Committee structure and its implications for monetary policy decision-making

Jan Marc Berk*and Beata K. Bierut†‡

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Abstract

We investigate the implications for the setting of interest rates when monetary policy decisions are taken by a committee, in which a subset of members may meet prior to the voting in the committee and therefore has the possibility to reach consensus ex ante to vote unanimously ex post. We allow for different committee sizes, various voting rules and differences in skills among committee members. We find that the size of the committee is much less important in determining the degree of interest rate inertia than the skills of committee members. Moreover, prior interaction of a subgroup only has a minor effect on the setting of interest rates by the committee, provided that members on average are equally skilled and voting takes place using a simple majority rule. If either of those assumptions are relaxed, prior interaction has substantial effects on the setting of interest rates.

JEL codes: E52, E58

Key words: monetary policy, interest rates, voting

1 Introduction

Most textbooks on monetary policy are based, either implicitly or explicitly, on the assumption that policy decisions are taken by a homogenous entity, often denoted by 'the' central bank. However, in reality these decisions are the competence of a group of persons, organized in the form of a committee. Prominent examples include the Federal Open Market Committee (FOMC) of the Federal Reserve System and the Governing Council of the European Central Bank (ECB). As noted by, inter alia, Blinder (1998), the fact that monetary

*De Nederlandsche Bank, Vrije Universiteit Amsterdam and Tinbergen Institute, the Netherlands.

†De Nederlandsche Bank, Erasmus University Rotterdam and Tinbergen Institute, the Netherlands. Corresponding author. E-mail: B.K.Bierut@dnb.nl.

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decision-making is conducted by a committee could have implications for the way policy is conducted. One could, for example, argue that committees tend to be inertial, as they tend to adopt compromise positions.

In addition, members of monetary policy committees are often chosen to ensure a broad representation of society. This set-up is often imbedded in a central bank structure characterized by a main office in a central location, with additional regional offices throughout the currency area. The US, where the Federal Reserve Act requires all of the monetary policy-makers to have some regional identity (see Meade and Sheets (2002)) again is a good example of such a hub-and-spokes-system. As a consequence, the FOMC consists of the members of the Board of Governors (hub) as well as the presidents of the Federal Reserve Banks (spokes). The Governing Council of the ECB includes members of the Executive Board of the ECB (hub) as well as governors of all euro area national central banks (spokes).

This paper investigates the implications for the setting of interest rates when decisions are taken by a 'hub-and-spokes' committee. Our main contribution to the literature is that we allow for a subset of members (the 'hub') to meet prior to the voting. This interaction may modify their behavior during the actual voting in the committee: they may for example ex ante decide to take an unanimous stand.[1] We investigate this issue in the second section, under the assumption of a simple majority voting rule. Section 3 extends this analysis to the case in which there exists an asymmetry in decisional skills of committee members, i.e. they differ in the degree of accuracy in assessing the state of the economy, between the 'hub' and the 'spokes'. This asymmetry may (but need not) be related to an informational asymmetry. One could think of a situation in which the center produces, and disseminates only with some time lag, some statistical information, which is an important input in monetary policy discussions. In sections 4 and 5 we take up the issue of alternative voting rules, i.e. unanimity and the optimal rule, that is the one which maximizes the degree of accuracy of the collective decision-making process.

Our results indicate that the possibility of prior interaction of a subgroup has a marginal effect on the interest rate set by the committee, provided members are on average equally skilled and committee decisions are taken by simple majority. Skill differentials and/or unanimity voting rule, however, imply that prior interaction has a substantial effect.

2 The voting game

We investigate incomplete-information voting outcomes in a committee of individuals, in which a group of members ('the Board') has the possibility to reach consensus ex ante and therefore may vote unanimously ex post. The Committee meets in order to decide whether interest rates should be changed (decision

[1] In reality unanimous voting by a subset of the committee is rather common in monetary policy decision-making, see Gildea (1992). Whether this is the result of ex ante co-ordination remains to be seen, however.

A) or not (decision B). The Committee members $i = 1, 2...n$ are not certain what is the true state of the world or, in other words, whether economic conditions require a change of policy interest rates (state A) or not (state B). The decision-taking procedure is as follows:

1. The states of the world are not necessary equally likely. The probability that a state of the world occurs which requires a change in interest rates is Q (henceforth called the 'prior') and the probability that the state is such that rates should be kept constant is $1 - Q$:

$$\begin{aligned} P(A) &= Q \\ P(B) &= 1 - Q \end{aligned}$$

   These probabilities form a benchmark, as they represent the 'correct' level of monetary policy activism (Q) or inertia ($1 - Q$).

2. Committee members take monetary policy decisions by voting.[2] Each individual member has two choices: vote in favor of a change in the policy rate (vote A) or vote against a change in the policy rate (vote B). The latter is, in our set-up, identical to a vote in favor of keeping the policy rate unchanged. The decision of the individual Committee member is conditional on imperfect information about the true and unobservable state of the world. Committee members possess private knowledge of current economic conditions (i.e. economic data becoming available after briefing by their staff, private conclusions drawn based on some (possibly common) information, etc.), which differs in the degree of accuracy. Therefore the ability of assessing the current state of the world correctly is heterogenous among Committee members, i.e. the probability of supporting the change of interest rates in state A (opposing the change in state B) is individual:

$$\begin{aligned} P_i(\text{vote } A|A) &= P_i(\text{vote } B|B) = q_i \in (0,1) \\ P_i(\text{vote } B|A) &= P_i(\text{vote } A|B) = 1 - q_i \end{aligned}$$

   We assume that individual decisional skills of Committee members represent independent draws from a single distribution with $E(q_i) = q_C$. The latter may be also interpreted as assuming that Committee members on average are equally skilled. This may be due to the fact that expertise often is an important selection criterion for membership. The Maastricht Treaty, for example, in this respect mentions "recognized standing and professional experience in monetary or banking matters" (Article 11).

3. m out of n members (the Board) meet prior to voting in the Committee and exchange their views on economic conditions. This meeting may result

[2] We assume that the Committee as well as the Board decide only on monetary policy. In addition, we preclude any intertemporal correlation of monetary policy outcomes. That is, we only consider one-shot games. Furthermore, as our focus is on decisional skills of Committee members, we preclude any strategic behavior.

in three outcomes: (1) if k_B out of m Board members are in favor of a change in interest rates, the Board will vote unanimously for a change in interest rates in the upcoming meeting of the Committee (situation $C(A)$), (2) if k_B out of m Board members are against a change in interest rates, the Board decides to vote unanimously against the change (situation $C(B)$), (3) otherwise the Board does not assume any common position and all Board members will vote individually in the Committee (situation I).[3]

4. all n members of the Committee vote. Interest rates are kept unchanged if at least k members vote against (they vote B).[4]

2.1 Position of the Board

If the Board has the possibility to interact prior to the Committee meeting, the Board members will vote on their position regarding interest rates the same way as the Committee votes afterwards on the change of interest rates. There is, however, an important difference in that the Board - in contrast to the Committee, can decide 'not to decide', as the formal decision on interest rates is taken only in the Committee. The Board meeting thus can generate three outcomes, and the decision rule that we propose translates binary individual choices into three possible collective decisions. The Board members may decide to collectively vote in favor of the status quo ($C(B)$) or in favor of a change ($C(A)$) in the upcoming Committee meeting, if a certain majority of the Board's members is in favor of either alternative. Otherwise, Board members will vote individually in the Committee meeting (I).[5] In all cases, the corresponding probabilities depend on the likelihood of the state of the world occurring (i.e. the prior) and decisional skills of the Board members:

$$P(C(B)) = Q \sum_{\substack{S \subset M \\ s \geq k_B}} \prod_{i \in S} (1-q_i) \prod_{i \notin S} q_i + (1-Q) \sum_{\substack{S \subset M \\ s \geq k_B}} \prod_{i \in S} q_i \prod_{i \notin S} (1-q_i) \quad (1)$$

$$P(C(A)) = Q \sum_{\substack{S \subset M \\ s \geq k_B}} \prod_{i \in S} q_i \prod_{i \notin S} (1-q_i) + (1-Q) \sum_{\substack{S \subset M \\ s \geq k_B}} \prod_{i \in S} (1-q_i) \prod_{i \notin S} q_i \quad (2)$$

$$P(I) = 1 - P(C) = 1 - P(C(B)) - P(C(A)) \quad (3)$$

where the sums are taken over all subsets S of the set of the Board members $M = \{1, 2, 3, ..., m\}$, such that s (the number of members in S) is at least k_B.

