1-1-2006

Let Me Vote! An experimental study of vote rotation in committees

R Bosman
De Nederlandsche Bank

P Maier
De Nederlandsche Bank

V Sadiraj
Georgia State University

F Winden
University of Amsterdam

Let Me Vote!
An experimental study of vote rotation in committees

R. Bosman[†], P. Maier[†], V. Sadiraj[‡], F. van Winden[◇]
[†]De Nederlandsche Bank[*] [‡]University of Arizona
[◇]University of Amsterdam

Abstract

We conduct an experiment to investigate (i) whether rotation in voting increases a committee's efficiency, and (ii) the extent to which rotation is likely to critically influence collective and individual welfare. The experiment is based on the idea that voters have to trade-off individual versus common interests. Our findings indicate that the choice of a rotation scheme has important consequences: it 'pays' to be allowed to vote, as voting committee members earn significantly more than non-voting members. Hence, rotation is not neutral. We also find that smaller committees decide faster and block fewer decisions. This reduces frustration among committee members.

Keywords: Decision-making, committee, experiment, voting, rotation
JEL codes: D70, D78, E58

1 Introduction

Many people feel that committees lead to endless discussions.[1] Ways are sought to increase a committees' efficiency, defined as (a) a committee's ability to reach agreement and (b) to maximise the committee members' objective function in a timely efficient way. Implementation of a rotation scheme – i.e. restricting

[*]Corresponding author: Philipp Maier, De Nederlandsche Bank, Monetary and Economic Policy Division, P.O. Box 98, 1000 AB Amsterdam, The Netherlands, Email: p.maier@dnb.nl. The views expressed are the authors' and need not reflect those of De Nederlandsche Bank. We wish to thank Jos Theelen for programming the computer software and Karin Breen for research assistance. Helpful comments from participants of the 2004 Public Choice Conference in Baltimore and the 2004 ESA Conference in Tuscon are gratefully acknowledged.

[1]'Had Newton served on more faculty committees at Cambridge, his first law of motion might have read: A decisionmaking body at rest or in motion tends to stay at rest or in motion in the same direction unless acted upon by an outside force' (Blinder, 1998).

the right to vote on a rotating basis – is one such possibility. As an example, U.S. monetary policy decisions are taken by the Federal Open Market Committee (FOMC) of the U.S. Federal Reserve System. The FOMC comprises seven Board members, the President of the Federal Reserve Bank of New York, and four of eleven regional Federal Reserve Bank Presidents.[2] The latter serve one-year terms *on a rotating basis.* Chappell et al. (2004) conclude that the non-voting FOMC members did not significantly influence decision-making in the FOMC.[3] Thus, there is a risk that decisions might be biased towards the individual interests of the persons currently allowed to vote. Rotation may speed up decision-making, but potentially at high social costs if there is a conflict between the common and individual interests.

The formal study of committees goes back to Condorcet (1785), who viewed committees as tools to efficiently aggregate information. The literature has focused on various aspects of committee decision-making. First, various authors have examined committees' abilities to pool and process information (e.g. Bulkley et al., 2001, Blinder and Shiller, 2004).[4] Second, the merits of different decision rules have been analysed extensively (see Mueller, 2003), also in situations where conflicting preferences promote manipulation (Li et al., 2001). A third strand of the literature focuses on private versus public information, which enables strategic interaction among committee members. Gerling et al. (2003) provides an overview of studies in this area. Fourth, behavioural economists have studied – among other things – the trade-off between common and individual interests (e.g. Kagel and Roth, 1995).[5]

Experimental studies on the effectiveness of committee decision-making as defined above are relatively scarce. Waldner et al. (2003) is the only experimental study focusing on rotation, examining the effect of rotation on decisions for the voluntary provision of a public good, where insiders can exclude outsiders from the benefits of the public good. Their results indicate that rotation need not change the provision of the public good, but a strong temptation exists for insiders to exploit outsiders' contribution to the public good by exclusion. Other experimental studies explore the effect of uncertainty on committee decision-making: Blinder and Morgan (2005) find that groups are not more inertial and make better decisions than individuals; similar findings are reported by Lombardelli et al. (2002).

[2]Johnson (1995) provides a good summary of the founding of the Federal Reserve.

[3]'The results indicate that non-voting alternates have no appreciable influence over policy outcomes... If policymaking in the FOMC is consensual, that consensus does not appear to encompass the views of non-voting members' (Chappel et al., 2004, p. 418).

[4]Gilligan and Krehbiel (1990) conclude that a committee '...is superfluous if it possesses no special expertise and informational inefficiency is increasing in the uncertainty associated with the policy.'

[5]Beniers and Swank (2004) and Maier et al. (2003) have studied the optimal composition of a committee.

This paper investigates the following research questions: Is rotation a useful tool to increase a committee's efficiency in a common knowledge information setting? Does the type of rotation scheme matter? Does rotation lead to frustration with negative behavioural consequences? And does a temporary lack of voting power result in 'being ripped off'? To explore these questions we develop an experiment whereby participants have to trade-off private versus common payoffs. Committees consist of five members. We examine three treatments: first, no rotation, i.e. every member is allowed to vote. Second, three out of five committee members are allowed to vote, and every player rotates at the same frequency. Third, one player has permanent voting rights, whereas the other four players rotate at the same speed. In addition, we measure the players' emotions. To remove possible distortions arising from uncertainty, signalling behaviour etc., we provide all committee members with full information.

