy objectives, such as low inflation or output stabilization, which may result from ideological biases and/or sensitivity to political pressure as well as different time horizons. This dimension is especially important for a MPC designer when the central bank as an institution lacks independence and when partisan politics has a major influence on the process of appointments. The first branch of the literature we examine explores the circumstances under which decision making by committee can help mitigate or solve the time-inconsistency problem of monetary policy, whereby a policymaker is tempted to produce inflation surprises in order to stimulate output in the short run and therefore is likely to generate high and costly inflation expectations. We explain how the magnitude of the benefits which can be reaped along this dimension through a properly structured MPC depends in theory on the importance of the time-inconsistency problem, the strength of political pressures, and on the extent of preference heterogeneity across the political spectrum.

Most studies that have tried to estimate empirically the extent of preference heterogeneity and political pressures within a MPC have focused on the United States, a country where the central bank is independent and accountable, and where the appointment process to the Federal Reserve Board of Governors de facto requires bipartisan support. Perhaps unsurprisingly then, these studies have tended to find little heterogeneity across policymakers. We shall therefore speculate about how lack of monetary policy credibility due to the time-inconsistency problem is likely to be an issue that depends on a country's degree of institutional development, and consequently about when preference heterogeneity should be a major object of focus for a MPC designer.

A second dimension of heterogeneity across potential policymakers is their belief regarding the state of the economy and/or its mechanisms, for example, the size of the output gap or the strength of the various transmission channels of monetary policy. To the extent that these beliefs contain valuable information, the structure of a MPC should aim at making the best use of that information. At first sight, it would seem that a larger and more diverse MPC would be able to pool more information and perspectives, and therefore would make better decisions. However, one also needs to recognize that incentives may have to be provided to acquire and interpret information and that direct communication, which is essential to assess the precision of information presented by others, may be associated with coordination costs. Also there may be some limits to efficient information sharing and acquisition within committees due to processes of social influence, cognitive biases and the decision rule. These aspects are important for a static analysis of MPC decision making, but also for a dynamic one which would integrate the degree of convergence of individual beliefs as a function of MPC structure.

The rest of the paper is structured as follows. Section II briefly illustrates the cross-country diversity of institutional arrangements regarding MPC structure. Section III discusses aspects of an ideal and comprehensive normative analysis of MPC design. Section IV analyzes studies focusing on preference aggregation while Section V discusses the belief aggregation approach. Section VI summarizes our main findings and concludes.

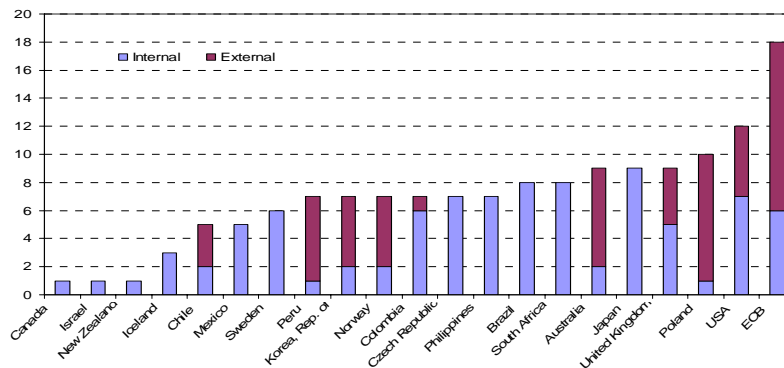
II. A LARGE DIVERSITY OF MONETARY POLICY COMMITTEES

In their recent surveys of central bank laws, Lybek and Morris (2004) and Tuladhar (2005) document many dimensions of heterogeneity of central bank governance structures. Their discussion of provisions for decision making indicates that size and composition of MPCs, appointment rules, length of terms, distribution of voting rights, publication of votes and minutes are several of the dimensions along which there is substantial cross-country variation. Although the objective of our paper is not to provide a positive theory or empirical analysis of existing MPC structures,⁵ we briefly give a sense of this diversity to provide some factual background to the reader.

A. Size and Composition of MPCs

Figure 1 shows the size and composition of MPCs in a sample of 21 countries—mostly inflation targeters—at the end of 2003.⁶ Three countries are associated with a size of one—Canada, Israel and New Zealand—since they have entrusted the responsibility of monetary policy decisions to the governor alone. However, in these cases where the governor is solely responsible for decision-making de jure, he is typically surrounded by an advisory committee de facto. For example, the Governing Council of the Bank of Canada is currently composed of six members.⁷ Large MPCs also do often receive advice by experts and central bank staff members in a nonvoting position, including on the days when decisions are made. Another source of divergence between the de jure and de facto arrangements is that one or several positions on the committee can remain vacant for significant periods of time. The largest MPC in the sample is that of the European Central Bank (ECB). Its size is currently 18, and legal provisions in the ECB Charter cap it at 21 regardless of the number of countries that would eventually join the eurozone.

Figure 1. Size and Composition of Selected MPCs (end-2003)



Sources: Tuladhar (2005), and central bank websites.

⁵ See Berger, Nitsch, and Lybek (2006) for a cross-country study of the determinants of implementation board size.

⁶ See Sterne (2004a) for a larger sample of 42 countries at end-1999.

⁷ These members are the governor, the senior deputy governor, and the four deputy governors.

Regarding composition, while the definition of internal members is constant across countries⁸—they are policymakers in a full-time managerial position under the authority of the governor at the central bank—the meaning of external members varies significantly from country to country. These members may be chosen both to increase the legitimacy of the central bank as an institution and to diversify its range of expertise. Their mode of appointment is also usually different from that of internal members (see Box 1).

Box 1. Composition of Selected MPCs

The U.S. Federal Reserve’s Federal Open Market Committee

The FOMC is composed of the Board of Governors and the presidents of the district Reserve Banks. Board members (the internal members) are appointed by the President and confirmed by the Senate to serve 14-year terms. Terms on the Board are staggered, with one term expiring on January 31 of each even-numbered year. A member may serve only one full term in office; however, an individual originally appointed to fill an unexpired term may be reappointed to serve a full term. The President also designates one member of the Board of Governors to be the Chairman and another member to be the Vice Chairman, each for a four-year term and each subject to Senate confirmation. The presidents of the district Reserve Banks, however, are chosen to serve five-year renewable terms by the Board of Directors of these Banks, subject to approval by the Board of Governors.

Although the FOMC is comprised of all Governors and district Reserve Bank presidents, the FOMC’s decisions are formally made by majority vote among its voting members. Voting members include all seven Governors, the president of the Federal Reserve Bank of New York, and four of the presidents of the remaining 11 district Banks. Voting privileges rotate in a prescribed manner among the district Banks. The four rotation groups are: (i) Boston, Philadelphia, and Richmond; (ii) Cleveland and Chicago; (iii) Atlanta, St Louis, and Dallas; and (iv) Minneapolis, Kansas City, and San Francisco. Within each group, voting privileges rotate annually among the Banks.

The European Central Bank’s Governing Council

The ECB’s Governing Council comprises the Executive Board—the president, the vice-president, and four other members (the internal members)—and the governors of the national central banks of the participating countries—currently twelve countries. Executive Board members are appointed by common agreement among the heads of state of the eurozone for nonrenewable eight-year terms. No staggering of terms is provided for. Governors of participating central banks are appointed locally for at least five years and their terms can be renewed. Until the total number of Governors exceeds 15, each member of the Governing Council has one vote. As of the date when that number exceeds 15, governors will be allocated to two or three groups, the voting rights of which will sum to 15.

The Bank of England’s MPC

The nine-member committee comprises the governor, two deputy governors, two executive directors of the central bank appointed by the governor after consultation with the Chancellor (currently the Bank’s Chief Economist, the Executive Director for Markets), and four outside experts (the external members). The Governors are appointed for fixed renewable five-year terms, while the external members are appointed for renewable three-year terms. A representative from the treasury also sits with the MPC at its meetings.

The People’s Bank of China’s (advisory) MPC

The PBOC’s MPC comprises ten members and has an advisory role only. It is headed by the Governor and also includes two Deputy Governors, a Deputy Secretary-General of the State Council, a Vice Minister of the State Development and Reform Commission, a Vice Finance Minister, the Administrator of the State Administration of Foreign Exchange, the Chairman of the China Banking Regulatory Commission, the Chairman of the China Securities Regulatory Commission, the Chairman of the China Insurance Regulatory Commission, the Commissioner of the National Bureau of Statistics, the President of the China Association of Banks and an expert from academia. The committee is appointed by the State Council, with two-year terms for nongovernment officials.

Source: Chappell et al. (2005), J.P. Morgan (2000), and central banks’ websites.

⁸ However, it should be noted that while the governor is chosen by the executive branch of government, insiders other than the governor may or may not be directly appointed by the executive.

B. Decision-Making Process of MPCs

There is wide scope for interpretation of central bank laws in the domain of the decision-making process. While these laws usually establish the rule by which policy decisions are supposed to be made—autocratic rule in the case of a single individual, or simple majority voting in the typical case of an MPC—a more or less democratic consensus often prevails in practice, which a vote often only rubber-stamps. For example, after four years in the job the former Governor of the Bank of Finland S. Hamalainen wrote that “[there are voting procedures at the Bank of Finland], but it has not been necessary to vote” (Pringle, 2001, p. 111).

Although many central banks describe their decisions as being produced by consensus, this characterization falls short of providing enough precision about the decision-making process since according to the Webster dictionary consensus can be defined either as “general agreement” (i.e., unanimity) or as “the judgment arrived at by most of those concerned” (i.e., a form of supermajority). This semantic vagueness is certainly useful in practice to give the illusion of unanimity to the public and hide disagreement by a minority. Conversely, a nonunanimous vote may be a way for a unanimous MPC to send a signal to financial markets about an uncertain economic outlook while preserving the illusion that each individual policymaker has a firm opinion on the state of the economy.

Different country practices of consensus should therefore be distinguished. Blinder and Wyplosz (2004) make a first attempt at doing this when they propose a classification of central bank decision-making arrangements composed of four categories. At one extreme, they place the model of the individual central bank governor such as that of the Reserve Bank of New Zealand.⁹ At the other extreme lies the individualistic MPC, such as the Bank of England’s MPC, where each member not only expresses his or her opinion verbally, but also probably acts on it by voting and decisions are made by majority vote. In between these two categories, they distinguish two types of consensus-based MPCs. In the “autocratically-collegial” MPC, the chairman more or less dictates the group “consensus.” He may begin the meeting with the decision already made and simply inform other members. Or he may listen to the debate and then announce the group’s consensus, expecting everyone else to fall in line. But in either case, the group’s decision is essentially the chairman’s decision, informed by the views of the other committee members. The Federal Open Market Committee under Alan Greenspan has often been described as such a committee.¹⁰ In the “genuinely collegial” MPC, members may argue strenuously for their own points of view behind closed doors, but they ultimately compromise on a group decision, of which each member then assumes ownership. In any case, there are no (or negligible) public disagreements. The ECB’s Governing Council appears to be such a committee.