[3] Let us assume that $m = 6$ and $k_B = 5$. If there were 4 votes for A and 2 for B, then the Board would not reach a common position and would vote individually subsequently. If the votes were divided 5 to 1, then the Board would vote unanimously for A in the Committee meeting.

[4] In sections 2 and 3 we will consider only the simple majority voting rule. Therefore $k = \frac{n+1}{2}$ for odd n. In section 4 we will investigate the unanimity case: $k = n$.

[5] With such an assumption about the Board's decision rule we want to introduce an endogenous possibility that the Board does not reach any prior decision (and votes individually ex post). It turns out that this decision rule is superior to the ordinary simple majority (which would preclude the 'no-decision' outcome) in terms of the accuracy of *the Committee's decisions*: see the appendix.

Under the assumption that individual decisional skills of the Board members represent independent draws from a single distribution with $E\left(q_{i,i\in M}\right)=q_B$, then average (expected) probabilities of the Board taking either of the three actions are given as:

$$EP(C(B)) = Q\sum_{s=k_B}^{m}\binom{m}{s}(1-q_B)^s q_B^{m-s} + (1-Q)\sum_{s=k_B}^{m}\binom{m}{s}q_B^s\left(1-q_B\right)^{m-s} \quad (4)$$

$$EP(C(A)) = Q\sum_{s=k_B}^{m}\binom{m}{s}(1-q_B)^{m-s} q_B^{s} + (1-Q)\sum_{s=k_B}^{m}\binom{m}{s}q_B^{m-s}\left(1-q_B\right)^{s} \quad (5)$$

$$EP(I) = 1-EP(C)=1-\left[EP(C(B))+EP(C(A))\right] \quad (6)$$

Figure 1 presents graphically the expected probability that a 6-member Board assumes a common position in the Committee (i.e. collectively supports either a proposal to change interest rates or to leave them unchanged), $EP(C)=EP(C(B))+EP(C(A))$[6], as a function of average decisional skills of its members for two limiting cases: the maximum threshold (or unanimity, $k_B=6$)[7] and the minimum threshold ($k_B=4$)[8]:

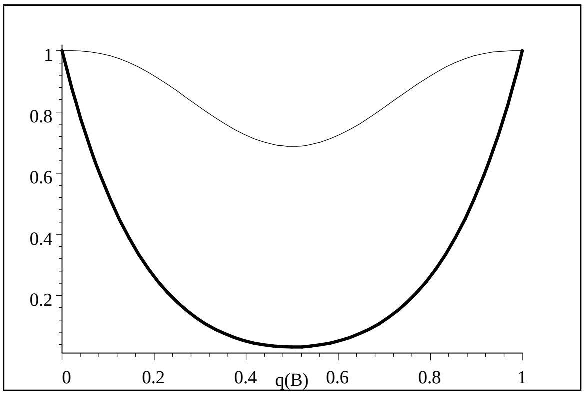

Figure 1: Expected probability that the Board will act unanimously in the Committee voting

The Board is most likely to vote in tandem in the upcoming Committee meeting if average decisional skills of its members are either very low or very high. However, in the first case the Board is likely to agree on the less probable ('wrong') state of the world, in the second case on the more probable ('right') one. The explanation is as follows: as q_B approaches either of the bounds the Board members become more uniform in their decisional skills (whether good or wrong) and therefore are more likely to reach a common position under all possible circumstances (i.e. in either of the states).

[6] Note that, as this probability does not distinguish between changing interest rates or not, it does not depend on the prior for a fixed threshold k_B.

[7] Thicker line

[8] Thinner line

Furthermore, the expected probability of a consensual outcome varies considerably (between 0.03 and 1) under the unanimity rule and remains consistently high if the threshold is 4 (between 0.69 and 1).

2.2 Voting in the Committee

If the Board does not interact prior to the Committee meeting, the decision-taking situation represents a standard voting game.[9] The probabilities of passing the decision in favor of status quo (decision B) or in favor of a change in interest rates (decision A) by the Committee under a simple majority voting rule, conditional on the Board voting individually, are:

$$P(\text{decision } B|I) = Q \sum_{\substack{S\subset N \\ s\geq \frac{n+1}{2}}} \prod_{i\in S} (1-q_i) \prod_{i\notin S} q_i + (1-Q) \sum_{\substack{S\subset N \\ s\geq \frac{n+1}{2}}} \prod_{i\in S} q_i \prod_{i\notin S} (1-q_i) \quad (7)$$

$$P(\text{decision } A|I) = 1 - P(\text{decision } B|I) \quad (8)$$

where $N = \{1, 2, 3, ..., n\}$ is the set of all Committee members (i.e. including the members of the Board).

As in the previous subsection, we can relate expected probabilities of passing either of the two decisions in the Committee to average decisional skills of Committee members, $q_C = E(q_{i,i\in N})$:

$$EP(\text{decision } B|I) = Q \sum_{s=\frac{n+1}{2}}^{n} \binom{n}{s} (1-q_C)^s q_C^{n-s} + (1-Q) \sum_{s=\frac{n+1}{2}}^{n} \binom{n}{s} q_C^s (1-q_C)^{n-s} \quad (9)$$

$$EP(\text{decision } A|I) = 1 - EP(\text{decision } B|I) \quad (10)$$

The interpretation of these probabilities is quite intuitive. If the prior probability indicates that the economic situation more likely does (does not) require a change in interest rates ($Q > (<)\, 0.5$), then the average probability of leaving status quo (decision B) is decreasing (increasing) in the average level of decisional skills, i.e. the Committee composed of better-informed individuals is more likely to agree on the appropriate action than the Committee composed of less-informed members. If both states of the world are equally likely ($Q = 0.5$), then the expected probability that either decision is taken is independent of the Committee size and average decisional skills and is equal to 50%.

Figures 2 and 3 depict graphically expected probabilities of interest rate change (decision A) for $Q = 0.25$ and $Q = 0.75$ for different Committee sizes, i.e. $n = \{9, 19, 29\}$.[10]

[9] See e.g. Austen-Smith and Banks (1996), Ben-Yashar and Nitzan (1997) or Nitzan and Paroush (1985)

[10] Thicker line indicates higher n.