Our main findings are the following: Rotation increases a committee's efficiency, but induces distributional effects. The right to vote 'pays off', and voting committee members 'exploit' the non-voting members. Moreover, in committees without rotation decisions are blocked more frequently. As the costs of blocking a decision are high, all rotation schemes outperform a situation without rotation for the committee as a whole. Committee members blocking decisions are punished by other committee members, even though the punishment comes at a cost for the punishing player and is only possible at the very end of the experiment. Lastly, all committee members could have increased their earnings by voting for the option with the highest payoff for the committee as a whole. It seems that by voting for own interests, the players end up in a 'prisoners' dilemma'-like situation, whereby each committee member earns less.

In what follows we discuss the design of the experiment (section 2), before we present our results in section 3. The final section discusses our main findings and applies them to the institutional setting of U.S. monetary policy.

2 Experimental design and behavioural considerations

2.1 Design

The design of the experiment was chosen such that each committee member faced a trade-off between 'own' and 'common' interests in a full information environment.[6] This reflects the idea that committees as a whole are responsible

[6] All experimental sessions were run at the Creed Laboratory of the University of Amsterdam. Subjects were recruited online and through announcements on bulletin boards. One experimental session lasted about 2.5 hours and average earnings per subject were 44.4 euro.

for the decision taken, while individual committee members might follow their own (private) agenda. Each committee comprises five members and has to decide between four options.[7] Based on the decision taken each player receives the following payoff:

- Each player earns an *individual payoff* according to his preferences (see example below).
- In addition, each player receives a *common payoff.* The common payoff is the weighted average of the individual payoffs. In calculating the weighted average three players weigh 10 percent each, and two players weigh 35 percent each (one can interpret this as players representing 'small' and 'large' regions). This payoff ensures that by setting an appropriate policy, welfare gains for the committee as a whole can be generated.

The *total payoff* for each player is the sum of the individual plus the common payoff. The preference structure – determining the individual payoff – of each player is characterized by a single-peaked, symmetric distribution. In each round, the peak of the distribution varies for each region.

Table 1 provides an example. For each option the individual payoffs per region are given by the first five rows. The next row shows the common payoff, that is the weighted sum of the individual payoffs (note that the countries 2 and 5 are given the weight of the 'large' regions, i.e. 35 percent each). Finally, the total payoff is given by the sum of the individual plus the common payoff. For example, should option 1 be chosen, the total payoff for player 1 is 350+265=615 eurocent. To isolate the effects of rotation and avoid distortions due to imperfect information, we have chosen a full information setting, whereby every player has full information about other player's incentive structure (i.e. every player receives the information contained in table 1).

In this example player 3, say, faces the following conflict: by voting for option 1 he maximises the common payoff and the payoff for the committee as a whole. However, this option also yields the lowest payoff of all options for himself. Option 4 would maximise player 3's total payoff, but a very low common and total payoff for the committee as a whole. Given these considerations it is not evident for which option player 3 will eventually vote.

The peaks of the distribution are chosen in such a way that over all rounds, every player experiences the peak at option 1, option 2 etc. equally often.[8] As

[7] We use the terms 'players', 'committee members' and 'regions' interchangeably. Note that this interpretation was not given during the experiment. The instructions distributed to the participants (and read aloud by the experimenter) and detailed rotation schemes are available upon request.

[8] An overview of the distribution of the peaks over the rounds is available upon request.

		Option 1	Option 2	Option 3	Option 4
	Player 1	350	200	100	25
	Player 2	200	350	200	100
Individual payoff	Player 3	25	100	200	350
	Player 4	350	200	100	25
	Player 5	350	200	100	25
Common payoff		265	242.5	145	83.75
	Player 1	615	442.5	245	108.75
Total payoff	Player 2	465	592.5	345	183.75
(=individual +	Player 3	290	342.5	345	433.75
common payoff)	Player 4	615	442.5	245	108.75
	Player 5	615	442.5	245	108.75

Table 1: Example of distribution of payoffs (in eurocent)

every participant experiences the same incentives equally often, we can compare the players' behaviour both across regions and treatments. During the experiment decisions are taken according to the following procedure: A sequence of players is randomly determined to make a proposal (which is made public), satisfying the condition that, over all rounds, every player gets to make the first, second or third proposal equally often. According to this sequence, player i, say, makes the first proposal. If this option is unanimously supported, it will be implemented.[9] If it is vetoed by any region, the next in the sequence is to make a new proposal, etc.[10] Every option can only be proposed once and each committee member has the power to veto any given proposal (except one's own). When four proposals are vetoed, we count this as a 'blocked decision' and each participant is paid 10 eurocent.[11]

We investigate three different decision-making schemes (experimental treatments): 'no rotation', 'equal rotation' and 'unequal rotation'. Each treatment is run with different participants and is played by 15 groups.

- *No rotation (NR):* All five committee members vote on all proposals.
- *Equal rotation (ER):* Only three members are allowed to vote. Regardless of the size of the region all committee members rotate equally often. This implies that every player votes in 60 percent of the rounds (see appendix A for the rotation scheme, which was also handed out to the participants).

[9] Blinder and Morgan (2005) do not find differences between group decisions made by majority rule and unanimity during an experiment. By imposing unanimity as decision rule we can also investigate the extent to which the outcomes in the experiment differ from the theoretical predictions of majority voting.

[10] A similar procedure isused in Fréchette et al. (2003), where bargaining in legislature is studied.

[11] Hence, the payoff if a decision has been blocked is considerably lower than the payoff for 'the worst possible option'. Note that strictly speaking, the last 'proposal' is not chosen among different options, but is simply the remaining option.

- *Unequal rotation (UR):* Only three members are allowed to vote. One large region always votes while the other large region rotates with the same frequency as the small regions (those regions vote in 50 percent of the rounds).

The rationale behind granting permanent representation to one large region is to investigate whether permanent representation (i.e. knowing that one player will *always* vote and participate in each decision) leads to differences in outcome: As the two large regions differ only that respect, differences in voting patterns or earnings between these two (otherwise identical) regions can be attributed to the permanent representation.