⁹ The former Governor of the Reserve Bank of New Zealand, D. Brash, is a strong supporter of this first model, because it implies unambiguous accountability (Brash, 2001). However, in his Review of the Operation of Monetary Policy in New Zealand, Svensson (2001) argues that such a strong dependence on a single person’s qualities is too risky.

¹⁰ Also, Chappell, McGregor, and Vermilyea (2002) estimate that the FOMC’s Chairman Arthur Burns exercised a weight between 40 percent and 50 percent in the choice of interest rates between 1970 and 1978.

Of course, there are intermediate cases which do not fit neatly into any of these categories. For example, Blinder (2004) puts the Bank of Canada somewhere between the individual governor and the “autocratically collegial” MPC categories. Indeed under the Bank of Canada Act the governor alone is responsible for monetary policy, but as described above, the governor seems to share that responsibility with fellow members of the Bank’s Governing Council in practice.

C. The Role of Staff in Gathering and Processing Information

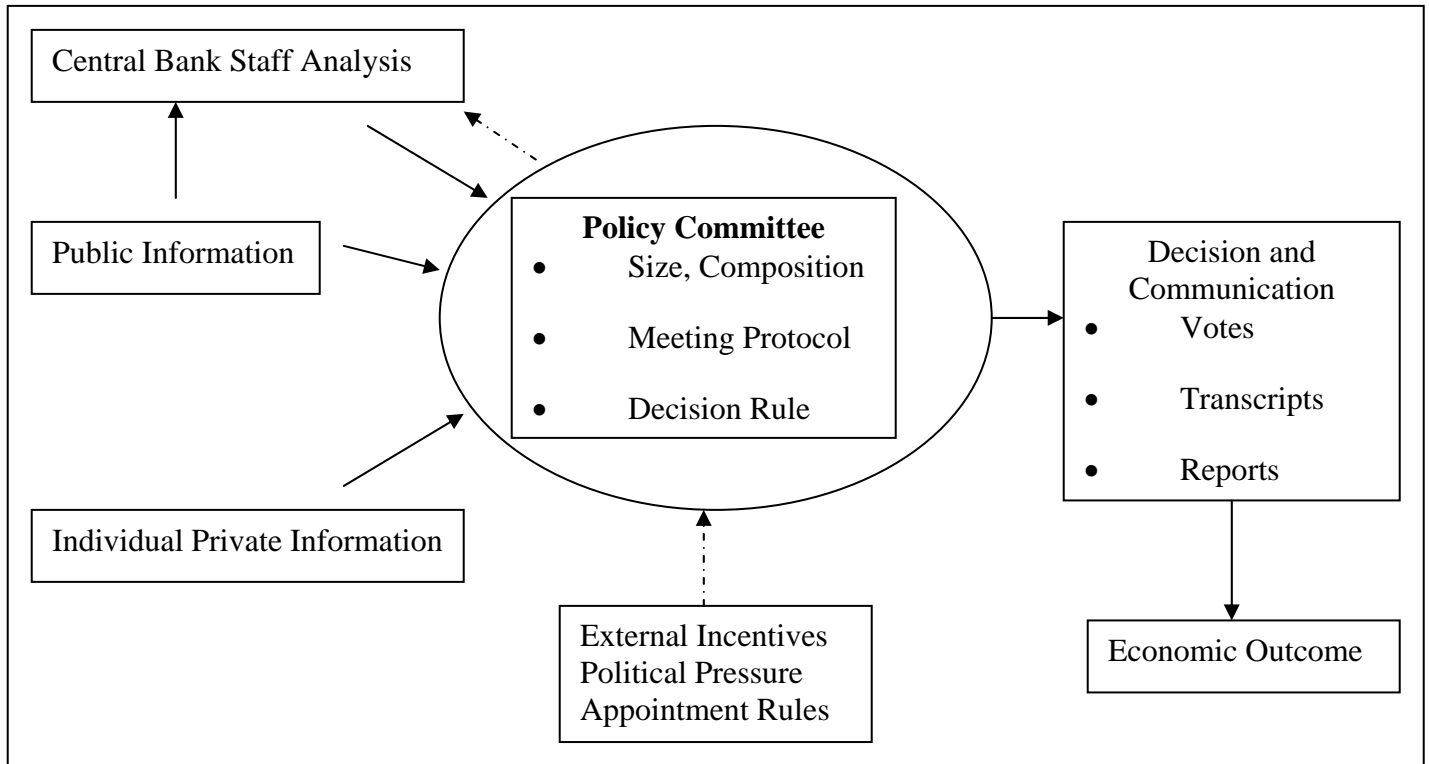
An important input in the MPC decision process is the large set of economic indicators as well as short-term and medium-term forecasts provided by central bank staff and usually reported in a comprehensive briefing paper. This document may even make very specific recommendations to decision makers. Therefore to a large extent, central bank staff acts as the agent of the MPC in a dual role of information provider and advisor.

The degree of interaction between the Bank’s staff and the members of the MPC varies a lot from one country to another. While Coletti (2004) describes the Bank of Canada’s forecast as a staff projection and Meyer (2005) presents the Federal Reserve’s Greenbook as “the staff’s independent judgment of economic trends,” Sterne (2004b) emphasizes that the Bank of England’s forecast is that of the MPC and is elaborated with the assistance of staff.

The roles of individual MPC members in this process of information gathering and analysis through interactions with central bank staff are not necessarily identical across members. The MPC Chairman is typically involved earlier in the process, which may give him an opportunity to influence the content of the briefing paper, and may also make his opinion more legitimate than that of other MPC members at the time of the final meeting since he would have spent more time being involved with data collection and analysis. For example, at the Reserve Bank of Australia, draft versions of the briefing paper are discussed with the governor and deputy governor—but not the other seven external members—about a week before an MPC meeting, and the finalized paper, which may include a recommendation, is sent ahead of the weekend preceding the Tuesday MPC meeting (Stevens, 2004).

III. NORMATIVE ISSUES IN MONETARY POLICY COMMITTEE DESIGN

Figure 2 provides a simple representation of the one-shot monetary policy game. It makes clear that, when thinking about optimal MPC design, several dimensions need to be taken into account simultaneously. These include not only the size of the committee, its composition, the appointment rules and the decision mechanism, but also the contracts offered to members (including their accountability), the gathering of the economic information made available to the committee, the protocol before and during meetings, the communication strategy, and—since the “game” is repeated—the frequency of meetings. A comprehensive optimization exercise should have all these dimensions, and probably others, as endogenous variables.

Figure 2. Representation of the One-Shot Monetary Policy Game

If such an exhaustive optimization exercise were feasible, its outcome would depend on a number of exogenous variables, which the designer would take as parameters. These exogenous variables would be: (i) the objective(s) of monetary policy and their relative weights if there are several; (ii) the relative preferences of society for type I versus type II errors (overshooting versus undershooting); (iii) the distribution of preferences; (iv) the distribution of ability and psychological traits across potential policymakers; (v) the operational difficulty of the task (e.g., implementing an exchange rate peg versus inflation targeting); (vi) the cost of delaying a decision; (vii) the cost of acquiring/analyzing information; (viii) the costs of communicating information within the committee; (ix) the psychological and social costs of dissenting with the majority and/or the authority figure; and (x) the availability of reputational incentives inside and/or outside the committee.

The operational difficulty of the task—item (v) above—of course is not constant across meetings since rather tranquil times can suddenly be interrupted by a crisis. One could imagine that a sophisticated central bank law might prescribe the use of different committee structures, in particular the use of different voting rules, depending on elements of the situational context or the type of decision to make. In the more realistic case where the law provides for a constant MPC structure, it should be designed to maximize expected intertemporal welfare, which implies that it should be close to the optimal structure for a complex situation, such as a crisis or an inflexion point, when the stakes and the risk of a significant output loss are higher.

This formalization of the designer’s problem is general enough that it can be applied to the design of a MPC with any degree of de jure goal or target autonomy. In any case, the designer would need to take into account the fact that an individual agent’s objectives may not be perfectly aligned with those of society and would have to design the MPC structure—including individual contracts—in order to compensate for this potential misalignment. For example, a pure implementation board (with no de jure target autonomy) should in principle be merely technical, but can de facto be political unless proper incentives are provided to its members.

In practice, the theoretical and empirical literature on group decision making, whether in economics or social psychology, examines at best two or three endogenous dimensions as a function of two or three exogenous factors at a time. This means that one can only expect to obtain partial answers from existing studies. Moreover, some important specificities of monetary policy decision making, such as its quasi-repeated game nature, are typically not analyzed in the belief aggregation branch of the literature. One should therefore be cautious in deriving direct practical conclusions from what follows.

IV. PREFERENCE AGGREGATION IN MONETARY POLICY COMMITTEES

A. Theoretical Analyses

The preference-aggregation branch of the literature analyzes how policy chosen by a properly structured committee can be welfare improving compared to policy chosen by a single individual. It shows that an improvement can be achieved through two distinct channels: (i) enhanced monetary policy credibility, hence lower inflation; and (ii) smoother policy. The magnitude of these two benefits depends on the size of the committee, the staggering of terms, and nomination procedures.

In this literature, the only two potential sources of heterogeneity across policymakers are the benefit they derive from surprise inflation shocks, i.e. their hawkish or dovish preferences, and their time horizon. In particular, there is no information asymmetry across policymakers. The decision rule which is typically assumed in these models is majority rule, and the outcome of the vote is determined by the preferences of the median voter.

MPCs as a mechanism to enhance monetary policy credibility

Using an infinitely repeated game setup, Barro and Gordon (1983) show how reputational forces could make an infinitely lived policy maker keep inflation low in spite of the temptation to create inflation surprises. An individual reputation mechanism can work in their setup because the policy maker has an infinite horizon. In a more realistic setting, the policymaker would live only a finite number of periods, would be tempted to “cheat” in the final period, and because of a classical backward induction argument would be unable to generate low inflation expectations —unless the policy maker were the most conservative central banker and he would have no incentive to generate inflation surprises in the first place.

A short paper by Tabellini (1987) shows how an infinitely lived committee of three members deciding by majority voting can achieve credibility and a low rate of inflation too, in spite of

being composed of finitely lived individuals with identical time inconsistent preferences. The simple intuition behind his result is that reputational forces are weakest at the end of a term. By staggering the terms of committee members, one can ensure that the median voter in the committee has a long enough horizon so that he prefers low inflation. In Tabellini's (1987) model, the larger the committee, the longer the horizon of the median voter and therefore the lower the achievable inflation rate (see Box 2).

Box 2. Staggering Terms of Committee Members to Achieve Central Bank Credibility

Tabellini (1987) constructs the following example. Each year, an individual policymaker is appointed to the committee, with a nonrenewable three-year term. Thus, in any year the committee is comprised of three different individuals. They all have exactly the same loss function within each period:

$$L = \frac{1}{2} \pi^2 - \alpha(\pi - \pi^e) \text{ with } \alpha > 0$$

where π (respectively π^e) is actual (respectively expected) inflation. Their decisions are taken by a simple majority rule.