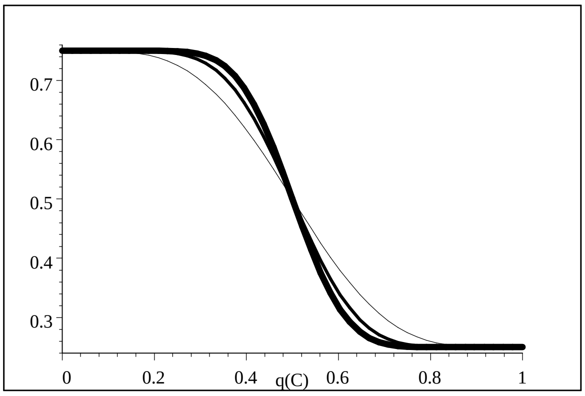

Figure 2: Expected probability that the Committee will change interest rates if $Q = 0.25$ (individual voting)

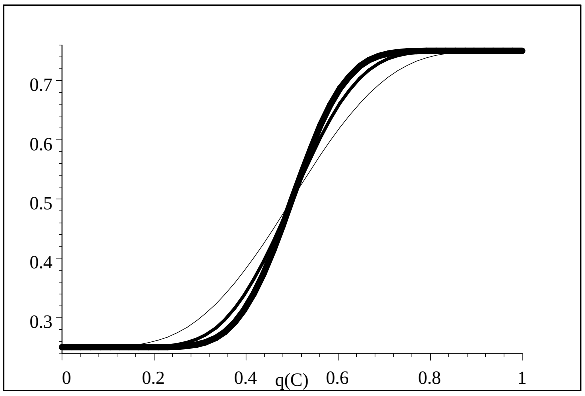

Figure 3: Expected probability that the Committee will change interest rates if $Q = 0.75$ (individual voting)

We start with an explanation of the asymptotics. As q_C approaches unity, on average every Committee member is able to assess the economic conditions correctly. Therefore the expected probability that the Committee will take a certain decision converges to the prior probability that the state of the world requires such an action. As q_C approaches zero, average decisional skills in the Committee are so low, that the Committee is increasingly likely to take a decision that is at odds with the state of the world.

Furthermore, the likelihood of a change in interest rates does not vary substantially with the actual size of the Committee. That is, increasing the size of the Committee does not necessarily increase the degree of interest rate inertia or activism. However, for given average decisional skills, the speed of convergence to the prior probability increases with the size of the Committee. In other words, the size of the Committee influences the relevance of individual decisional skills, in that this influence diminishes with the Committee size.

We now turn to an investigation of the effects of the prior interaction of the Board members and the *possibility* of the Board reaching consensus prior to the

Committee vote. We proceed in two stages. First, we compute the probabilities that interest rates will or will not be changed by the Committee, conditional on the fact the Board has decided on a unanimous position (that is $P($decision $A|C)$ and $P($decision $B|C))$. They are given as follows:

$$
\begin{aligned}
P(\text{decision } B|C) = P(A)\frac{P(C(A)|A)}{P(C|A)} & \left\{ \begin{array}{c} 0 \text{ if } m \geq \frac{n+1}{2} \\ \sum_{\substack{S\subset N-M \\ s\geq \frac{n+1}{2}}} \prod_{i\in S}(1-q_i)\prod_{i\notin S} q_i \text{ if not} \end{array} \right\} \\
+ P(A)\frac{P(C(B)|A)}{P(C|A)} & \left\{ \begin{array}{c} 1 \text{ if } m \geq \frac{n+1}{2} \\ \sum_{\substack{S\subset N-M \\ s\geq \frac{n+1}{2}-m}} \prod_{i\in S}(1-q_i)\prod_{i\notin S} q_i \text{ if not} \end{array} \right\} \\
+ P(B)\frac{P(C(A)|B)}{P(C|B)} & \left\{ \begin{array}{c} 0 \text{ if } m \geq \frac{n+1}{2} \\ \sum_{\substack{S\subset N-M \\ s\geq \frac{n+1}{2}}} \prod_{i\in S} q_i\prod_{i\notin S}(1-q_i) \text{ if not} \end{array} \right\} \\
+ P(B)\frac{P(C(B)|B)}{P(C|B)} & \left\{ \begin{array}{c} 1 \text{ if } m \geq \frac{n+1}{2} \\ \sum_{\substack{S\subset N-M \\ s\geq \frac{n+1}{2}-m}} \prod_{i\in S} q_i\prod_{i\notin S}(1-q_i) \text{ if not} \end{array} \right\}
\end{aligned}
\tag{11}
$$

$$P(\text{decision } A|C) = 1 - P(\text{decision } B|C) \tag{12}$$

where (by formulas (1) and (2))

$$
\begin{aligned}
P(C(A)|A) &= P(C(B)|B) = \sum_{\substack{S\subset M \\ s\geq k_B}} \prod_{i\in S} q_i \prod_{i\notin S}(1-q_i) \\
P(C(B)|A) &= P(C(A)|B) = \sum_{\substack{S\subset M \\ s\geq k_B}} \prod_{i\in S}(1-q_i) \prod_{i\notin S} q_i \\
P(C|A) &= P(C(A)|A) + P(C(B)|A) = P(C|B) = P(C)
\end{aligned}
$$

Obviously, if the Board is larger than the required size of a majority in the Committee, i.e. if $m \geq \frac{n+1}{2}$, then the common position of the Board determines the outcome of the Committee voting:

$$P(\text{decision } B|C)|_{m\geq\frac{n+1}{2}} = \frac{P(C(B))}{P(C)} \tag{13}$$

$$P(\text{decision } A|C)|_{m\geq\frac{n+1}{2}} = \frac{P(C(A))}{P(C)} \tag{14}$$

Otherwise, obtaining the majority for status quo requires, in the case of the Board voting against the status quo, that the required majority of $\frac{n+1}{2}$ non-Board members are in favor of status quo or, if the Board votes in favor, that at least $\frac{n+1}{2} - m$ non-Board members are in favor of status quo:

$$P(\text{decision } B|C)|_{m<\frac{n+1}{2}} = \frac{1}{P(C)} \left(\begin{array}{c} P(A)P(C(A)|A) \left(\sum_{\substack{S \subset N-M \\ s \geq \frac{n+1}{2}}} \prod_{i \in S} (1-q_i) \prod_{i \notin S} q_i \right) \\ +P(B)P(C(A)|B) \left(\sum_{\substack{S \subset N-M \\ s \geq \frac{n+1}{2}}} \prod_{i \in S} q_i \prod_{i \notin S} (1-q_i) \right) \end{array} \right)$$
$$+ \frac{1}{P(C)} \left(\begin{array}{c} P(A)P(C(B)|A) \left(\sum_{\substack{S \subset N-M \\ s \geq \frac{n+1}{2}-m}} \prod_{i \in S} (1-q_i) \prod_{i \notin S} q_i \right) \\ +P(B)P(C(B)|B) \left(\sum_{\substack{S \subset N-M \\ s \geq \frac{n+1}{2}-m}} \prod_{i \in S} q_i \prod_{i \notin S} (1-q_i) \right) \end{array} \right) \quad (15)$$

$$P(\text{decision } A|C)|_{m<\frac{n+1}{2}} = 1 - P(\text{decision } B|C)|_{m<\frac{n+1}{2}} \quad (16)$$

We can now compute the total probabilities of a change (decision A) or no change (decision B) in interest rates, conditional on the fact that the Board members interact prior to the Committee vote and have the possibility of reaching consensus. We therefore combine equations (7)-(8) and (11)-(12) in the following way:

$$\begin{aligned} P(\text{decision } B) &= P(I)P(\text{decision } B|I) + P(C)P(\text{decision } B|C) && (17) \\ P(\text{decision } A) &= 1 - P(\text{decision } B) && (18) \end{aligned}$$