Each committee played 50 rounds under the scheme 'no rotation' and 'equal rotation' and 48 rounds under 'unequal rotation'.[12] To counter income effects 10 rounds are randomly chosen at the end of the experiment for paying out. It is important to stress that players are given conflicting incentives as the option yielding the highest payoff differs between players. However, over all rounds, committee members face similar possibilities to 'earn and exploit', in the sense that (i) each member experiences equally often the maximal payoff at option 1, option 2, etc., (ii) each member votes an equal number of times,[13] and (iii) each player has similar positions in the voting procedure (i.e. every player has equal possibilities to make the first, second or third proposal).

To check whether the participants understood the instructions each player had to answer some test questions about the experiment before the actual experiment started. To investigate affective responses we used additional tools:

- During the experiment participants were asked to rate their mood on a scale of 1 (very happy) to 9 (very unhappy) after every 10th round (starting at round 5).[14]

- At the end of the experiment participants had to report their emotions by rating the experienced intensity of thirteen different emotions on a 7-point scale, ranging from 'no emotion at all' (1) to 'high intensity of the emotion' (7). The list includes the following emotions: Irritation, anger, contempt, envy, jealousy, sadness, joy, happiness, shame, fear, surprise, pride, and relief.[15]

[12]The number of rounds differs between ER and UR because of differences in the 'voting cycle': per voting cycle each player meets all other players the same number of times. The voting cycle is ten rounds (each player meets every other player three out of ten times) under no rotation and equal rotation, but six rounds (each rotating player meets every other rotating member one out of six times) under unequal rotation.

[13]The only exception is, of course, one large country under unequal rotation.

[14]'Self-report is the most common and potentially the best (...) way to measure a person's emotional experiences' (see Robinson and Clore, 2002, p. 934).

[15]Apart from the negative emotions that were expected to be particularly relevant for

- As part of the debriefing procedure all players were given the opportunity to 'punish' or 'reward' other players. The procedure used was the following. Each player received a lump sum payment of 600 eurocents, which was independent of the earnings in the voting experiment. This payment could be pocketed, or used to reward or punish other players in the player's group by up to 75 eurocents per player.

  Rewarding and punishing came at a cost: each eurocent spent for rewards or punishment cost an additional cent (hence, each player could thus use up to 300 eurocents to reward or punish). In addition, each player could be rewarded or punished by others with a maximum of 300 eurocents.[16]

Lastly, we asked the participants to fill in a questionnaire after the experiment.

2.2 Behavioural considerations

Based on economic theory one can think of different hypotheses concerning the participants' behaviour and the outcome of the experiment:

- *Naive voting:* Players are self-interested, but lack any strategic behaviour; they only propose and accept the option that gives the highest total payoff for themselves (i.e. highest common plus individual payoff);

- *Strategic voting:* Players behave like gamesmen maximising their own payoff and behave strategically in proposing options and vetoing them. This behavioural mode is normally assumed in the literature on game theory.[17]

- *Median voter decisive:* The preferred option of the median voter is chosen (this option would be chosen under the majority rule);

- *Highest common payoff:* Players do not maximise their own payoff, but the common payoff of the committee.

- *Highest total group payoff:* Maximisation of the sum of the total payoff over all players. This mode also provides a benchmark for how much the group as a whole could have earned (i.e. it can be viewed as maximisation of 'total social payoff').[18]

---

reciprocity (anger, irritation) some other negative as well as positive emotions were included as filler items, to avoid pushing participants in a particular direction.

[16]In order not to bias their decisions, players were unaware of this possibility during the experiment. Note also rewards and punishments cannot change other participants' earnings relative to one's owns, hence if they occur, they are likely to reflect emotional factors.

[17]Because players have complete information in each round, there exists a subgame perfect equilibrium for each round. Although this equilibrium result may be attainable via different paths, the theoretical outcome is always unique.

[18]Note that in 7 out of 50 rounds the predictions for the mode 'highest total group payoff' differ from those for 'highest common payoff'.

Voting for highest total group payoff also maximises *every* players' total payoff, averaged over all rounds. Note, however, that in many rounds players have an incentive to deviate from maximising the group payoff by chosing options which maximise their individual (total) payoff. In this respect, the experiment constitutes a prisoners' dilemma-like situation.

We derived theoretical predictions for the 'winning option' for each mode (see appendix B). In addition, for strategic voting we also derived the path to the winning option, i.e. from the first proposal to the final decision.

3 Results

3.1 Does rotation influence earnings?

Arguably the most interesting question is whether or not implementation of a rotation scheme leads to differences in earnings. Are the non-voting members justified in fearing that they will be ripped off if they are not allowed to vote?

In short the answer is: yes. We have two pieces of evidence, between and within treatments.

Earnings of voting versus non-voting members (between treatments)

We start by comparing the earnings of the voting and the non-voting committee members. Our null hypothesis is that rotation does not change earnings when moving from no rotation to a system of equal rotation; the alternative hypothesis is than (mean) earnings are higher for voting members. Our data rejects the null:[19] Earnings of the voting committee members under equal rotation increase by about 6 percent (from 4.4 to 4.7), relative to earnings of the voting committee members under no rotation, whereas earnings of those committee members that are not allowed to vote under rotation decrease by about 2.5 percent (from 4.3 to 4.2). Figure 1 displays the earnings of regions under no rotation and equal rotation, whereby we group the regions into two groups: those that 'retain' the voting power when the rotation scheme is implemented, and those that lose the right to vote. For those two groups we graph the deviation from average earnings (in percent). We clearly observe the increase in earnings for those that retain their voting power, whereas earnings of the non-voting committee members fall. Note that the differences between treatments are also statistically significant at the 1 percent level (two-sided Mann-Whitney test).