If no policy maker discounts the future, then there exists a trigger strategy equilibrium which can sustain forever a rate of inflation arbitrarily close to zero. Such an equilibrium is sustained by the following expectations function:

$$\begin{cases} \pi_{t+i}^e = \alpha & \text{for } i = 0,1 \text{ if } \pi_{t-1} \neq \pi_{t-1}^e \\ \pi_t^e = \bar{\pi} & \text{otherwise} \end{cases}$$

for $\bar{\pi}$ arbitrarily close to zero. It can easily be shown that for $\bar{\pi} = 0$ the committee member with median time horizon is just indifferent between inflating and not inflating, and that the oldest member prefers to inflate while the youngest prefers not to inflate. As the discount rate increases, the minimum rate of inflation sustainable by such a mechanism rises above zero. Also, the longer is the term of office of each committee member (i.e., the longer is the median time horizon), the lower is the equilibrium rate of inflation sustainable by such trigger strategies for any given discount rate.

In an overlapping generations model of decision making by a committee of size two, Sibert (2003) shows that when the public has imperfect information about the type of a policymaker, that is, whether he is a "hawk" or a "dove," full transparency (i.e., publication of individual votes) encourages younger committee members to vote more against inflation, in order to build a reputation of conservative central bankers.

MPCs as a mechanism to achieve policy smoothness

When monetary policy makers come in different types, that is, perceive different benefits from inflation surprises, setting up a MPC of heterogeneous agents to choose monetary policy tempers the costly policy fluctuations¹¹ which would result if decisions were made by a sequence of individual policy makers. This mechanistic smoothing property by aggregation is at the heart of Sibert's (2003) and Mihov and Sibert's (2006) result that monetary policy chosen

¹¹ These fluctuations are costly since they are not the result of any stabilization policy but of the succession of policymakers with different preferences.

by a committee¹² dominates that chosen by a series of individuals in welfare terms. In this type of framework, a larger committee would produce less policy volatility and improve welfare since society's loss function is assumed to be quadratic in inflation.¹³

Waller (2000) focuses on the appointment process of committee members. In his model, committee members are politically appointed for a fixed term. They go through a process of nomination by the executive branch of government and confirmation by the legislative branch. If the legislative branch does not confirm the nominee, the seat remains vacant. The constraint imposed by this confirmation process in a context where the government may be divided makes the executive nominate candidates with less extreme preferences than it would otherwise do. Consequently, this process generates more moderate committees and smoother policy decisions. Waller (2000) shows that longer terms make the confirmation constraint more binding and lead to smoother policy.

B. Empirical Evidence and Studies

In accordance with the lessons of theoretical analyses discussed above, there is evidence that some countries are seeking greater policy credibility and smoothness by changing the size and composition of their monetary policy committees. For example, on December 27, 2005, the Uruguayan government submitted draft legislation to Congress that would strengthen the central bank's operational independence, including by raising the number of board members from three to five, and staggering their terms. However, there is also evidence that governments are sometimes tempted to change the rules of the game to their advantage. For example, the Hungarian Parliament passed an amendment to the central bank law on December 14, 2004, which changed the composition and rules for nominating MPC members. In particular, it enabled the prime minister to nominate four new members on the committee—which as a result has currently 13 members—and to dilute the power of the current governor (since decisions are taken by simple majority rule).¹⁴

To get a better sense of the benefits brought by preference aggregation, it would be useful to actually measure the extent of preference heterogeneity and of the influence of partisan politics on the decision-making process. Analyses of this type have been done by several authors using voting records or transcripts of MPC meetings mostly in the context of the U.S. Federal Reserve's FOMC and, to a lesser extent, of the Bank of England's MPC. Comparable time series of voting data or transcripts unfortunately do not seem to be available or to have been exploited in other countries, where preference heterogeneity and political influence would be expected to be greater on average.

¹² These two papers consider committees of size two which decide by consensus, i.e., choose a weighted average of each individual's preferred policy.

¹³ See also Riboni and Ruge-Murcia (2006). They analyze a committee of size two and assume that if a proposal by the chairman is rejected by the other, less conservative committee member, policy remains unchanged compared to the previous period. This assumption generates less than full adjustment to shocks and policy stickiness.

¹⁴ The governor expressed public discontent at the amendment (see Magyar Nemzeti Bank's website for details).

Studies based on voting records

Numerous studies of voting at the FOMC have examined monetary policy votes cast by Board members, Reserve Bank presidents, or both. These studies have typically found that policy makers with an academic or a banking profile tend to dissent on the side of tightening while those with a long experience as Fed staff tend to dissent on the side of easing, and also that Board members are more sensitive to political and bureaucratic influences than Reserve Bank presidents. However, these studies often suffer from serious econometric problems, such as omitted variables bias or truncation of the data.¹⁵

In a recent book, Chappell et al. (2005, chapter 4) use dissent voting data at the FOMC over 1966–96 to estimate monetary policy reaction functions.¹⁶ They estimate individual-specific intercepts for 83 members of the FOMC who served during this period and document some degree of heterogeneity in policy preferences across members. As earlier researchers, they find that, as a group, members of the Board of Governors preferred a looser monetary stance than Reserve Bank presidents. They also find support for the hypotheses that FOMC members' reaction function shifts toward ease when the Democrats assume the Presidency¹⁷ and when elections are approaching. They also show that partisan pressures work both through direct influence from the President and indirectly through the power of appointment—governors appointed by Democrat Presidents tend to favor easier policies than those appointed by Republicans. Overall their results confirm the presence of political pressures on individual policymakers in a way that is consistent with models of partisan politics.

Meade and Sheets (2005) also look at monetary policy decisions of the FOMC between 1978 and 2000 and present some interesting descriptive statistics.¹⁸ This period includes 214 votes. Dissenting votes represent about 8 percent of total votes cast, with Board members and Bank Presidents dissenting at rates of 7.7 percent and 8.9 percent, respectively. However, if votes by the Chairman are excluded, the dissent rate for Board members rises to 9.2 percent, above that for Bank presidents. Of the 198 dissenting votes registered in their sample, two-thirds were dissents for tighter monetary policy, while one-third were for easier monetary policy. Dissenting votes cast by Board members were split about evenly between easing and tightening, while Bank presidents dissented for tighter monetary policy six times more frequently than for easier policy, a finding consistent with previously discussed evidence.

¹⁵ Studies on the determinants of individual votes at the Fed include (among others) Gildea (1990), Havrilesky and Schweitzer (1990), and Krause (1996).

¹⁶ By so doing, they interpret individual votes as the reflection of individual preferences only and implicitly assume that there is no divergence of beliefs about the state of the world across individuals. They also rule out any form of individual learning or strategic behavior by assumption.

¹⁷ Note that they do not establish any causality in this respect.

¹⁸ Meade (2002) compares dissent rates at the FOMC and at the Bank of England's MPC. She finds that the dissent rate at the Federal Reserve between February 1970 and August 2002 has been 7.8 percent, compared to a dissent rate of 16.6 percent at the MPC of the Bank of England between June 1997 and May 2002 (these numbers exclude votes by the committee chairman). During the same periods, dissents were registered at 48 percent of the FOMC meetings compared to 63 percent at the BoE's MPC.

Perhaps more interestingly, Meade and Sheets (2005) find that policymakers take into account developments in regional unemployment when casting votes on monetary policy, and that these regional developments are more important for Board members than for Reserve Bank presidents.¹⁹ They find that an increase of one percentage point in a region's unemployment rate relative to the national rate reduces the probability that a voter from that region will dissent for tightening by 2.4 percentage points. Their empirical estimates also suggest that membership on the Fed's Board reduces the probability of dissenting for tighter monetary policy by 4.2 percentage points and increases the likelihood of dissenting for easier monetary policy by 1.8 percentage points. However, the magnitude of these effects seems too small to have any actual impact on policy decisions.

Finally, Gerlach-Kristen (2003a) analyses votes at the 72 MPC meetings at the Bank of England between June 1997 and April 2003. She finds that external policymakers have dissented more frequently, for longer periods of time and have tended to favor lower interest rates than the majority. However, looking directly at the original voting records available on the Bank of England's website, the degree of disagreement expressed through voting appears rather small overall.

Studies based on transcripts

Blinder et al. (2001, p. 39) note that the "FOMC does vote in a formal sense, but it is widely known that individual members often do not vote their true preference. Instead, each committee member decided whether to support or oppose the chairman's policy recommendation, which is almost always made first. And a Fed tradition dictates that a member should "dissent" only if they find the majority's—that is the Chairman's— opinion unacceptable." Given this reality, several authors have also analyzed transcripts of FOMC meetings to determine the true extent of dissent and of preference heterogeneity.

Examining transcripts of 72 face-to-face FOMC meetings between 1989 and 1997, Meade (2005) indeed finds that voiced dissent on the short-term interest rate happens in 28.2 percent of cases, compared to 7.5 percent for official dissent. The rate of voiced dissent is even higher for nonvoting FOMC members; in that case, it reaches 34 percent. Regarding the policy "bias,"²⁰ voiced dissent reaches a rate of 49 percent for voters and 44 percent for nonvoters. Focusing on the period 1992–96, Meade (2002) notes that the difference between the mean and the median preference—as inferred through the transcripts— does not help predict the change in interest rates, but is correlated with the policy bias. This finding suggests that the bias is instrumental in achieving consensus on the interest rate decision. The discussion in Meade (2005) also supports this conclusion.

¹⁹ However, using data for an earlier period, Tootell (1991a, 1991b) finds no significant difference between the two groups when estimating their individual reaction functions.

²⁰ This "bias" is a post-meeting statement by the FOMC regarding the likely course of future monetary policy.

Meade (2002) finds that voiced dissent rates are smaller during the period 1992–96, which implies that voiced dissent must have been very high during the early Greenspan years. As suggested by Meade and Stasavage (2005), this may be because policymakers became more wary of voicing dissent after 1993, when the transcripts of FOMC meetings became public. It may also reflect the fact that Alan Greenspan commanded more and more deference over the years.

Last, Chappell et al. (2005, chapters 7–8) analyze transcripts for the Burns and Greenspan eras, and estimate monetary policy reaction functions for individual committee members. Their ranking of individuals on an ease-to-tightness scale is generally consistent with that obtained in their analysis based solely on voting data.

Implications of these studies

These studies suggest that some degree of preference heterogeneity exists at the FOMC and the Bank of England’s MPC but is likely to be small. For example, although statistically significant, the difference between Democrat and Republican appointed Governors does not look quantitatively significant. Using their voting dataset, Chappell et al. (2005) find that a typical Democrat-appointed Governor prefers a funds rate that is about 19 basis points lower than a typical Republican-appointed colleague. In spite of the caveats attached to Chappell et al. (2005)’s methodology to estimate individual preferences,²¹ this finding casts doubt on the economic relevance of preference heterogeneity for MPC design in the current context of U.S. monetary policy institutions and more generally in G-20 countries.^{22, 23} To the extent that time inconsistent preferences mostly reflect the effect of political pressure, it is likely that strong independence, transparency and accountability of the central bank would be sufficient to guarantee a high degree of credibility of monetary policy (see Box 3). In countries where the institutional environment is not that strong, however, a properly structured MPC with staggered terms and a process of appointment that includes confirmation by the legislative branch of government may bring substantial benefits in terms of isolating monetary policy decisions from political pressure and adding support to a legal commitment to central bank independence.²⁴ But no attempt has been made so far to estimate those.