These probabilities depend on the size of the Board, the size of the Committee, prior probabilities and decisional skills of all Committee members. Assuming again that decisional skills are independently distributed, we can express expected probabilities of either outcome as a function of average decisional skills of the Board members and all Committee members:

$$\begin{aligned} EP(\text{decision } B) &= EP(I)EP(\text{decision } B|I) + EP(C)EP(\text{decision } B|C) && (19) \\ EP(\text{decision } A) &= 1 - EP(\text{decision } B) && (20) \end{aligned}$$

where the expected probability of deciding in favor of status quo, if the Board acts unanimously, $EP(\text{decision } B|C)$, can be expressed as:

$$\begin{aligned}
EP(\text{decision } B|C) &= P(A)\frac{EP(C(A)|A)}{EP(C)}\left\{\begin{array}{c} 0 \text{ if } m \geq \frac{n+1}{2} \\ \sum_{s=\frac{n+1}{2}}^{n-m}\binom{n-m}{s}(1-q_C)^s q_C^{n-m-s} \text{ if not} \end{array}\right\} \\
&+P(A)\frac{EP(C(B)|A)}{EP(C)}\left\{\begin{array}{c} 1 \text{ if } m \geq \frac{n+1}{2} \\ \sum_{s=\frac{n+1}{2}-m}^{n-m}\binom{n-m}{s}(1-q_C)^s q_C^{n-m-s} \text{ if not} \end{array}\right\} \\
&+P(B)\frac{EP(C(A)|B)}{EP(C)}\left\{\begin{array}{c} 0 \text{ if } m \geq \frac{n+1}{2} \\ \sum_{s=\frac{n+1}{2}}^{n-m}\binom{n-m}{s}q_C^s(1-q_C)^{n-m-s} \text{ if not} \end{array}\right\} \\
&+P(B)\frac{EP(C(B)|B)}{EP(C)}\left\{\begin{array}{c} 1 \text{ if } m \geq \frac{n+1}{2} \\ \sum_{s=\frac{n+1}{2}-m}^{n-m}\binom{n-m}{s}q_C^s(1-q_C)^{n-m-s} \text{ if not} \end{array}\right\} \quad (21)
\end{aligned}$$

Figures 4 and 5 depict graphically the expected likelihood of the Committee deciding on a change in interest rates, conditional on the Board interacting before the Committee meeting, i.e. $EP(\text{decision } A)$, (solid lines) and under the assumption that the average of decisional skills is the same for the Board members and for the whole Committee, i.e. $q_B = q_C = q$. Given the large number of parameters involved, we present expected probabilities for two priors, $Q = \{0.25, 0.75\}$[11], and two Committee sizes, $n = \{9, 29\}$[12], $m = 6$ and $k_B = 4$. Dotted lines refer to the case in which the Board has no option to meet prior to the interest rate voting and can be traced back to figures 2 and 3.

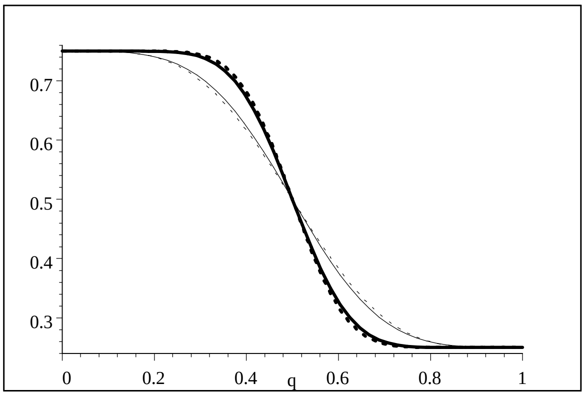

Figure 4: Expected probability that the Committee will change interest rates ($Q = 0.25$)

[11] For $Q = 0.5$ expected probabilities of taking either decision are equal, i.e. $EP(\text{decision } B) = EP(\text{decision } A) = 0.5$, regardless whether the Board members do or do not decide ex ante to take an unanimous position ex post.

[12] Thicker line corresponds to larger n.

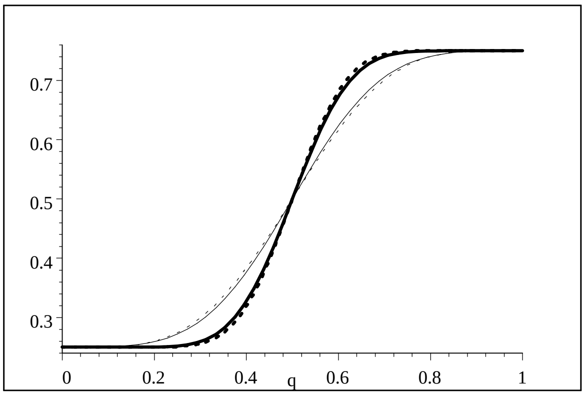

Figure 5: Expected probability that the Committee will change interest rates ($Q = 0.75$)

It follows from these graphs that prior interaction of the Board members has a minor effect on the average degree of monetary policy activism. Further interpretation is similar to the conclusions presented earlier: Committee's size does not seem to be very relevant in determining the likelihood of a change in interest rates. The skills of Committee members are very relevant in this context, as poor skills lead to an increased likelihood that the Committee takes a wrong decision.

3 Implications of skills' asymmetry

In this section we will make the structure of the game more complex by assuming that the average of decisional skills among Board members is higher than the average in the whole Committee, i.e. $q_B > q_C$.[13] Figures 6 and 7 correspond to figures 4 and 5 in the previous subsection and represent expected probabilities of an interest rate change for $q_B = 0.8$ as a function of average decisional skills of the whole Committee q_C ($Q = \{0.25, 0.75\}$[14], $n = \{9, 29\}$, $m = 6$, $k_B = 4$).[15]

[13]Which implies that average decisional skills among other Committee members (i.e. non-Board members) are very low (since $q_C = \frac{m}{n} q_B + \frac{n-m}{n} q_{NB}$).

[14]When the prior is neutral, i.e. $Q = 0.5$, the likelihood of a change in interest rates is fixed at 50%.

[15]Dotted lines again refer to the case in which the Board does not interact prior to the voting in the Committee.