Risk averse committee members might not only be interested in average earnings, but also in the variance of their earnings. Table **??** shows that rotation

[19] As the setup of the rounds in the treatment 'unequal rotation' is different from the other two, we cannot directly compare this treatment with the other two.

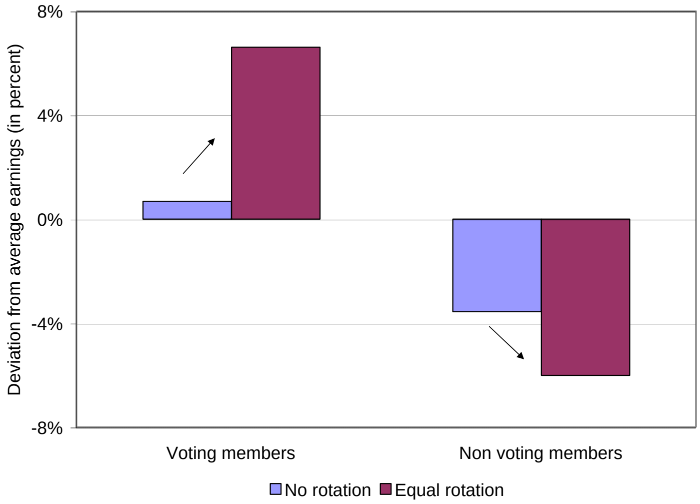

Figure 1: Deviation from av. earnings of voting vs. non-voting committee members (per round)

leads to a higher 'polarisation' of earnings, i.e. the difference in earnings between voting and non-voting committee members increases as a result of rotation. After correcting for rounds where no decisions were taken, we find that in the equal rotation treatment the variance of the earnings is significantly higher than in the no rotation treatment.[20] If players are risk-averse, one could imagine that they do not like the higher variability in earnings under rotation. This is not what we find: As we show in more detail in section 3.3, our measurement of emotions does not reveal statistically significant differences in happiness between treatments. Hence, we can reject the hypothesis that relatively higher variability in earnings has negative consequences for (emotional) well-being.

Earnings within each treatment

That having the right to vote pays off is also supported by looking at earnings within each experimental treatment. Comparing average earnings per round, the null hypothesis is that no differences are found between between rounds where regions do or do not have the right to vote (the alternative hypothesis is that earnings differ depending on whether or not regions have the right to vote). Again we can reject the null, as earnings increase substantially when one has the right to vote: In the equal rotation treatment, small regions earn

[20]The differences between equal and unequal rotation on the one hand, and no rotation and unequal rotation on the other, are insignificant (Mann Whitney tests, the difference in variation between no rotation and equal rotation is significant at the 1 percent level, the other two are only significant at the 20 percent level).

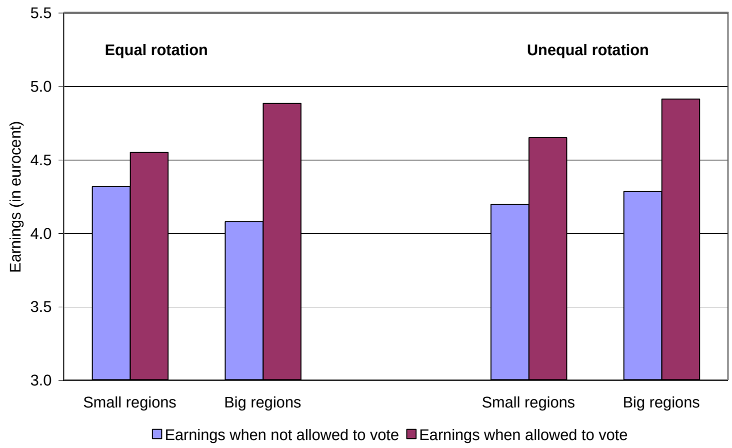

Figure 2: Influence of the right to vote on earnings

5.4 percent more in that case, while big regions receive a whopping 20 percent extra. In the unequal rotation treatment, earnings of small regions increase by almost 11 percent, and the rotating large country earns almost 15 percent more (earnings in eurocent are displayed in figure 2).

Hence, substantial distributional effects occur between small and large regions. Big regions gain more than small regions when they can vote. On the other hand, they have more to lose if they are not allowed to vote. In the unequal rotation treatment we see a similar pattern, although the differences in earnings between big and small regions are less pronounced.

Lastly, similar results are found when examining differences in earnings between the two big regions. Recall that the two were identical, except that in the unequal rotation case one region was granted permanent voting rights. Comparing earnings within the unequal rotation treatment between the two big regions for rounds in which the rotating region does not have the right to vote (i.e. for 24 out of 48 rounds), we find that 'permanent in' region earns on average 7 percent more than the 'rotating' region.

Rotation hardly changes total earnings

Summarising the above, under rotation the voting committee members earn more than the non-voting committee members. Given these distributional effects, one might wonder whether rotation also influences the payoffs of the committee as a whole (i.e. does rotation expand the 'pie' or is the 'pie' simply distributed in a different way?).

The left part of table 2 reports earnings per player for all three treatments,

All regions	Av. payoff	Possible gain[a]
No rotation	439	12.1 %
Equal rotation	449	9.6 %
Unequal rotation	449	9.6 %

[a]The 'possible gain' is the difference between actual payoffs and the payoffs that could have been realised when maximising the total payoff.

Table 2: Earnings per player per round incl. vetoes in eurocent

averaged over all rounds.[21] On average, each player earns 4.39 euro per round in the no rotation treatment. Average earnings are about 2 percent higher under rotation. This difference is significant at the 5 and 10 percent level for equal and unequal rotation, respectively. Hence, we can conclude that rotation has primarily distributional effects, and only a very marginal effect on total earnings of the committee.