²¹ See footnote 14.

²² Note this comment by Mervyn King on differences of view among the Bank of England’s MPC committee members: “ From the outset, commentators have been unable to resist labeling members of the Committee as either “hawks” or “doves.” I have argued before that it makes no sense to use these descriptions because each member of the Committee has the same objective.” (King, 2002, p.5)

²³ See Arnone, Laurens and Segalotto (2006), who document a significant improvement in central bank *de jure* autonomy in OECD countries between 1990 and 2003.

²⁴ Interestingly, Bank of Ghana (2002, p. 33) states that “the inauguration of the MPC [at the Bank of Ghana in 2002] gives meaning to the government’s commitment to give operational independence to the Bank of Ghana and to insulate the monetary policy process from undue political influence.”

Box 3. Is Time Inconsistency a Real Issue for Monetary Policymakers?

Several prominent American monetary economists have argued that lack of credibility because of time inconsistency is not a major issue for American monetary policy. For example Blinder (1997, p.14), a former Vice-Chairman of the Federal Reserve, wrote: “[M]y central banker friends would not be surprised to learn that academic theories that assume that they seek to push unemployment below the natural rate then deduce that monetary policy will be too inflationary. They would doubtless reply, “Of course. That’s why we don’t do it.” De Long (1997) also wrote that he had “found no sign in Federal Reserve deliberations in the 1970s that time-inconsistency issues played any role in policy formation” and Mayer (1999, p.8) concluded “all in all, it would be hard to write a reasonable history of Fed policy in which time inconsistency played a major role.”

Romer and Romer (1996) too argue that dynamic inconsistency has been overemphasized as a source of monetary policy failure even outside the United States. While they recognize that policymakers may have an incentive to inflate once expectations are set, they claim that this is not the crucial obstacle to desirable policy that many authors have assumed. Instead, they suggest that limited knowledge about how the economy operates and the effects of policy has been a much more pervasive obstacle to good policy.^{1/} They use a series of examples of monetary policy failures in several countries to show that limited knowledge on the part of economists, monetary policymakers, elected leaders and voters has been a frequent source of monetary policy mistakes.^{2/} In this, they echo Friedman and Schwartz’s (1963) explanation of the depth of the great depression by the lack of understanding and experience of most decision makers sitting at the Open Market Investment Committee at the time of the crisis. Friedman and Schwartz’s (1963) also emphasize the importance of the broadening of the membership on the Committee in March 1930 which led to a dilution of the Reserve Bank of New York’s power and to a lack of leadership at a crucial moment.

1/ These factors are discussed in greater detail in the section on belief-aggregation below.

2/ In particular, they take the example of the failure of the Cruzado Plan in Brazil in 1986, described in Simonsen (1988), and that of the failure of monetary policy in Russia in 1992–93 described in Sachs (1994).

V. BELIEF AGGREGATION IN MONETARY POLICY COMMITTEES

As briefly discussed in the introduction, policymakers also differ from each other because of the idiosyncrasy of their judgment, or belief regarding the state of the world. This heterogeneity may be the result of a common prior belief coupled with idiosyncratic private information, as is usually assumed in the game theoretical literature, or because of different prior beliefs (or perspectives). This latter possibility may be thought of as a special case of the former where the private information would be of the softest—that is, least verifiable—form. Differences in modes of reasoning can also be captured in reduced form by differences in soft private information, especially when the context is static. Therefore for practical purposes, one can view a MPC member’s opinion as a combination of soft and hard pieces of information amalgamated with a common prior belief, and the theoretical information aggregation literature can then be scrutinized for potential insights about MPC design.

When motives exist to manipulate private information and/or when individuals vote strategically, the analysis of information aggregation requires a game theoretic framework to study the efficiency of different aggregation procedures. By contrast, when such motives are not present and individuals express themselves sincerely, the analytical results are essentially statistical in nature. This latter type of assumption is also a good characterization of the cooperative context in which experimental studies we shall examine are typically embedded.

To the extent that individual private information is valuable and that it is not fully correlated across individuals, it would seem that a larger and more diverse committee would collectively possess strictly more information and therefore would have the potential to make better decisions. It would seem also that the decision rule would be largely irrelevant if all useful information were shared between committee members before any vote took place. The literature, however, suggests that the decision rule as well as the size of the committee may need to preserve individual motivation and possibly avoid too much convergence of individual judgment over time.

A. The Theory of Information Aggregation in Committees

The information aggregation literature starts from the premise that information is distributed across individuals and examines how this scattered information can be best aggregated. MPC design is only one possible application of the models among several others, including criminal jury design in particular. A limitation of some of these analyses for our purposes is that choice by unanimity rule between two exogenously fixed alternatives—such as guilty and innocent—is a less than fully satisfactory proxy for choice by consensus prevailing in many MPCs. Indeed, under consensus, the policy choice which attracts a unanimity of votes *ex post* has to be discovered during the discussion through bargaining and persuasion among a menu of more than two options.

Information aggregation in small electorates with similar preferences

The famous Condorcet Jury Theorem and subsequent research on the information aggregation properties of voting has mostly focused on large electorates (see Box 4). A smaller literature exists that is motivated by the efficiency of voting rules in a criminal jury context and therefore focuses on small electorates, our object of interest. Feddersen and Pesendorfer (1998) show that when jurors vote strategically, unanimity rule may lead to a high probability both of acquitting the guilty and convicting the innocent and that a wide variety of voting rules lead to lower probabilities of both kinds of error. However, Coughlan (2000) demonstrates that when communication between jurors (in the form of a single nonbinding straw vote) is allowed, sincere voting is a Nash equilibrium provided jurors' utility functions are similar enough, and unanimity performs as well as any alternative rule in minimizing the probability of trial error and maximizing expected utility. Consequently, since voting in MPCs is always preceded by an extensive discussion phase, this literature would seem to suggest the irrelevance of the voting rule.

Box 4. Information Aggregation in Large Electorates and the Condorcet Jury Theorem

The typical analytical setup of studies of information aggregation in large electorates is as follows. There are two possible states of the world, high (H) or low (L). The common prior probability that the state is H is $p > 0$. A group of individuals has to choose between two policies, P_H or P_L . Each individual has similar or identical preferences—he or she prefers P_H to be implemented if the state is H, and P_L if the state is L—and receives one signal of given precision. A deliberation phase may or may not take place, then a vote is called and the collective decision is determined by a voting rule (e.g., simple majority or unanimity).

An early famous contribution to that literature is the paper by Condorcet (1785), who showed that if the prior probability is $p = 1/2$, signals are informative and individuals vote nonstrategically (i.e., they follow their private signal), then the probability that the efficient policy is chosen goes to 1 as the number of voting individuals goes to infinity. Although this result is entirely statistical in nature, the basic intuition of Condorcet on the informational efficiency of voting institutions has been confirmed by papers by Feddersen and Pesendorfer (1996, 1997) and Myerson (1998) in a context where voters behave strategically.^{1/} These papers show that many voting rules aggregate information efficiently asymptotically (i.e., when the size of the electorate goes to infinity) even if signals are distributed asymmetrically across states of nature or if individuals rationally abstain from voting because they feel less precisely informed than others.^{2/}

1/ See also Austen-Smith and Banks (1996)

2/ Dynamic voting games with more than two options, in which voting can be used as a signaling device, are analyzed in Piketty (2000) and Castanheira (2003).

Klevorick, Rothschild, and Winship (1984) demonstrate one benefit of truthful information sharing in a jury context. They quantify how much better a jury can perform if it optimally uses the collective information available to it than if it decides cases by a simple majority vote (with sincere voting) before any deliberation or information sharing occurs. In their model, each juror observes a common signal plus some idiosyncratic noise. Because the median voter in the large jury—i.e. the member who received the median signal—makes an observation in which the idiosyncratic noise approaches zero, he should take this into account when voting. Unless information sharing occurs, he does not and his vote will lead the jury to a nonoptimal decision.²⁵

Persico (2004) aims at jointly characterizing the optimal voting rule and committee size when information acquisition is costly and information is therefore endogenous.²⁶ In such a context, a desirable voting rule must give incentives to acquire information, as well as aggregate information efficiently. In his setup, there is no deliberation stage and committee members vote strategically on whether to move away from a status quo option. He shows that a voting rule that is very inclusive (in the extreme, unanimity) can be optimal only if the information available to each committee member is sufficiently accurate. When individual signals are not precise, requiring a large supermajority to move away from the status quo attenuates committee members' incentives to invest in information. In actual monetary policy settings, however, an

²⁵ A related point is made by Gerlach-Kristen (2003b) in a model with nonstrategic voters. She assumes that communication is akin to receiving other voters' information plus some noise. Consequently, the median voter's information is more precise post deliberation, and the group makes better decisions.

²⁶ More general collective choice mechanisms when information acquisition is costly are analyzed in Gerardi and Yariv (2004).

inclusive rule takes the form of consensus in favor of a bargained-over policy rather than unanimity in favor of an exogenously defined option versus the status quo. Persico (2004)'s main result therefore does not tell whether or when consensus versus simple majority rule provides better incentives. Nevertheless, his perspective suggests that increasing the size of an MPC need not result in a gain of available information as it can lead to loss of motivation.

Information communication and aggregation when preferences are heterogeneous

When MPC members have identical or very similar preferences, one would expect that they fully share their information (i.e., reveal their private signal) during the deliberation phase by adopting a “spirit of investigation, not advocacy” such as that supposedly prevailing in the Bank of England’s MPC according to Mervyn King (King, 2002). In that case, individual beliefs should converge during the discussion and, as mentioned above, the voting rule would be irrelevant.²⁷ In that case, a committee of N members would be perfectly equivalent to a single individual who has observed N signals.

Communication in the form of cheap talk can become a concern when individual preferences are too dissimilar, although repeated interactions among policymakers and reputational concerns within the committee could significantly moderate the amount of untruthful information sharing. Models of deliberation in a committee with cheap-talk communication are presented in Austen-Smith and Feddersen (2002, 2005) and Doraszelski, Gerardi, and Squintani (2003).²⁸ In particular, Austen-Smith and Feddersen (2005) analyze a game of voting preceded by a simultaneous cheap talk stage²⁹ in a committee of three members. The committee has to decide whether or not to move away from the status quo. They establish that on balance, majority rule induces more information sharing and fewer decision-making errors than unanimity. They explain that “although unanimity rule creates incentives for supporters of the status quo to reveal information, it likewise creates incentives for others to conceal information favoring that status quo. This in turn generates an externality rendering information from all members of the committee suspect. In contrast, majority rule balances the incentives of those biased for and against the status quo to the extent that, under at least some circumstances, everyone can truthfully reveal their private information in debate.” As Persico (2004)'s, a translation of this result into a comparison between majority rule and consensus in a MPC context would require serious caveats.