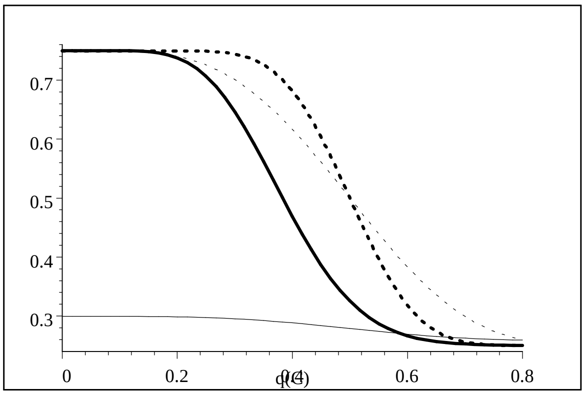

Figure 6: Expected probability that the Committee will change interest rates if $Q = 0.25$ ($q_C < q_B$)

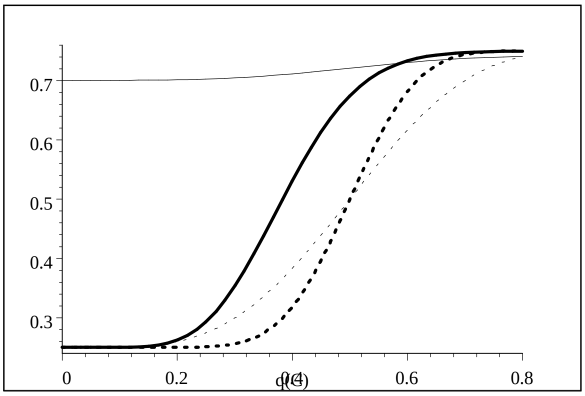

Figure 7: Expected probability that the Committee will change interest rates if $Q = 0.75$ ($q_C < q_B$)

The fact that Board members are (on average) more accurate in their decisions modifies the conclusions from the previous section. Whereas we concluded in the latter that the possibility of the Board reaching consensus a priori did not have a major influence, we now see that a relatively high expertise of the Board members actually improves the accuracy of the decision making process, measured by the deviation of the expected probability that the Committee takes a certain decision from the prior probability that such an action should be taken.[16]

Especially if the Committee is small, such that the size of the Board is larger than the required size for Committee majority, the expected probability of a change in interest rates differs by (only) 0.05 from the true probability Q, even if average decisional skills in the whole Committee approach zero. Were

[16]This result holds for any value of $q_B > q_C$. If $q_C = q_B = q < 0.2$, the accuracy of decisions taken by the Committee would be very low: the expected probability of a change in interest rates would be close to $1 - Q$ (and not Q). Fixing the Board's average decisional skills at 0.2 results in the lowering of the degree of *inaccuracy* in the Committee's decisions by at most 0.008 (if $n = 9$) and 0.00004 (if $n = 29$).

average decisional skills equal among all members of the Committee, a low level of skills would induce the Committee to actually change interest rates with the frequency of $1-Q$ (instead of Q). In a large Committee, high decisional skills of the Board improve monetary policy decision making as well: the average degree of activism approaches the prior probability Q much quicker than in the case of equal skills (the difference is as low as 0.08 even if the average accuracy among all Committee members is 50% (i.e. if $q_C = 0.5$)).

4 Consensual voting

In the previous sections we imposed a simple majority rule for decision making in the Committee ($k = \frac{n+1}{2}$). We now turn to an investigation of the consequences of unanimity ($k = n$) for the degree of monetary policy activism. We will assume that the default option is status quo and that interest rates are changed only if Committee members unanimously vote against the proposal of keeping rates unchanged. We start by assuming (as in the second section) that Board and Committee members are on average equally skilled, i.e. $q_B = q_C = q$. The probabilities of a change in interest rates (decision A) in the two cases: no prior interaction (case 1) and prior interaction (case 2) read as follows:

$$P^1(\text{decision } A) = Q\prod_{i\in N} q_i + (1-Q)\prod_{i\in N}(1-q_i) \tag{22}$$

$$\begin{aligned} P^2(\text{decision } A) &= Q\left(\sum_{\substack{S\subseteq M\\ s\geq 4}}\prod_{i\in S} q_i \prod_{i\notin S}(1-q_i)\right)\prod_{i\in N-M} q_i \\ &\quad +(1-Q)\left(\sum_{\substack{S\subseteq M\\ s\geq 4}}\prod_{i\in S}(1-q_i)\prod_{i\notin S} q_i\right)\prod_{i\in N-M}(1-q_i) \end{aligned} \tag{23}$$

The expected probabilities (computed under the assumptions $m = 6$ and $k_B = 4$) are now given as:

$$EP^1(\text{decision } A) = Qq^n + (1-Q)(1-q)^n \tag{24}$$

$$\begin{aligned} EP^2(\text{decision } A) &= Q\left(\sum_{s=4}^{6}\binom{6}{s} q^s (1-q)^{6-s}\right) q^{n-6} \\ &\quad +(1-Q)\left(\sum_{s=4}^{6}\binom{6}{s} q^{6-s}(1-q)^s\right)(1-q)^{n-6} \end{aligned} \tag{25}$$

Figures 8, 9 and 10 present expected probabilities of a change in interest rates under a unanimous voting rule for three Committee sizes: $n = \{9, 19, 29\}$[17] and three priors: $Q = \{0.25, 0.5, 0.75\}$.

[17] Thicker line corresponds to larger n.

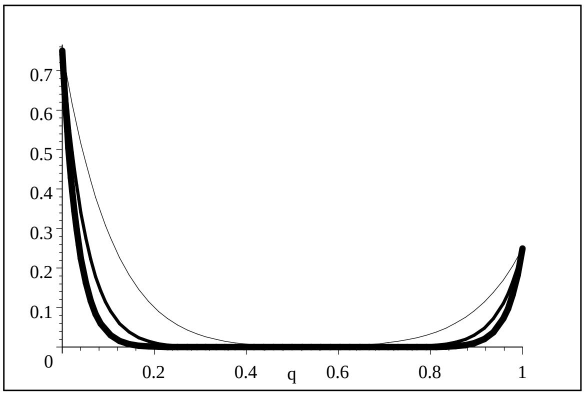

Figure 8: Expected probability of interest rate change under unanimity ($Q = 0.25$)

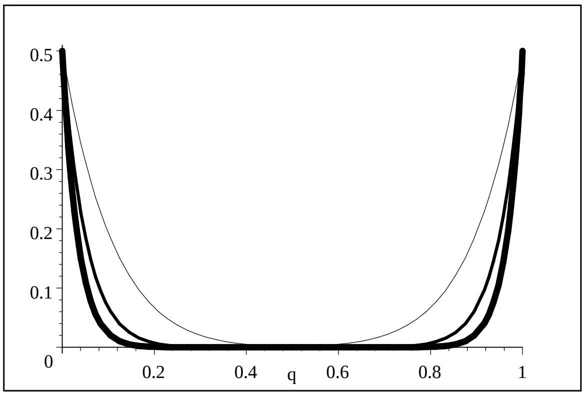

Figure 9: Expected probability of interest rate change under unanimity ($Q = 0.5$)

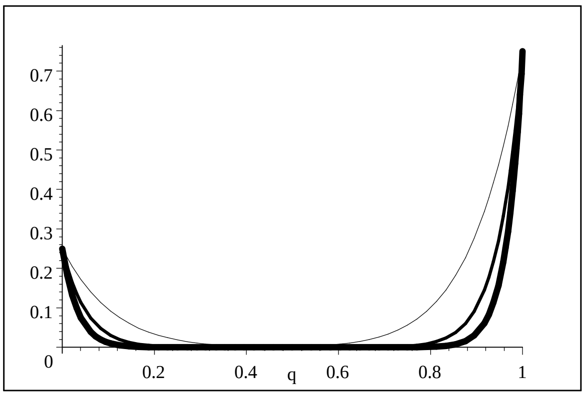

Figure 10: Expected probability of interest rate change under unanimity ($Q = 0.75$)

The figures corroborate the largely qualitative statements made by Blinder

(1998), as quoted in the introduction. If the Committee favors consensus, the degree of monetary policy activism is close to zero. Only at relatively high level of decisional skills q does the probability of taking a certain decision converge to the true probability Q. The convergence to the prior is furthermore achieved for much higher decisional skills than in the case of simple majority.