On the other hand, the maximum average payoff each player could have obtained per round was 492 eurocent. The right part of table 2 indicates how much (on average) could have been gained, had all players simply voted for the option that maximises total group payoff. In the rotation treatments, committee members could have earned almost 10 percent more; without rotation earnings could have been more than 12 percent higher. Additional tests indicate that simply voting for the option that maximises the total group payoff would have increased earnings of *all* committee members, irrespective of their size. In other words, because players do not simply vote for the option that maximises the total payoff of the committee as a whole, but instead vote for own interests, the committee ends up in a 'prisoners' dilemma'-like situation and each committee member earns less.

3.2 Behavioural modes

If, in addition to the findings reported so far, we are able to identify typical behavioural modes, we can better describe the conditions under which the choice of a particular decision-making system might influence the outcome. Suppose, for instance, that all players aim to maximise the committee's total payoff. In that case the winning option will not be influenced by the composition of the committee. If, however, the participants vote strategically or if the median voter is decisive, then the composition of the committee is indeed a crucial factor in determining the outcome of a decision.

Overall, more than 88 percent of the results is consistent with at least one behavioural mode. In what follows we analyse the extent to which the behaviour

[21]The term 'total earnings' refers to the sum of 'individual' and 'common' payoff, i.e. the total earning of a player per decision.

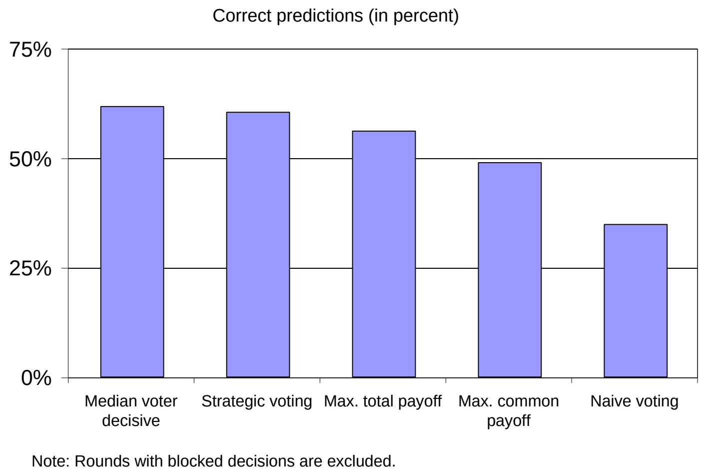

Figure 3: Behavioural modes and outcomes in percent of correct predictions

of the participants is consistent with the different modes outlined in section 2.2. Unfortunately, this is not as straightforward as it may seem, as in many cases the theoretical predictions yield similar outcomes. We thus have to find ways to distinguish between the various modes. We start by observing that blocking a decision is inconsistent with all behavioural modes. Therefore, in what follows we exclude rounds where the final proposal has been vetoed. After excluding these rounds, figure 3 shows the percentage of decisions that is consistent with each of the modes considered. Moreover, it is apparent that naive voting is not very prominent, and maximisation of the common payoff seems to do worse than maximisation of the total payoff. The case for strategic versus median voting is more ambiguous. In addition, as many results are consistent with more than one behavioural mode, we must seek ways to distinguish them.

As next step we therefore exclude rounds that yield similar predictions. To maximise the number of rounds with different predictions we take the behavioural modes two by two and test which one performs better.[22] Two such tests are displayed in table 3, where we report how many rounds are consistent with the theoretical predictions (in percent). The upper half tests the mode 'median voter decisive' against 'Maximisation of the total payoff' for those rounds where the outcomes predicted are different. The predictions differ sufficiently to be able to test the two modes in all three treatments. Clearly, maximisation of the total payoff is less frequently employed by the players.[23] The lower half of table 3 compares strategic voting versus the median being decisive. Again,

[22]To save space we summarise the main results, additional tests are available upon request.

[23]Similar results are found when testing the median voter against maximisation of the common payoff.

	No rotation	Equal rotation	Unequal rotation
Median voter decisive	42.9%	56.0%	55.1%
Total payoff	29.7%	27.2%	28.9%
P-value χ^2 test	0.1	0.0	0.0
Median voter decisive	50.4%	-	-
Strategic voting	39.3%	-	-
P-value χ^2 test	0.0	-	-

Note: Only rounds where the strategies differ are considered; rounds with blocked decision are excluded.

Table 3: Testing the different behavioural modes (percentage of correct predictions)

the behavioural mode 'median voter decisive' is the more prominent one, as it is able to explain more decisions than strategic voting (a χ^2 test reveals that the differences are significant at the 1 percent level). Note, however, that the two modes yield similar predictions in the treatments equal and unequal rotation.

To be able to differentiate between 'median voter decisive' and strategic voting in the rotation treatments additional evidence is needed. We postulate that for an outcome to be consistent with median voting the first proposal also needs to be the preferred outcome of the median voter, whereas in the case of strategic voting the first proposal must be consistent with the theoretical prediction.[24] Table 4 tests the ability of the two behavioural modes to explain the first proposal made in those rounds where both strategies yield different predictions (under the assumptions made). Across all treatments median voting outperforms strategic voting (significant at the 1 percent level). A similar comparison between median voting and maximisation of the total payoff again reveals that median voting is able to explain the participants' behaviour significantly better.[25] Overall, we find that median voting can best describe the committee members' behaviour. This holds irrespective of the voting procedure (treatment). That said, note that median voting is only able to explain about 60 percent of the outcomes.[26] This suggests that either different behavioural modes are mixed over time, or that between or within groups participants follow different modes.

Lastly, finding support for the median as being decisive also implies that if

[24]Note that in some cases various 'paths' lead to the same outcome. We only look at the 'shortest' path, i.e. the most direct way to obtain the unique subgame perfect equilibrium.