B. Social Influence During Group Decision Making: Experimental Evidence

In the course of an MPC deliberation, members exchange arguments, ideas and information which affect each other's position and belief. The previous theoretical discussion had showed

²⁷ Similarly, strategic voting is not likely to be an issue in practice if preferences are very similar and committee members can communicate.

²⁸ Models of committee choice based on mechanism design are provided by Hao, Rosen, and Suen (2001), and Gerardi and Yariv (2006).

²⁹ In the cheap talk stage, each player sends a signal to the other two players which may or may not truly reflect his private information on the state of the world.

that, except in unlikely cases of strategic manipulation of private information, the deliberation phase would most likely enable the full disclosure of private information and the rational updating as well as the convergence of individual beliefs. However, the social psychology literature presents instances where these channels of informational influence from one member to another may be obstructed or biased. In particular it suggests that individuals tend to treat other people's information as less precise than their own, omit to discuss information that is not initially collectively shared and may bias their collective information search and examination. It also emphasizes the importance of normative influence on top of informational influence, a distinction which was ignored above.

The influence of anonymous advisors

From the perspective of an individual member firming his opinion about the appropriate course of future monetary policy, other MPC members are akin to a group of advisors providing potentially useful information. The literature on the influence of advice is therefore helpful to understand how individuals change opinions. In a series of experiments, Yaniv (2004) explores the effect of (anonymous) advice on individual accuracy in judgment.³⁰ He presents evidence showing that (i) people tend to place a higher weight on their own opinion than on the advisor's opinion; (ii) the more knowledgeable individuals discount the advice more; (iii) the weight of advice decreases as its distance from the prior opinion increased; and (iv) the use of advice improves accuracy significantly, though not optimally. Using a similar experimental context, Yaniv and Milyavsky (2006) analyze how individuals make use of multiple sources of advice. They find that individuals trim egocentrically the opinion sets such that opinions distant from their own are greatly discounted, and that—in the specific task they study—the marginal beneficial effects of increasing the number of advisors are small above two. These studies suggest that useful informational influence is likely to take place in MPCs, but that the more autocratic the decision rule is, the less efficient is information aggregation, unless expertise is positively correlated with voting power.

Information exchange among members of a group

Not only do individuals fail to take full advantage of benevolent advisors' opinion, they also do not seem to share fully their own information with other group members. Stasser (1991) and Wittenbaum and Stasser (1996) find that groups often do not discuss all the information that their members possess, but concentrate instead on information that members initially share.³¹ When the group must consider information that is initially unshared to make a correct decision, the bias toward discussing shared information can lead to an incorrect decision. However, this bias is not always strong. The tendency for groups to discuss shared information is weaker in particular when discussion has gone on for some time and when group members are informed about their own and others' expertise in various domains (Levine and Moreland, 1998). Larson

³⁰ The specific task used in his studies is the estimation of the year in which certain historical events took place.

³¹ In the experiments discussed in these papers, groups have to choose one of two possible alternatives and each member is given pieces of evidence that support either alternative. These pieces of evidence may be distributed to only one member or to several members of the group.

et al. (1998) also find that group leaders are more likely than others to repeat unshared information. Active leadership may therefore increase its impact and improve the group decision-making's efficacy.

Stasser (1991) and Wittenbaum and Stasser (1996) explain the poor group decisions in their studies with a simple statistical argument based on collective information sampling. By contrast, Gigone and Hastie (1993) propose that shared information affects group decision quality in a different way—namely, through its impact on individual members' judgment prior to the discussion (a phenomenon they called the “common knowledge effect”). From this perspective, group discussion is mainly an occasion for normative influence, in which members negotiate the weighting of their prediscussion opinions.

The “groupthink” phenomenon and selective information seeking in groups

Problems associated with failure to exchange views are highlighted in Janis's (1982) famous analysis of “groupthink” in a series of case studies. According to Janis, factors such as high cohesion, structural faults (e.g., directive leadership), homogeneity of members' social background and a provocative situational context (e.g., external threats) produce a concurrence-seeking tendency, excessive confidence of the group, closed mindedness, and pressures toward uniformity, which in turn lead to defective decision making, including an incomplete survey of available options, a failure to assess the risks of the preferred option, and a selective bias in processing information. As a result, the group is less likely to make a good decision and more likely to become psychologically entrapped in a poor decision.

In spite of its popularity as a way of explaining poor group decisions, groupthink has received mixed empirical support, in particular in laboratory studies (Aldag and Fuller, 1993). Nevertheless these studies highlight the importance of distinguishing the effect of each individual factor which Janis included as a cause of groupthink. Among those, the factor that has received the most consistent support is directive leadership. But the other central variable of cohesiveness has not been found to play a negative role in group performance. In fact, this factor may even be positive by promoting morale and confidence (Choi and Kim, 1999).

In a related study, Schulz-Hardt et al. (2000) provide evidence that groups, just like individuals, prefer supporting to conflicting information when making decisions.³² They document that the strength of this bias depends on the distribution of the group members' initial favorite option: the more group members had chosen the same alternative prior to the group discussion, the more strongly the group preferred information supporting the alternative. This study, as well as Janis's (1982) book, suggests therefore that information acquisition and processing is likely to be less biased in MPCs where a variety of perspectives are represented.

³² A large literature in psychology has been devoted to documenting systematic biases in individual judgment. One could wonder which biases are magnified and which are attenuated when decisions are made by groups. In their review of the relative susceptibility of individuals and groups to fifteen systematic judgmental biases Kerr et al. (1996) found no clear general pattern and we will therefore not explore this topic further.

The effect of discussion and the group polarization phenomenon

Moscovici and Zavalloni (1969) provide evidence of a phenomenon called group polarization, which describes the tendency for individuals' opinion to become more extreme (in whatever direction they originally favored collectively) after discussion than before. Both informational and normative explanations of group polarization have been proposed, but Kaplan (1987) argues that normative influences are relatively more likely with judgmental issues than with intellectual issues. Since monetary policy decisions have both judgmental and intellectual dimensions, it is likely that normative influences associated with group polarization have some relevance in a MPC context. In that case, deliberation could lead to too extreme beliefs and decisions, especially if a strong majority favors the same action initially.

C. Accuracy of Individual versus Group Judgment: Experimental Evidence on the Effects of Size and Composition

The previous discussion highlighted how information could be less than perfectly acquired and communicated in groups during the process of collective judgment formation. In the remainder of this Section, we shall focus on outcomes rather than processes and discuss how the three main aspects of MPC structure we are interested in, that is, size, composition and decision rule, are empirically related to several performance measures in a variety of experimental contexts. In all of these experiments, the interests of all individuals in a group are perfectly aligned, and potential motives for strategic manipulation of information should be of no concern.

Available evidence does not provide precise guidance about the optimal size of a MPC and suggests that some degree of heterogeneity of perspectives is likely to be beneficial. Exactly how much is a question that has not been directly addressed. The literature leaves us with a number of trade-offs relevant for MPC design rather than quantitative indications.

Effects of group size

Social psychologists have long been interested in comparing the quality of individual and group decisions. Reviewing the research on individual versus group accuracy on judgment tasks, Hastie (1986) argued that task characteristics often influence the relative performance of individuals and groups. He concluded that the critical determinant of group performance is solution demonstrability; that is, groups perform best on tasks with correct solutions that can be readily demonstrated and communicated to members. Gigone and Hastie's (1997) conclusions echo Hastie's (1986). They find that group judgments tend to be approximately equal in accuracy to the mean judgment of their member, and less accurate than the judgments of their most accurate member.³³ However, Michaelsen et al. (1989) and Watson et al. (1991) find that when groups solve problems repeatedly, average group performance over time can often exceed the average performance of the best member, although groups do not outperform the best individual at the level of the single test, as shown by Tindale and Larson (1992) or Stasson and Bradshaw (1995).

³³ The size of groups in the studies included in the review varies between three and eight. However, the effect of size on performance is not discussed.

More recently, Blinder and Morgan (2005) conducted an experiment which imitated real-life monetary policy decisions (see Box 5). They found that decisions made by groups (of five members) were on average better than individual decisions.³⁴ Lombardelli, Proudman, and Talbot (2002) replicated Blinder and Morgan's (2005) experiment and confirmed their results.

Box 5. Blinder and Morgan's (2005) Monetary Policy Experiment

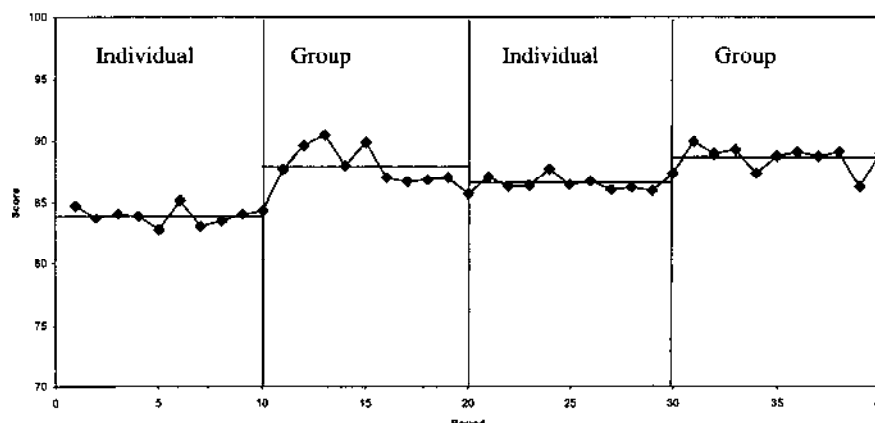
Blinder and Morgan's (2005) experiment asked subjects to assume the role of monetary policymaker. A computer was programmed with a simple two-equation macroeconomic model, with parameter values that resemble the U.S. economy. Both the unemployment rate and inflation were hit each period by transitory stochastic shocks and a permanent (positive or negative) fiscal shock hit the economy within the first ten periods of the game. Subjects did not know the details of the model's specification but they did know the probability law that governed the fiscal shock.

Each play of the game proceeded as follows. The system started in steady state equilibrium. Then in each period the computer selected values of the random shocks and displayed the values of unemployment and inflation on the screen, along with past values. Subjects were then asked to choose an interest rate for the next period and the game continued. Each game lasted twenty periods.

Subjects' loss function in each period was linear in deviations of unemployment and inflation from their steady-state values, with equal weight on both variables, and their score for the game was the unweighted average of their score over the twenty periods. In the first part of the experiment, subjects played the game ten times alone. In the second part of the game, they played in groups of five ten times, and everyone in a group received the same payoff. Half of these sessions used majority rule, while the other half used unanimity rule. In the third part of the experiment, subjects played another ten rounds of the game alone, and in the fourth and last part of the experiment, they played in groups of five again, using the decision rule they had not used in the second part.