We now turn to an investigation of the impact of prior interaction of the Board members. Figure 11 presents *relative expected probabilities* of a change in interest rates, i.e. the differences in expected probabilities between the case of prior interaction and no interaction (i.e. EP^2(decision A) $-$ EP^1(decision A)), under an unanimous voting rule. The concept of the relative probability provides simple means of seeing whether, and by how much, prior interaction by the Board increases or lowers the degree of Committee's activism, in comparison to individual voting.

We allow for two Committee sizes: $n = \{9, 29\}$[18]. Dotted lines denote the case when $Q = 0.25$, dashed lines - $Q = 0.5$ and solid lines - $Q = 0.75$.

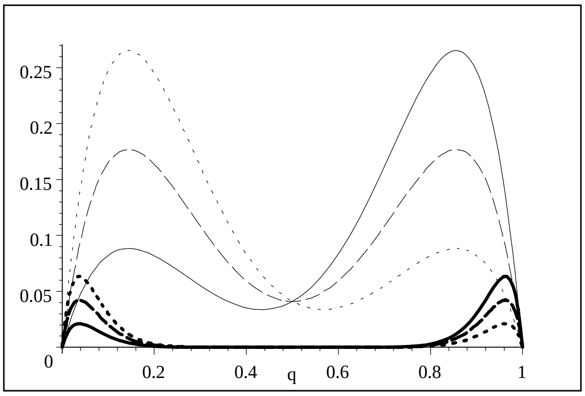

Figure 11: Relative expected probability of interest rate change under unanimity ($q_C = q_B = q$)

Under the simple majority rule a prior interaction by the Board members hardly affected the average likelihood of a change in interest rates (at least if we do not assume superior skills among the members of the Board). Under the consensual voting rule, however, prior interaction increases the probability that interest rates will be changed by up to 27%. This is because prior interaction 'softens' the rigidity inherent in the unanimous voting rule, i.e. the requirement that all members must be of the same opinion. If the Board is allowed to decide on its common position as described in subsection 2.1, the actual number of Committee members which have to be in favor of a change in interest rates is $n - m + k_B$, and not n; the remaining $m - k_B$ members of the Board will vote for a change against their private opinion. The impact is larger, ceteris paribus, the smaller the Committee: in a small Committee the expected likelihood of a change in interest rates is larger for all values of q; in a large Committee this effect is limited to extreme average competence levels.

[18] Thicker line corresponds to larger n.

We now relax the assumption of equal average voting skills by considering the expected probability of interest rate change in the case of higher skills among Board members: $q_B > q_C$ (case 3):

$$EP^3(\text{decision } A) = Q\left(\sum_{s=4}^{6}\binom{6}{s}q_B^s(1-q_B)^{6-s}\right)q_C^{n-6} + (1-Q)\left(\sum_{s=4}^{6}\binom{6}{s}q_B^{6-s}(1-q_B)^s\right)(1-q_C)^{n-6} \quad (26)$$

In this case, we confirm the earlier findings under the simple majority rule (see figures 6 and 7) that the effect of prior interaction are more profound. Figure 12 below presents relative expected probabilities of a change in interest rates (i.e. $EP^3(\text{decision } A) - EP^1(\text{decision } A)$) for $q_B = 0.8$ and $n = \{9, 29\}$ as a function of average decisional skills in the Committee q_C. Dotted lines denote the case when $Q = 0.25$, dashed lines when $Q = 0.5$ and solid lines when $Q = 0.75$.

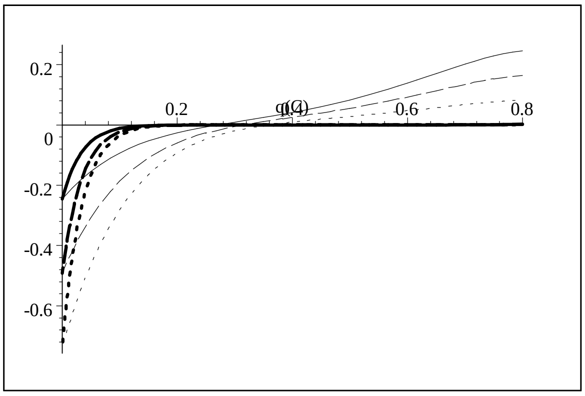

Figure 12: Relative expected probability of interest rate change under unanimity ($q_C < q_B = 0.8$)

In the case when Committee members, which interact prior to voting on interest rates, have superior decisional skills ($q_B = 0.8$), the effect of the interaction depends on the level of skills of other members and the size of the Committee. If the skills are low, the interest rates are (on average) less likely to be changed if interaction takes place. If the skills are higher (larger than 0.4) and the Committee is small (e.g. $n = 9$), the effect is opposite: the interest rates are more likely to be changed. If the Committee was large (e.g. $n = 29$) and the skills were higher than 0.2, the Board's action would have no effect on the interest rates (the relative probability is zero). This pattern is largely the same for all priors.

If the 'superior' decisional skills of the Board were as low as 0.2, prior interaction would have roughly one effect: an increase in the frequency of interest rate changes (see figure 13 below).

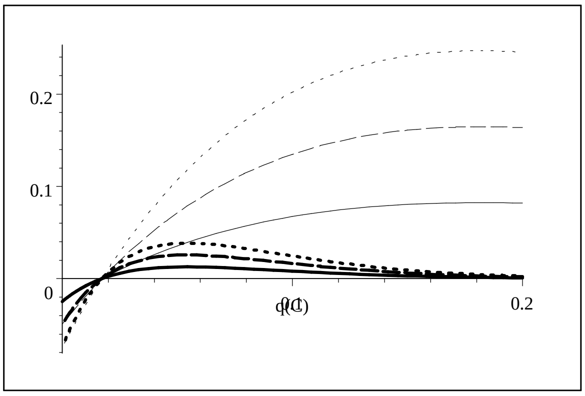

Figure 13: Relative expected probability of interest rate change under unanimity ($q_C < q_B = 0.2$)

5 Optimal voting rule

In the analysis so far, the Committee used either a simple majority rule or the unanimity principle when deciding on interest rates. The motivation for these rules is mainly their real-life applicability. The FOMC for example uses a simple majority rule, whereas the Governing Council of the ECB - although de jure also supposed to use a simple majority rule - de facto sets interest rates based on the principle of consensus.[19] Using either of these rules, we investigate the consequences for the degree of interest rate activism or inertia. In this section, we broaden the perspective by turning to a rule that is optimal in the sense that it maximizes the degree of accuracy of the collective decision-making process.

Although we introduce the possibility of prior interaction of Board members, it has no influence on an ex ante defined voting rule (since the game is simultaneous). Therefore standard results from the literature hold: the optimal voting rule derived by Ben-Yashar and Nitzan (1997) for the case when all Committee members vote individually remains optimal here. We therefore know that the optimal rule need not be simple majority. The optimality of simple majority requires strong assumptions: (1) identical decisional skills among all members of the Committee and (2) equal prior probability of the states of the world occurring, i.e. $Q = 0.5$.

We will proceed by examining the probabilities of a change and no change in interest rates under the optimal voting rule. As our setup is fairly complex, we will retain the first assumption of equal decisional skills among all Committee members, i.e. for all $i \in N$

$$\begin{aligned} P_i(\text{vote } A|A) &= P_i(\text{vote } B|B) = q \in (0,1) \\ P_i(\text{vote } B|A) &= P_i(\text{vote } A|B) = 1-q \end{aligned}$$

[19]This statement is based on public comments by the ECB President during hearings in the European Parliament in April and December 1999.