[25]Table 4 seems to suggest that subjects find it easier to behave strategically in the rotation treatments, as computing the backward induction path is easier for committees with three members than for committees with five members. This is, however, not what we find, as there are no statistically significant differences between treatments regarding the first proposals.

[26]Although we have imposed unanimity as decision-making rule about 60 percent of the outcomes are still consistent with majority voting. Note also that if the first proposal is consistent with majority voting this proposal is only vetoed in 36 percent of all cases. This illustrates the 'power' the median voter seems to have.

	No rotation	Equal rotation	Unequal rotation
Median voter decisive	42.5%	43.9%	53.4%
Strategic voting	19.7%	22.1%	21.0%
P-value χ^2 test	0.0	0.0	0.0

Note: Only rounds where the predicted first proposal differs are considered.

Table 4: Median voter decisive versus strategic voting (first proposals, percentage of correct predictions)

as a result of rotation the median voter changes, distributional effects will occur. Indeed, looking at results for those rounds where rotation changes the median, we find that outcomes change accordingly in 71 percent of the cases. In that regard the results of this analysis correspond with our earlier findings.

3.3 Which decision-making procedure is preferable?

As we have seen implementation of a rotation scheme will influence earnings and induce distributional effects. However, there are also other ways to investigate the attractiveness of the various decision-making procedures. In what follows differences across treatments are discussed with regard to how quickly decisions are reached, how many decisions have been blocked, and in terms of rewards and punishment.

Do smaller committees take faster decisions?

To investigate whether rotation speeds up a committee's ability to take decisions we examine how many proposals are made before a decision is reached and how many decisions are blocked.

Figure 4 shows how long it takes to reach a decision. In the first round, agreement was reached in 41.1 and 37.6 percent of all cases under unequal and equal rotation, respectively. In comparison, only 27.1 percent of all proposals were accepted in the first round in the no rotation-treatment. Overall, figure 4 clearly shows that with rotation, decisions are taken in an earlier phase of the decision-making process compared to no rotation. The difference between no rotation and equal/unequal roation is also statistically significant. In addition, decisions are taken faster under unequal rotation than under equal rotation.[27] Hence, if fast decision-making is important, our results clearly recommends unequal rotation.

[27]All results are statistically significant at the 1 percent level (two-sided Pearson χ^2 test).

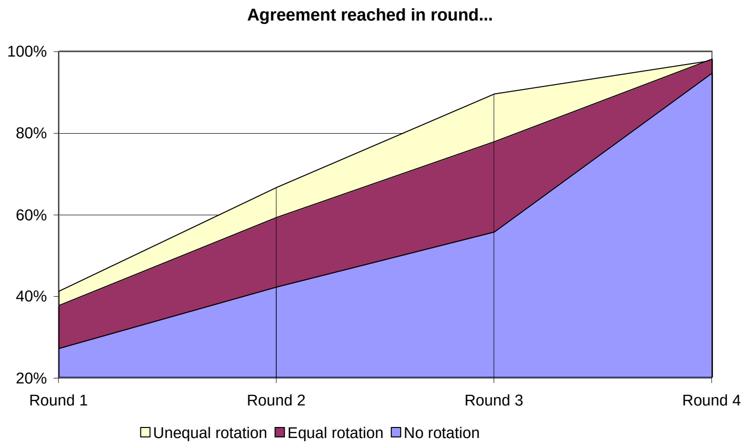

Figure 4: How long does it take to reach a decision?

Why vetoes are important

Interestingly, introduction of a rotation scheme reduces the number of vetoes: Without rotation, it turns out that in 41 out of 750 rounds, decisions are blocked. Under equal and unequal rotation this number is much lower: 15 out of 750 and 17 out of 720 decision rounds, respectively.[28] To check for habituation we plot the number of blocked decisions for each treatment in figure 5. The number of vetoes fluctuates somewhat over time, but there is no statistically significant pattern. Further testing indicates that the relationship between the number of vetoes and the rotation schemes is stable over time. This suggests that committees do not learn to avoid vetoes over time.

These findings raise the question whether the drop in vetoes is the result of having less people on a committee, or whether each committee member becomes less 'likely' to veto a proposal. The latter is the case: Without rotation the average committee member vetoes the last proposal with a probability of 1.2 percent. Under equal or unequal rotation this probability drops to 0.71 and 0.79 percent, respectively. Thus, each committee member becomes less likely to veto the last proposal (similar results are found for earlier proposals). Lastly, note that in the unequal rotation treatment the two large regions behave differently: the rotating large region blocks twice as many decisions as the region with permanent voting right (six versus three vetoes).

Regarding the interpretation of blocked decisions, 'in real life' not reaching a decision need not always be a bad solution, as the decision to 'do nothing' can actually be very wise. But note that any of the four options can also be regarded

[28] The differences between NR and ER and between NR and UR are also statistically significant (two-sided Pearson χ^2 test, all p-values<0.05).