The results of the experiment supported the hypothesis that groups outperform individuals in a monetary policy game (see Figure 3 below). There was no indication of an influence of the decision rule on outcomes, and some indication of learning from others rather than learning by doing.

Figure 3. Mean Score by Round in Blinder and Morgan's (2005) Experiment



³⁴ They also found that groups were not slower than individuals in reacting to shocks.

Empirical evidence therefore seems to support the idea that a group performs better than an individual in a context similar to that of monetary policy. However, we have already emphasized that a central bank governor alone responsible for monetary policy decisions—such as that of the Reserve Bank of New Zealand—typically has a team of advisors which provides inputs into the decision-making process until the last moment. Blinder and Morgan’s experiment would have therefore been more useful for our purpose if it had compared the performance of groups of equal size but with different distributions of power.

The experiments by Blinder and Morgan (2005) and Lombardelli et al. (2002) did not address the question of the optimal size of the committee. However, this question has been of interest to scholars of psychology and law and the U.S. Supreme Court in the context of criminal jury decision making (Ellsworth and Mauro, 1998). For example, The U.S. Supreme Court concluded in 1978 (*Ballew vs. Georgia*, 1978) that juries with fewer than six members were less representative, less reliable and less accurate than larger juries. However, Hastie et al. (1983, page 35) conclude that “methodological flaws in the research designed to detect jury size effects render any conclusions tentative.” Nevertheless they suggest that recall of evidence during deliberation is likely to be more complete in larger juries, and the variety of viewpoints represented on a twelve-person jury is likely to be greater than on a six-person jury.

More generally, social psychologists insist on the following trade-off. On the one hand, when a group grows larger, it has access to more resources, so its performance would be expected to improve. But in larger groups, coordination losses are also more likely, as are motivation losses due to social loafing and free riding (Levine and Moreland, 1998).

Effects of Group Composition

One source of evidence on the benefits of aggregating various viewpoints—even without any communication—comes from the economic forecasting literature, which has documented that forecasting is improved by combining individual forecasts using different models. Surveying the literature on forecast combination, Timmermann (2005) observes that empirical findings suggest in particular that simple combination schemes are difficult to beat and that forecasts based exclusively on the model with the best in-sample performance often lead to poor out-of-sample forecasting performance.

Research by social psychologists on diversity shows that it can affect both the dynamics and performance of groups. According to Levine and Moreland (1998), the effects of diversity on group dynamics are largely negative. For example, as the heterogeneity of a group increases, its members tend to communicate less often, and in more formal ways, with one another. In contrast, diversity can have positive effects on group performance since it endows a group with flexibility, which can be valuable if the group’s tasks change or become more complex. Diversity also fosters innovation and can improve a group’s relation with various outsiders, who are often diverse themselves.

In a famous experiment that highlights the value of opinion diversity within a group, Hall (1971) asked teams to rank by order of importance fifteen items that persons might use for returning to the mother ship if they were lost on the Moon. He found that “the best-performing groups (...) were those which were least consensual in the early stages of discussion, exploring all possible avenues and ideas. Groups which established a common consensus quickly were often ineffective, suggesting that at least some disagreement is beneficial for committee performance because it stimulates discussion and hard thinking.”

D. Effects of the Decision-Making Procedure: Experimental Evidence

The existing experimental literature on the effects of the decision-making mechanism typically compares the majority rule with the unanimity rule (or consensus). It has documented that compared to the majority rule, the unanimity rule is more likely to promote extensive discussion of an issue, compromise decisions, public and private change of group member’s positions, and positive feelings toward one another.

These studies highlight several virtues of decision making by consensus as opposed to majority rule, in particular the exploration of more alternatives and the better atmosphere prevailing in the group, a factor which could be important for group morale. On the other hand, majority rule seems to enable the preservation over time of a diversity of viewpoints within the group, which could prove useful if the group has to acknowledge a bad decision made in the past or adapt to a new environment.

Effect on group decision outcome and performance

In a MPC context, the group has in principle to choose between a number of alternatives larger than two, by contrast with an adjudication of guilt. In those situations, compromise becomes a possibility and social psychologists have found that unanimity rule results in more compromise decisions than versions of majority rule (Miller, 1985, Kaplan and Miller, 1987, Miller, 1989).

Blinder and Morgan (2005) observe that groups of five perform better than the average individual under both decision rules, and that the two rules do not yield significantly different results. However, they also observe that in their experiment, “majority decisions quickly evolved into unanimous decisions. In almost all cases, once three or four subjects agreed on a course of action, the remaining one or two fell in line immediately.” This suggests that the task in their experiment was much more intellectual than judgmental and therefore was less likely to generate persistent dissent.

Guarnaschelli, McKelvey, and Palfrey (2000) provided experimental evidence that the probability of making an incorrect decision in a criminal jury-type context was actually smaller under unanimity rule than under majority rule in juries of size six, whether a straw poll took place or not, contrary to the Nash equilibrium predictions obtained with the parameter values chosen for the experiment.

A study by Holloman and Hendrick (1972) found that consensus decisions were significantly more accurate than decisions made by majority rule, and both were more accurate than

decisions representing the average position of group members or decisions representing the position of randomly selected members (see Box 6). A study by Bower (1965) also found unanimity rule slightly superior to majority rule, but his results were not statistically significant. Both studies argued that a stricter decision rule heightened pressures on group members to exchange information and search more intensively for better solutions.

The decision rule may also have an effect on performance through the convergence of beliefs within the group. Kameda and Sugimori (1993) analyze how an assigned decision-rule, majority or unanimity, affects the extent to which a group is subject to psychological entrapment. This phenomenon refers to a faulty-decision-making process whereby individuals escalate their commitment to a previously chosen, though failing, course of action. In a group context, the sunk investments at stake may not necessarily be limited to physical costs such as money, time or energy but are also likely to include social and interpersonal investments. Proposing a change may cause loss of face for some members and may violate group harmony. In a series of two experiments, they show that the use of majority rule is more likely to reduce the unity of a group and thus may hinder collective entrapment; in contrast, the use of unanimity may promote group cohesiveness and foster collective entrapment, as in the groupthink phenomenon described above. They suggest that a potentially entrapping situation may cause a greater tendency to rationalize the ongoing action in unanimity rule than in majority rule groups, and that members who initially belong to the minority are more likely to keep playing the role of the devil's advocate in majority rule groups.

Effect on positions of individual members

As suggested by the Kameda and Sugimori (1993) experiment, not only do group decision rules differentially affect the group decision, they also differentially affect changes in the opinions of individual members of the group. In unanimous rule groups, as compared to groups using variants of majority rule, substantial convergence occurs during the decision-making process (Hastie et al., 1983; Kaplan and Miller, 1987). This convergence effect occurs not only with respect to the publicly stated positions of the members, but also with respect to their privately held opinions as well in the case of judgmental issues (Kaplan and Miller, 1987). Those members with less popular preferences are less likely to maintain their initial positions under unanimous rule than under majority rules. It is possible that the public expression of an opinion contrary to one's private position creates dissonance that leads to a change in the private position (Festinger and Carlsmith, 1959).

Effect on group discussion

Decision rules may affect the rate at which various members participate in the discussion. Hastie et al. (1983, page 119) found that for members of small factions (one or two persons), the probability of participating in group discussion was much greater under unanimity rule than under 8/12ths or 10/12ths majority rule. Similarly, Hans (1978)³⁵ found that minority faction members participated more in discussion under unanimity rule than under 5/6ths majority rule.

³⁵ Cited in Hastie et al. (1983, pp. 30–31).

Thus, under unanimity rule majority faction members dominate discussion to a lesser extent than they do under forms of majority rule. Hans (1978) also found that this was due to within-faction discussion rather than between-faction persuasion attempts.

Effects on group members' feelings toward one another

Hastie et al. (1983) found that jurors under all decision rules had more favorable impressions of others with whom they agreed than of others with whom they disagreed. They also found that jurors had more positive impressions of others in unanimous rule juries than majority rule juries. However, because unanimity rule typically results in greater eventual agreement among group members than does majority rule, it is likely that the effect of decision rule on liking was due largely to the effect of rule on agreement.

VI. SUMMARY AND CONCLUSIONS

Our review suggests that there are good reasons to believe that entrusting monetary policy decision making to a properly designed committee is likely to improve performance. A MPC can be instrumental in minimizing the influence of political pressure on decisions and reducing ideology-driven policy volatility linked to changing political majorities, provided MPC members' terms are staggered and the voting rule is democratic enough. We have argued that these types of benefits are most likely to accrue in countries where central bank independence, either de jure or de facto, is still incomplete. In these countries, as well as those with modern, independent central banks, moving from individual to committee decision making may also be desirable because collective expert judgment is likely to dominate individual judgment.

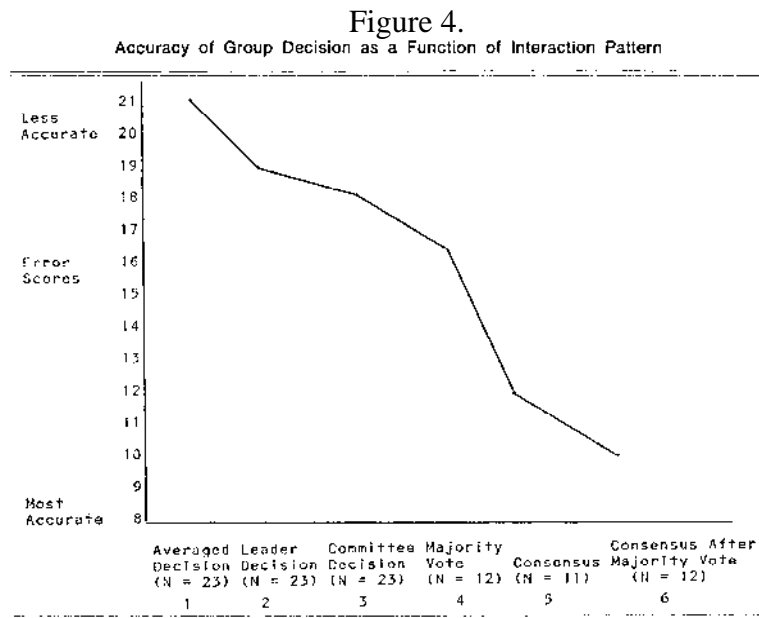
The literature does not point to any magical number which would define the optimal MPC size. Rather, it highlights several benefits of greater size and diversity such as access to more resources, information and knowledge; reduced policy volatility; enhanced flexibility and innovation potential in the face of a changing environment; and improved relations with various outsiders. Higher heterogeneity of viewpoints also provides stronger incentives to acquire information to defend one's perspective and seems to stimulate exploration of more options, decrease the extent of biased information search and the likelihood of group polarization due to normative influence. These benefits have to be traded-off against the risk of coordination and motivation losses as well as that of less efficient communication.