In this case the optimal quota, i.e. κ^* such that the majority $k = \lceil n\kappa^* \rceil$[20], is given as:

$$\kappa^* = \frac{1}{2}\left(1 + \frac{\ln\left(\frac{Q}{1-Q}\right)}{n\ln\left(\frac{q}{1-q}\right)}\right) \tag{27}$$

The optimal quota is closest to 50% (simple majority) only if decisional skills are very low or very high. It can therefore be concluded that, since in practice the voting rule cannot change too frequently, and it is likely that Q will not always equal 0.5, the best way to make the simple majority both the optimal rule and relatively independent from Q, is to aim for high decisional skills of Committee members. As q approaches 0.5 the quota becomes infinite (undefined). In the intermediate range of decisional skills $q \in (0.2, 0.4) \cup (0.6, 0.8)$ the optimal quota varies between 43% and 57%.[21] In the table below we present the size of the optimal majority for the Committee of 19 members, for various priors and skill levels.

Q/q	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
0.25	10	10	11	11	-	9	9	10	10
0.50	10	10	10	10	10	10	10	10	10
0.75	10	10	9	9	-	11	11	10	10

In figures 16 and 17 we present the probability of a change in interest rate under the optimal voting rule (the thin line) and the simple majority rule (the thicker line) for $n = 19$. Solid lines depict the case when Committee members vote individually, whereas dotted lines correspond to the case when the Board interacts a priori.

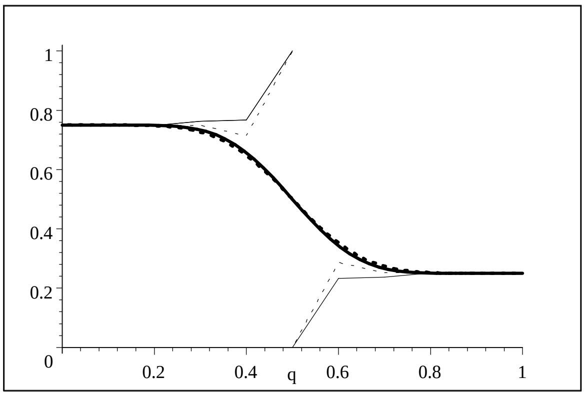

Figure 16: Expected probability that the Committee will change interest rates if $Q = 0.25$

[20] Where $f(x) = \lceil x \rceil$ denotes the ceiling function, i.e. the smallest integer greater than or equal to x.

[21] The variation in the optimal decisive quota κ^* decreases with the size of the Committee: $\kappa^* \in (0.35, 0.65)$ if $n = 9$, whereas $\kappa^* \in (0.45, 0.55)$ for $n = 29$.

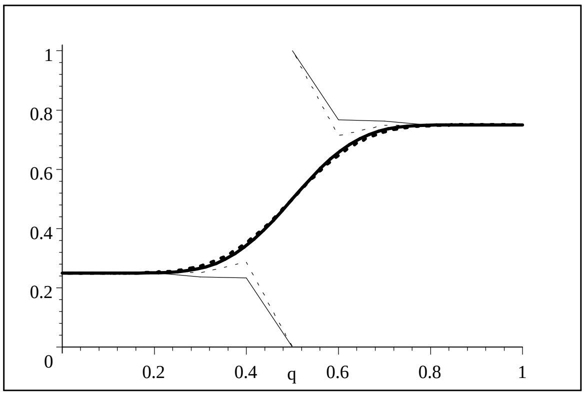

Figure 17: Expected probability that the Committee will change interest rates if $Q = 0.75$

We conclude that, although simple majority in general does not constitute the optimal voting rule, in practice the former seems to perform reasonably well. There are two reasons for such a claim. First of all, it is well defined for values of q close to 0.5. Furthermore, the convergence of the probability that the Committee takes a certain decision to the prior probability Q is by no means worse under the simple majority in comparison to the optimal voting rule.

6 Conclusions

Our results have some interesting implications for actual monetary policy making, when conducted in a committee. First of all, although decision-making by a committee is often associated with inertia, our analysis shows that this is by no means necessary. In fact, the size of the committee is far less important than the skills of its members in determining inertia (under a simple majority voting rule). Indeed, larger committees may be beneficial, in that the accuracy of monetary policy decisions (measured as the convergence of the probability of the actual interest rate decision to the theoretical best decision) is increasing in the committee size. Second, our finding that the skills of committee members are crucial in determining the quality of monetary policy decision making stresses the importance of professional reputation in monetary policy matters as selection criterion for committee membership. Given the political dimension that often surrounds appointments to monetary policy committees, this point is worth emphasizing. Third, decisional skills of committee members are defined as the ability to identify correctly the monetary policy stance that is appropriate given the prevailing economic situation. This definition illustrates that the quality of the staff supporting each committee member, and of the information they base their advice on, will be instrumental in ensuring high skills of all individual committee members, both from the hub and from the spokes. Fourth, under a simple majority voting rule, equal level of skills between the hub and the spokes ensures that prior interaction of the hub does not materially affect the interest rate setting in the committee. Conversely, when the committee decides on interest rates by consensus, prior interaction of the hub will affect the outcome, even if skills are equal. Finally, the US FOMC and the ECB Governing Council differ regarding in the degree of centralization: in the FOMC, the hub has the majority in the committee, in the ECB Governing Council the committee majority lies with the spokes. Our results show that a large hub affects the outcome of the simple-majority voting only if it has superior skills. Especially if hub members are highly skilled, their dominance is beneficial for the accuracy of the decision making process. Conversely, were committee's decisions driven by consensus, hub's domination would have the largest impact in terms of reducing interest rates inertia if the skills were comparable among all committee members. In a large committee, dominated by spokes, neither the possibility of interaction nor the skills of hub members have a significant effect on the decision process. Admitting prior interaction under the unanimity rule reduces the committee's tendency towards inertia only if hub members have excellent decisional skills.

We would like to conclude by stating that, while the main motivation of this research is based on real life, i.e. the hub-and-spokes monetary policy committees of the US Federal Reserve and the ECB, our analysis is highly stylized and contains some important caveats. This should be kept in mind when interpreting our results. A prime example of such a caveat is that in our set-up there is no interaction among members, and there is no exchange of arguments that would lead to a change of position. This assumption is unrealistic as it is recognized (see, for example, DNB (2000) and Goodfriend (1999)) that this interaction, where a common vision on interest rates evolves from an exchange of views based on economic analysis, is an important characteristic of monetary policy decision making by real-life committees such as the ECB Governing Council or the FOMC of the Federal Reserve. Introducing some form of communication between committee members in our set-up involves imposing correlation between their votes. In this case, it can be shown (see Nitzan and Paroush (1985)) that, if the exchange of arguments leads an individual to follow the majority view, the quality of collective decision-making process is adversely affected. Other studies that allow for interaction among committee members (for example Swank and Wrasai (2002)), however, find that a debate in the committee can be beneficial. We therefore conclude that further research is warranted on this topic. Other important caveats include the static nature of our analysis, which clearly is at odds with the fact that monetary policy decisions are taken on a regular basis, so that the intertemporal dimension may be relevant for the current setting of interest rates. We plan to take up the latter issue in future research.

7 Appendix

Here we aim to motivate the assumed behavior of the Board as stated in section 2.1.

As Kenneth Arrow has proved in 1952, there is no consistent method of making a fair choice among three alternatives (decision A, decision B or no decision). In other words, there is no consistent rule, majority voting or otherwise, for constructing social preferences from arbitrary individual preferences.[22] Therefore there does not exist an optimal decision rule for the choice between more than two alternatives.