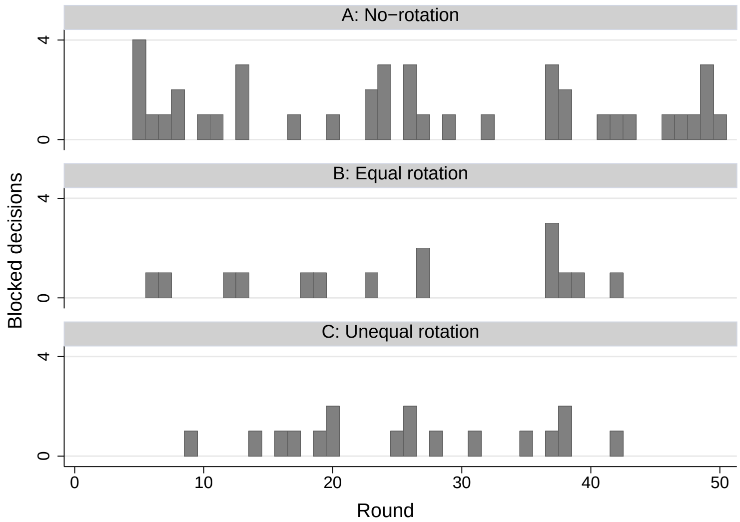

Figure 5: Blocked decisions

the decision to do nothing. This illustrates that blocking a decision is, in this case, really a sign of not reaching an agreement in this round. Moreover, the payoff for blocked decisions is considerably lower than that of every player's least preferred option. One might argue therefore that it is not economical to veto the last proposal. On the other hand, blocking a decision can be seen as a costly signal to the other committee members that certain options are unacceptable. Emotions such as anger can lead to vetoes, but one can also use vetoes to build up a 'reputation' or to 'punish' other players (due to lack of data we cannot formally test for reputational effects).

The fact that fewer decisions are blocked under rotation has two important implications.

- First, it increases players' satisfaction: we find that groups where decisions were blocked are significantly less happy than groups that have always reached a decision.[29]
- Second, vetoes influence the extent to which players wish to punish or reward other committee members at the end of the experiment, as shown hereafter.

[29] Comparing groups in which decisions were blocked with groups where vetoes never occured, we find that blocking decisions lowers participants' degree of happiness. This effect is found for each of the first three measures of happiness(Mann-Whitney test, p=0.001). It is not found in the data collected after rounds 35 and 45. This may be the result of habituation, i.e. players get used to decisions being occasionally blocked. This result is not driven by the number of vetoes, as in the later rounds the number of vetoes does not decrease significantly.

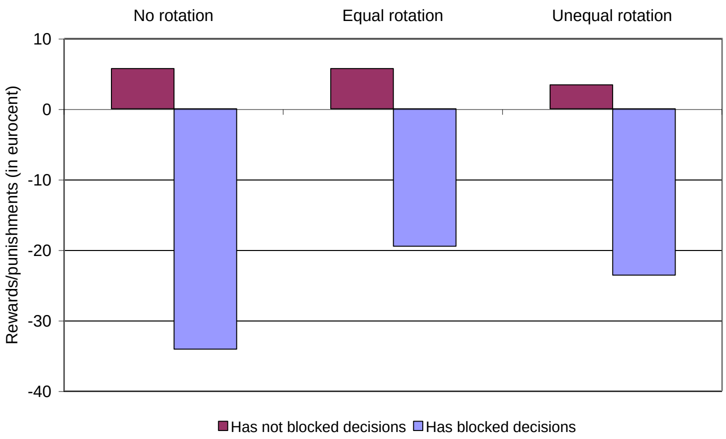

Figure 6: Rewards and punishments

Rewards, punishment and emotions

As mentioned in section 2.1 each player had the opportunity to reward or punish other players in the committee at the end of the experiment. In total, 51.6 percent of the players made use of the possibility. We find clear evidence that players blocking the decision – i.e. vetoing the last proposal, which leads to 'no decision taken' – are punished (see figure 6): players blocking final proposals were on average punished by 26.9 eurocents, while those that did not block a decision were – on average – rewarded by 4.9 eurocents. This difference is statistically significant at the 1 percent level. Moreover, the share of players blocking a decision is substantially higher under no rotation than under the two rotation treatments (28 percent of all players blocked one or more decisions under no rotation, whereas only 19 percent of the players blocked decisions under the two rotation treatments). In other words, blocking a decision by a 'final veto' occurs more often in the no rotation case, and this is regarded as sufficiently negative to make others willing to sacrifice real resources for punishment, even though the experiment has finished. If the negative feelings underlying such behaviour persist, blocking decisions today in a committee could very well have spill-over effects on other issues tomorrow. This is an area for future research.

Rewards and punishments are not related to total earnings (i.e. it is not the case that 'low income' members are supported systematically (or 'high income' members are punished). Further analysis reveals relatively large differences across treatments, e.g. the average punishment a large region received increases from -34.3 eurocent under equal rotation to -49.1 eurocent under unequal rotation. Recall that the difference between equal and unequal rotation stems from one large country having permanent voting rights, so it may seem plausible that the differences between those two treatments stem from differences in behaviour of the two large regions. This is indeed what we find: distinguishing the two large regions we find that the region with the permanent seat spends about twice as much on rewards and punishments than the 'rotating' large region (p=0.09, two-sided Mann Whitney test). This could indicate that as a result of the permanent seat, this region may feel a stronger 'emotional interest' in the overall distribution of payoffs, or simply has a better view on whom to reward and whom to punish.

As rewards and punishments are costly (and in the case of punishments the payoffs of both players even drop), both can be interpreted as a sign that strong emotions occur. Since participants had to report their emotions before they rewarded or punished (see section 2.1) we can check with this additional information. Indeed, we do not find differences in the 'level' of emotions between the treatments, but in the extent to which they generate punishments:[30] The results show that three negative emotions (anger, irritation and contempt) significantly influence punishments,[31] but the relationship between negative emotions and punishments is (i) stronger in unequal rotation than in the other two treatments, (ii) stronger for the large region with permanent voting rights than for the rotating large region, and (iii) stronger for the larger regions than for the smaller regions. Rewarding is less straightforward to interpret. Rewards and emotions are not statistically correlated, and as Sefton et al. (2002) have noticed, rewarding is generally less well-understood than sanctioning.