Experimental evidence in various contexts hints at the superiority of consensus over majority rule when decisions are one-shot. Requiring consensus appears to favor more in-depth discussions, more accurate judgment sometimes, and more positive feelings within the group ex post which is positive for group morale. However, consensus also seems to promote the convergence of members' views over time, which may be detrimental to preserving a healthy diversity of perspectives within the MPC. Therefore a main conjecture that follows from our review is that a trade-off may exist between short-run efficiency, which would favor consensus, and long-term efficiency, which would favor majority rule.

Box 6. Group Decision Rule and Quality of Decisions: Holloman and Hendrick's (1972) Experiment

Holloman and Hendrick (1972)'s study compared the adequacy of decisions made across six conditions: (i) individual decision; (ii) decision made by an elected leader; (iii) decision made by two elected leaders; (iv) majority rule; (v) consensus; and (vi) consensus after majority vote. Groups were of size six. Subjects saw the beginning of the film *Twelve Angry Men* by Sidney Lumet depicting the deliberations of a jury in a murder trial. They saw the initial vote of the jury, which was 11 to 1 in favor of a guilty verdict. The film was then stopped, and subjects were told that during the remainder of the film the jurors switched their votes one by one to not guilty. Each subject was asked to predict the order in which the jurors would change their votes from guilty to not guilty. Subsequently, subjects had to reach group decisions about the sequence of juror changes according to one of the five-group conditions listed above.

This decision of each subject/group was compared to the correct solution. Their score was computed as the sum of the absolute differences between their decision and the correct solution. Figure 4 summarizes the mean error scores obtained for each decision-making process. The data reveal no statistically significant difference between the first three processes used. They also show that majority voting is superior to averaging of individual decision but is not significantly more accurate than the decisions made by a chosen leader or two chosen leaders. Consensus and Consensus after majority vote were both superior to the other processes investigated.



The paper also suggests a number of directions for further research. A first deficiency of the literature for our purposes is that many papers analyzing information or judgment aggregation are set in a static (one-shot) context whereas monetary policy is dynamic in essence, and therefore it may not be legitimate to transpose their conclusions to a dynamic context. In particular, it would be useful to learn how the voting rule affects the dynamics of preferences and perspectives over time in order to test our conjecture. Second, Blinder and Morgan (2005)—type of monetary policy experiments could be enriched to yield more informative conclusions. In their type of environment, one could easily vary size, heterogeneity, task

complexity, repeat the game over long periods of time (so that more natural groups form), and compare committees deciding with majority or unanimity rule with autocrats advised by a team. Third, the relationship between MPC structure and the role of central bank staff in conducting economic analyses and projections that feed MPC discussions is an important area which has not attracted much attention either theoretically or empirically. Fourth, to the best of our knowledge, there has been no empirical study trying to link committee structure to performance measures of monetary policy, such as inflation, inflation expectations, or volatility of output. This is probably due to the lack of a comprehensive panel database providing the evolution over time of these variables together with indicators of governance structure by country. A challenge to build such a database would be to precisely characterize the de facto decision rule, given its frequent divergence from the de jure rule.

VII. REFERENCES

- Aldag, R., and S. Fuller, 1993, "Beyond Fiasco: A Reappraisal of the Groupthink Phenomenon and a New Model of Group Decision Processes," *Psychological Bulletin*, Vol. 113, pp. 533–52.
- Arnone, M., B. Laurens, and J.-F. Segalotto, 2006, "Measures of Central Bank Autonomy: Empirical Evidence for OECD and Developing Countries, and Emerging Market Economies," IMF Working Paper 06/228 (Washington: International Monetary Fund).
- Austen-Smith, D., and J. Banks, 1996, "Information Aggregation, Rationality, and the Condorcet Jury Theorem," *American Political Science Review*, Vol. 90, No.1, pp. 34–45.
- Austen-Smith, D., and T. Feddersen, 2002, "The Inferiority of Deliberation Under Unanimity Rule," Northwestern University, Center for Mathematical Studies in Economics and Management Science Discussion Paper No 1360.
- , 2005, "Deliberation and Voting Rules," in Austen-Smith, D., and J. Duggan, eds., *Social Choice and Strategic Decisions: Essays in Honor of Jeffrey S. Banks*, Berlin: Springer.
- Bank of Ghana, 2002, *Annual Report 2002*, Accra.
- Barro, R., and D. Gordon, 1983, "Rules, Discretion and Reputation in a Model of Monetary Policy," *Journal of Monetary Economics*, Vol. 12, pp. 101–21.
- Berger, H., 2006, "Optimal Central Bank Design: Benchmarks for the ECB" Center for Economic Studies and the IFO Institute. CESIFO Working Paper Series (Germany); No. 1697:1–27 March 2006
- Berger, H., V. Nitsch, and T. Lybek, 2006, "Central Bank Boards Around the World," IMF Working Paper (Washington: International Monetary Fund). Forthcoming.
- Blinder, A., 1998, *Central Banking in Theory and Practice* (Cambridge, Massachusetts: MIT Press).
- , 2004, *The Quiet Revolution: Central Banking Goes Modern* (New Haven: Yale University Press).
- Blinder, A., C. Goodhart, P. Hildebrand, D. Lipton, and C. Wyplosz, 2001, "How Do Central Banks Talk?" *Geneva Reports on the World Economy*, Number 3, CEPR (London).
- Blinder, A., and J. Morgan, 2005, "Are Two Heads Better Than One? Monetary Policy by Committee," *Journal of Money, Credit, and Banking*, Vol. 37, No 5.

- Blinder, A., and C. Wyplosz, 2004, "Central Bank Talk: Committee Structure and Communication Policy" (unpublished; Paper presented at the session "Central Bank Communication" at the ASSA meetings, Philadelphia, January 9, 2005).
- Bower, J., 1965, "The Role of Conflict in Economic Decision-Making Groups," *Quarterly Journal of Economics*, Vol. 70, pp. 253–77.
- Brash, D., 2001, "Making Monetary Policy: A Look Behind the Curtains," *Reserve Bank of New Zealand Bulletin*, Vol. 64(1), pp. 45–50.
- Castanheira, M., 2003, "Why Vote for Losers?" *Journal of the European Economic Association*, Vol. 1(5), pp. 1207–38.
- Chappell, H., R.R. McGregor, and T. Vermilyea, 2005, *Committee Decisions on Monetary Policy, Evidence from Historical Records of the Federal Open Market Committee*, (Cambridge, Massachusetts: MIT Press).
- Choi, J.N., and M.U. Kim, 1999, "The Organizational Application of Groupthink and its Limitations in Organizations," *Journal of Applied Psychology*, Vol. 84, No. 2, pp. 297–306.
- Coletti, D., 2004, "Constructing the Staff Economic Projection at the Bank of Canada," *Practical Experience with Inflation Targeting*, (Prague: Czech National Bank).
- Condorcet, M.D., 1785, *Essai sur l'Application de l'Analyse à la Probabilité des Décisions Rendues à la Pluralité des Voix* (Paris).
- DeLong, J.B., 1997, "America's Peacetime Inflation: The 1970s," in C. Romer and D. Romer, eds., "Reducing Inflation: Motivation and Strategy" (Chicago: University of Chicago Press).
- Doraszelski, U., D. Gerardi, and F. Squintani, 2003, "Communication and Voting with Double-Sided Information," *Contributions to Theoretical Economics* (Vol. 3, No.1, Article 6).
- Ellsworth, P., and R. Mauro, 1998, "Psychology and Law," in D. Gilbert, S. Fiske, and G. Lindzey, eds., *Handbook of Social Psychology*, Volume 3, pp. 684–732 (New York: McGraw-Hill Press).
- Feddersen, T., and W. Pesendorfer, 1996, "The Swing Voter's Curse," *American Economic Review*, Vol. 86, pp. 408–24.
- , 1997, "Voting Behavior and Information Aggregation in Elections with Private Information," *Econometrica*, Vol. 65, pp. 1029–58.

- , 1998, “Convicting the Innocent: The Inferiority of Unanimous Jury Verdicts under Strategic Voting,” *American Political Science Review*, Vol. 92, No. 1, pp. 23–35.
- Festinger, L., and Carl Smith, 1959, “Cognitive Consequences of Forced Compliance,” *Journal of Abnormal and Social Psychology*, Vol. 58, pp. 203–10.
- Friedman, M., and A. J. Schwartz, 1963, *The Great Contraction 1929–33*, (Princeton, New Jersey: Princeton University Press).
- Fujiki, H., 2005, “The Monetary Policy Committee and the Incentive Problem: A Selective Survey,” IMES Discussion Paper No. 2005-E-4:1–72 July (Tokyo: Bank of Japan, Institute for Monetary and Economic Studies).
- Gerardi, D., and L. Yariv, 2004, “Information Acquisition in Committees,” (unpublished; University of California Los Angeles).
- Gerardi, D., and L. Yariv, 2005, “Deliberative Voting,” *Journal of Economic Theory*. Forthcoming.
- Gerlach-Kristen, P., 2003, “Monetary Policy Committees and the Benefits of Deliberation,” (unpublished; University of Basel).
- Gerlach-Kristen, P., 2003, “Insiders and Outsiders at the Bank of England,” *Central Banking* Vol. XIV, No. 1, pp. 96–102.
- Gerling K., H.P. Gruner, A. Kiel, and E. Schulte, 2003, “Information Acquisition and Decision Making in Committees: A Survey,” European Central Bank Working Paper No. 256.
- Gigone, D., and R. Hastie, 1997, “Proper Analysis of the Accuracy of Group Judgments,” *Psychological Bulletin*, Vol. 121, No. 1, pp. 149–67.
- Gildea, J., 1990, “Explaining FOMC Members’ Votes,” in *The Political Economy of American Monetary Policy*, edited by Thomas Mayer, (Cambridge U.K.: Cambridge University Press), pp. 211–28.
- Goodhart, C., and E. Meade, 2003, “Central Banks and Supreme Courts,” London School of Economics (unpublished; London).
- Guarnaschelli S., R. McKelvey, and T. Palfrey, 2000, “An Experimental Study of Jury Decision Rules,” *American Political Science Review*, Vol. 94, No. 2, pp. 407–23.
- Hall, J., 1971, “Decisions, Decisions, Decisions,” *Psychology Today*, November, pp. 51–54 and pp. 86–88.
- Hans, V., 1978, “The Effects of the Unanimity Requirement on Group Decision Processes in Simulated Juries”(unpublished doctoral dissertation, University of Toronto).