Nevertheless, we can still compare different decision rules in terms of their accuracy. Let us do so for the Board's decision rule that we have suggested in section 2.1 (formalized in equations (1)-(3)) with the ordinary simple majority, which should be expressed as follows (in analogy to expressions (7) and (8)):[23]

$$\widetilde{P}(C(B)) = Q\sum_{s=k_B}^{m}\binom{m}{s}(1-q)^s q^{m-s} + (1-Q)\sum_{s=k_B}^{m}\binom{m}{s}q^s(1-q)^{m-s} \quad (28)$$

$$\widetilde{P}(C(A)) = 1-\widetilde{P}(C(B)) \quad (29)$$

$$\widetilde{P}(I) = 0 \quad (30)$$

Our criterion is the degree of accuracy in the decisions of the whole Committee. Therefore we will be in favor of the rule which yields higher value for the following sum of conditional probabilities:

$$\Pi = P(\text{decision } A|A) + P(\text{decision } B|B) \quad (31)$$

Let us proceed in two cases: the case when the Board has the majority in the Committee and the case when it does not.

7.1 Case 1: The Board dominates (i.e. $m \geq \frac{n+1}{2}$)

In this case the Committee's decisions are driven by the Board. Therefore the criterion function for the simple majority decision rule is given as follows:[24]

$$\Pi(SM) = 1 - \sum_{s=\frac{m}{2}+1}^{m}\binom{m}{s}(1-q)^s q^{m-s} + \sum_{s=\frac{m}{2}+1}^{m}\binom{m}{s}(1-q)^{m-s}q^s \quad (32)$$

whereas for our decision rule, the 'modified majority', it is:

$$\begin{aligned}\Pi(MM) = 1 - \Bigg(P(I|A)\left(\sum_{s=\frac{n+1}{2}}^{n}\binom{n}{s}(1-q)^s q^{n-s}\right) + P(C(B)|A)\Bigg) \\ + P(I|B)\left(\sum_{s=\frac{n+1}{2}}^{n}\binom{n}{s}q^s(1-q)^{n-s}\right) + P(C(B)|B) \quad (33)\end{aligned}$$

In figure 1A we present the values of the criterion function Π for the simple majority rule (the thicker line) and our decision rule (thinner lines) for $n = 9$, $m = 6$ and $k_B = \{4, 5, 6\}$.

[22] This is the famous Arrow's Impossibility Theorem.

[23] For the sake of simplicity we assume identical decisional skills for all Committee members, q.

[24] Assuming m is even.

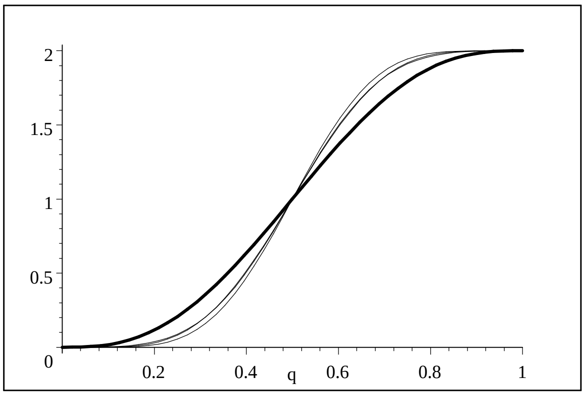

Figure 1A: The criterion function $\Pi = P(\text{decision } A|A) + P(\text{decision } B|B)$

It is clear that our decision rule yields superior results for high decisional skills ($q \geq 0.5$) for all the threshold levels k_B. Let us now turn to a more complicated case of a large Committee.

7.2 Case 2: The Board is in minority (i.e. $m < \frac{n+1}{2}$)

In this case the position of the non-Board members matters for the final decision. The criterion function for the simple majority decision rule is given as:

$$\begin{aligned}
\Pi(SM) &= 1 - [\left(1 - \sum_{s=\frac{m}{2}+1}^{m} \binom{m}{s} (1-q)^s q^{m-s}\right) \left(\sum_{s=\frac{n+1}{2}}^{n-m} \binom{n-m}{s} (1-q)^s q^{n-m-s}\right) \\
&+ \left(\sum_{s=\frac{m}{2}+1}^{m} \binom{m}{s} (1-q)^s q^{m-s}\right) \left(\sum_{s=\frac{n+1}{2}-m}^{n-m} \binom{n-m}{s} (1-q)^s q^{n-m-s}\right)] \\
&+ \left(1 - \sum_{s=\frac{m}{2}+1}^{m} \binom{m}{s} q^s (1-q)^{m-s}\right) \left(\sum_{s=\frac{n+1}{2}}^{n-m} \binom{n-m}{s} q^s (1-q)^{n-m-s}\right) \\
&+ \left(\sum_{s=\frac{m}{2}+1}^{m} \binom{m}{s} (1-q)^{m-s} q^s\right) \left(\sum_{s=\frac{n+1}{2}-m}^{n-m} \binom{n-m}{s} q^s (1-q)^{n-m-s}\right) \quad (34)
\end{aligned}$$

whereas for the decision rule we suggest it is:

$$\begin{aligned}\Pi(MM) &= 1-[P(I|A)\left(\sum_{s=\frac{n+1}{2}}^{n}\binom{n}{s}(1-q)^s q^{n-s}\right)+P(C(A)|A)\left(\sum_{s=\frac{n+1}{2}}^{n-m}\binom{n-m}{s}(1-q)^s q^{n-m-s}\right. \\ &\quad +P(C(B)|A)\left(\sum_{s=\frac{n+1}{2}-m}^{n-m}\binom{n-m}{s}(1-q)^s q^{n-m-s}\right)] \\ &\quad +P(I|B)\left(\sum_{s=\frac{n+1}{2}}^{n}\binom{n}{s}q^s(1-q)^{n-s}\right)+P(C(A)|B)\left(\sum_{s=\frac{n+1}{2}}^{n-m}\binom{n-m}{s}q^s(1-q)^{n-m-s}\right) \\ &\quad +P(C(B)|B)\left(\sum_{s=\frac{n+1}{2}-m}^{n-m}\binom{n-m}{s}q^s(1-q)^{n-m-s}\right) \qquad (3\end{aligned}$$

In figure 2A we again present the criterion function. We chose for $n = 29$.

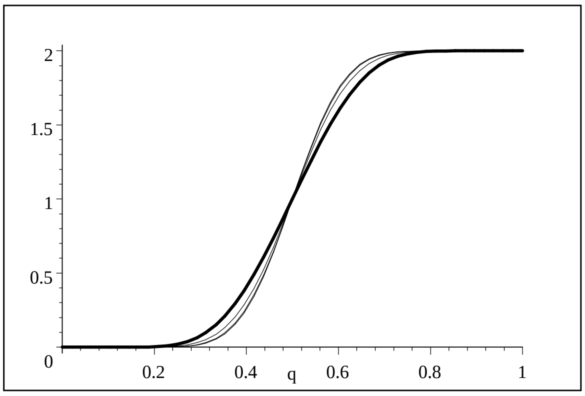

Figure 2A: The criterion function $\Pi = P(\text{decision } A|A) + P(\text{decision } B|B)$

Although the difference is much smaller now, our decision rule still performs better than the ordinary simple majority (for $q \geq 0.5$).

We therefore claim, that the Board should be in favor of the decision rule we suggest versus ordinary simple majority.

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