- Hao, L., S. Rosen, and W. Suen, 2001, "Conflicts and Common Interests in Committees," *American Economic Review*, Vol. 91, No. 5, pp. 1478–97.
- Hastie, R., S. Penrod, and N. Pennington, 1983, *Inside the Jury* (Cambridge, Massachusetts: Harvard University Press).
- Hastie, R., 1986, "Review Essay: Experimental Evidence on Group Accuracy," in G. Owen and B. Grofman, eds., *Information Pooling and Group Decision Making*, pp. 129–57 (Westport, Connecticut: JAI Press).
- Havrilesky, T., and R. Schweitzer, 1990, "A Theory of FOMC Dissent Voting with Evidence from the Time Series," in *The Political Economy of American Monetary Policy*, ed. by Thomas Mayer, pp. 197–210 (Cambridge, U.K.: Cambridge University Press).
- Holloman, C., and H. Hendrick, 1972, "Adequacy of Group Decisions as a Function of the Decision-Making Process," *Academy of Management Journal*, Vol. 15, pp. 175–84.
- Hung, A., and C. Plott, 2001, "Information Cascades: Replication and Extension to Majority Rule and Conformity-Rewarding Institutions," *American Economic Review*, Vol. 91, pp. 1508–20.
- Issing, O., V. Gaspar, I. Angeloni, and O. Tristani, 2001, *Monetary Policy in the Euro Area: Strategy and Decision-Making at the European Central Bank* (Cambridge, U.K.: Cambridge University Press).
- Janis, I., 1982, *Groupthink: Psychological Studies of Policy Decisions and Fiascoes*, Second edition (Boston, Massachusetts: Houghton Mifflin).
- J.P. Morgan, 2000, "Guide to Central Bank Watching."
- Kameda, T., and S. Sugimori, 1993, "Psychological Entrapment in Group Decision-Making: An Assigned Decision Rule and a Groupthink Phenomenon," *Journal of Personality and Social Psychology*, Vol. 65, No. 2, pp. 282–92.
- Kaplan, M., 1987, "The Influencing Process in Group Decision-Making," in C. Hendrick, ed., *Review of Personality and Social Psychology*, Vol. 8, pp. 189–212 (Newbury Park, California: Sage).
- Kaplan, M., and C. Miller, 1987, "Group Decision Making and Normative vs. Informational Influence: Effects of Type of Issue and Assigned Decision Rule," *Journal of Personality and Social Psychology*, Vol. 53, pp. 306–13.
- Kerr, N., R. MacCoun, and G. Kramer, 1996, "Bias in Judgment: Comparing Individuals and Groups," *Psychological Review*, Vol. 103, No. 4, 687–719.

- King, M., 2002, "The Monetary Policy Committee: Five Years On," Speech delivered to the Society of Business Economists at the Royal College of Pathologists, May 22, 2002, (London).
- Klevorick, A., M. Rothshild, and C. Winship, 1984, "Information Processing and Jury Decision-Making," *Journal of Public Economics*, Vol. 23, pp. 245–78.
- Krause, G., 1996, "Agent Heterogeneity and Consensual Decision-Making on the Federal Open Market Committee," *Public Choice*, Vol. 88, pp. 83–101.
- Larson, J. R., Jr., C. Christensen, A.S. Abbott, and T.M. Franz, 1996, "Diagnosing Groups: The Pooling, Management, and Impact of Shared and Unshared Case Information In Team-Based Medical Decision Making," *Journal of Personality and Social Psychology*, Vol. 75, pp. 93–108.
- Levine, J., and R. Moreland, 1998, "Small Groups," in D. Gilbert, S. Fiske, and G. Lindzey, eds., *Handbook of Social Psychology*, Volume 3, pp. 415–469 (New York: McGraw-Hill).
- Lombardelli, C., J. Proudman, and J. Talbot, 2002, "Committees versus Individuals: An Experimental Analysis of Monetary Policy Decision-Making," Bank of England Working Paper No. 165.
- Lybek, T., and J. Morris, 2004, "Central Bank Governance: A Survey of Boards and Management," IMF Working Paper 04/226 (Washington: International Monetary Fund)..
- Macklem, T., 2002, "Information and Analysis for Monetary Policy: Coming to a Decision," *Bank of Canada Review*, Summer 2002, pp. 11–18.
- Mayer, T., 1999, *Monetary Policy and the Great Inflation in the United States: The Federal Reserve and the Failure of Macroeconomic Policy 1965–79*, (Cheltenham, U.K.: Edward Elgar).
- Meade, E., 2002, "Central Bank Decision: How Does One Good Head Compare with a Rule?" (unpublished; Center for Economic Performance, London School of Economics).
- , 2005, "The FOMC: Preferences, Voting and Consensus," *Federal Reserve Bank of Saint Louis Review*, March/April, Part 1, pp. 93–102.
- and N. Sheets, 2005, "Regional Influences on FOMC Voting Patterns," *Journal of Money, Credit and Banking*, Vol. 37, No. 4, pp. 661–677.
- Meyer, L., 2004, *A Term at the Fed: An Insider's View* (New York: HarperBusiness).
- Michaelsen, L., W. Watson, and R. Black, 1989, "A Realistic Test of Individual vs. Group Consensus Decision Making," *Journal of Applied Psychology*, Vol. 74, pp. 834–839.

- Mihov, I., and A. Sibert, 2006, "Credibility and Flexibility with Independent Monetary Policy Committees," *Journal of Money Credit and Banking*, Vol. 38, pp. 23–46.
- Miller, C., 1985, "Group Decision-Making Under Majority and Unanimity Decision Rules," *Social Psychology Quarterly*, Vol. 48, pp. 51–61.
- _____, 1989, "The Social Psychological Effects of Group Decision Rules," in P.B. Paulus, ed., *Psychology of Group Influence*, pp. 327–355, (Hillsdale, New Jersey: Erlbaum, 2nd ed.).
- _____, P. Jackson, J. Mueller, and C. Schersching, 1987, "Some Social Psychological Effects of Group Decision Rules," *Journal of Personality and Social Psychology*, Vol. 52, pp. 325–32.
- Moscovici, S., and M. Zavalloni, 1969, "The Group as a Polarizer of Attitudes," *Journal of Personality and Social Psychology*, Vol. 12, pp. 125–35.
- Myerson, R., 1998, "Extended Poisson Games and the Condorcet Jury Theorem," *Games and Economic Behavior*, Vol. 25, pp. 111–31.
- Persico, N., 2004, "Committee Design with Endogenous Information," *Review of Economic Studies*, Vol. 71, No. 1, pp. 165–94.
- Piketty, T., 2000, "Voting as Communicating," *Review of Economic Studies*, Vol. 67, pp. 169–91.
- Pringle, R., ed., 2001, *Governors on the Record* (London: Central Banking Publications).
- Riboni, A., and F. Ruge-Murcia, 2006, "The Dynamic (In)Efficiency of Monetary Policy by Committee," CIREQ Working Paper 2006-02.
- Romer, C., and D. Romer, 1996, "Institutions for Monetary Stability," NBER Working Paper No. 5557.
- Sachs, J., 1994, "Prospects for Monetary Stabilization in Russia," in A. Aslund, ed., *Economic Transformation in Russia*, pp. 34–58 (London: Pinter Publishers).
- Schulz-Hardt S., D. Frey, C. Luthgens, and S. Moscovici, 2000, "Biased Information Search in Group Decision Making," *Journal of Personality and Social Psychology*, Vol. 78, No. 4, pp. 655–669.
- Sibert, A., 2003, "Monetary Policy Committees: Individual and Collective Reputations," *Review of Economic Studies*, Vol. 70, pp. 649–665.
- Sibert, A., 2006, "Central Banking by Committee," CEPR Discussion Paper No. 5626.

- Simonsen, M.H., 1988, "Price Stabilization and Incomes Policies: Theory and the Brazilian Case Study" in M. Bruno et al., eds., *Inflation Stabilization: The Experience of Israel, Argentina, Brazil, Bolivia, and Mexico*, pp. 259–286 (Cambridge, Massachusetts: MIT Press).
- Stasser, G., 1991, "Pooling of Unshared Information During Group Discussion," in S. Worchel, W. Wood, and J. Simpson, eds., *Group Process and Productivity*, pp. 48–67 (Newbury Park, California: Sage).
- Stasson, M., and S. Bradshaw, 1995, "Explanations of Individual-Group Performance Differences: What Sort of 'Bonus' Can Be Gained Through Group Interaction?" *Small Group Research*, Vol. 26, pp. 296–308.
- Sterne, G., 2004a, "Forecasting at the Bank of England: A Discussion of Don Coletti "Constructing the Staff Economic Projection" in *Practical Experience with Inflation Targeting*, International Conference held at the Czech National Bank, May 13–14, 2004.
- , 2004b, "Inflation Targets, Independence and MPCs: The United Kingdom and International Experience" in *Practical Experience with Inflation Targeting*, International Conference held at the Czech National Bank, May 13–14, 2004.
- Stevens, G., 2001, "The Monetary Policy Process at the RBA," *Reserve Bank of Australia Bulletin*, October, pp. 19–26.
- Svensson, L., 2001, "Independent Review of the Operation of Monetary Policy in New Zealand," *Reserve Bank of New Zealand Bulletin*, Vol. 64, No. 1, pp. 4–11.
- Tabellini, G., 1987, "Reputational Constraints on Monetary Policy: A Comment," *Carnegie Rochester Conference Series on Public Policy*, Vol. 26, pp. 183–190.
- Timmermann, A., 2005, "Forecast Combinations," CEPR Discussion Paper No. 5361.
- Tindale, R., and J. Larson, 1992, "Assembly Bonus Effect or Typical Group Performance? A Comment on Michaelsen, Watson, and Black," *Journal of Applied Psychology*, Vol. 77, pp. 102–105.
- Tootell, G., 1991a, "Are District Presidents More Conservative Than Board Governors?" *New England Economic Review*, September 3–12.
- , 1991b, "Regional Economic Conditions and the FOMC Votes of District Presidents," *New England Economic Review* (March), pp. 3–16.
- Tuladhar, A., 2005, "Governance Structures and Decision-Making Roles in Inflation Targeting Central Banks," IMF Working Paper 05/183 (Washington: International Monetary Fund).

- Waller, C., 2000, "Policy Boards and Policy Smoothing," *Quarterly Journal of Economics*, Vol. 115, No. 1, pp. 305–39.
- Watson, W., L. Michaelsen, and W. Sharp, 1991, "Member Competence, Group Interaction, and Group Decision Making: A Longitudinal Study," *Journal of Applied Psychology*, Vol. 76, pp. 803–09.
- Wittenbaum, G., and G. Stasser, 1996, "Management of Information in Small Groups," in J. Nye, and A. Brower, eds., *What's Social about Social Cognition? Social Cognition Research in Small Groups*, pp. 3–28 (Newbury Park, California: Sage).
- Yaniv, I., 2004, "Receiving Other People's Advice: Influence and Benefit," *Organizational Behavior and Human Decision Processes*, Vol. 93, pp. 1–13.
- , and M. Milyavsky, 2006, "Using Advice from Multiple Sources to Revise and Improve Judgments," *Organizational Behavior and Human Decision Processes*. Forthcoming.
- Yellen, J., 2005, "Policymaking on the Federal Open Market Committee (FOMC): Transparency and Continuity," presentation to the Bank of Japan's 12th International Conference of the Institute for Monetary and Economic Studies.