The data on emotions, rewards and punishment can also be interpreted as measures of the attractiveness of the different decision-making procedures. Taken together our results seem to indicate that participants view equal rotation as the 'fairest' decision-making procedure, as all participants get to vote equally often. Moreover, as punishments under equal rotation are relatively low, this voting system seems to produce a minimum of frustration among the players.

4 Discussion

Our main results can be summarized as follows:

- First, committees that feature a rotation scheme decide faster. Without rotation, committees tend to block decisions more frequently.

[30] As we measure emotions at intervals a (theoretical) possibility exists that experienced emotions might differ over time between the treatments.

[31] The correlation between emotion and punishment is 0.25, 0.15 and 0.21 for anger, irritation and contempt, respectively.

- Second, rotation is likely to induce distributional effects. With rotation voting committee members have additional scope to vote in their own interests (as opposed to maximising the group payoff). Consequently, their earnings increase, relative to non-voting committee members. Having permanent voting rights increases the payoff even more.

- Third, all committee members could have increased their (average) earnings by voting for the option with the highest total group payoff. By maximising their own payoff, they get caught in a prisoners' dilemma-like situation. In addition, it seems that this effect is stronger without rotation than with rotation.

- Fourth, there is a positive correlation between blocked decisions and frustrations of players. Players vetoing final proposals get punished, even though this comes at a cost for the punisher and is only possible at the very end of the experiment.

The design of the experiment captures various important aspects of real life committee decision-making (albeit in a highly stylised manner), such as U.S. monetary policymaking: The Federal Reserve System is composed of a central 'hub' – the Board in Washington – and twelve regional 'spokes' (the regional Federal Reserve Banks, which are located throughout the country). The Federal Open Market Committee (FOMC) – the body responsible for U.S. monetary policy – comprises the seven Board members and the President of the Federal Reserve Bank of New York, plus four of the other eleven regional FED Presidents. Among the latter the right to vote rotates following a pre-determined sequence.[32] The twelve FED districts are not equal in size (measured either in terms of economic size and population).

In various aspects our design can be related to the FOMC: We have (i) regions of different sizes, (ii) a region with a permanent seat and (iii) the trade-off between common and individual interests. Regarding the latter, Meade and Sheets (2005) suggest that at least some FOMC members face a similar trade-off between regional and 'common' interests. Given these similarities, our results indicate that decisions taken by the FOMC need not always maximise U.S. welfare. FOMC members might use their right to vote to address economic conditions in their constituency, rather than the U.S. economy as a whole. Relative to a situation where all FOMC members vote, U.S. monetary policy might thus

[32] The 1942 amendment to the Federal Reserve Act prescribes a rotation scheme of four seats on the FOMC among eleven Federal Reserve districts. This annual rotation began on March 1, 1943; since 1990, the rotation has taken place each year on January 1. One voting seat is rotated in a fixed fashion among members of each of the following FED districts: Cleveland and Chicago; Atlanta, Dallas, and St. Louis; Boston, Philadelphia, and Richmond; Kansas City, Minneapolis, and San Francisco (see Meade and Sheets, 2005).

be biased. In addition, decisions might also be systematically biased in favour of the New York FED, as it has a permanent seat. That said, regional representation has a number of advantages, e.g. ensuring broad regional representation, gathering and sharing of regional information by regional FED Presidents etc., which were not captured in our experimental design. These are clearly issues for future research.

Appendix: Theoretical predictions

Overview

In determining how participants behave we can distinguish two alternative approaches: first, own interests dominate group interests. This can come in the form of 'naive' or 'strategic' voting: naive voting implies that participants simply vote for their first-best option, without considering possible strategic interactions. 'Strategic' voting is possible within each round, as every participant has perfect information about all committee members' preferences'. Hence, each player can use backward induction to determine the subgame perfect equilibrium. Alternatively, it could be the case that group interests are more important than individual interests. In that case individuals could strive to maximise the total payoff for the group as a whole (i.e. the sum of individual and common payoffs), or simply aim at the highest common payoff. Table 5 and 6 contain theoretical predictions for the following behavioural modes:

- *Naive voting:* Players make sincere proposals and veto (absence of any strategic behaviour);
- *Strategic voting:* Players behaving strategically both in proposing options and vetoing them;
- *Median voter decisive:* The preferred option of the median voter is chosen;
- *Highest common payoff:* Maximisation of the common payoff;
- *Highest total payoff:* Maximisation of the total group payoff.

Strategic voting

To solve for strategic voting we exploit the fact that all rounds are independent. Let the set of options be $I = \{1, 2, 3, 4\}$ and let C denote the set of countries with the right to vote,[33] i.e. $C = \{c \mid c \text{ in the committee}\}$. Without any loss

[33]Note that this set differs across rounds for equal and unequal rotation treatments.

	No rotation					Equal rotation					Unequal rotation				
Round	NV[a]	SV[b]	MV[c]	CP [d]	TP[e]	NV[a]	SV[b]	MV[c]	CP[d]	TP[e]	NV[a]	SV[b]	MV[c]	CP[d]	TP[e]
1	3	2	2	2	2	3	2	2	2	2	2	2	2	2	2
2	4	1	1	1	1	1	1	1	1	1	2	1	1	1	1
3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	3	2	2	2	2	3	2	2	2	2	3	2	2	2	2
5	2	3	3	3,4	3,4	2	3	3	3,4	3,4	2	3	3	4	4,3
6	2	4	3	4	3	2	3	3	4	3	2	3	3	4	3
7	3	1	2	1,3	2	3	1	1	1,3	2	3	2	2	1	2
8	1	3	4	4	4	3	4	4	4	4	3	2	2	2	2
9	3	3	2	2	2	3	2	2	2	2	3	4	4	4	4
10	3	2	2	4	2	3	2	2	4	2	3	2	2	4	2
11	1	3	3	3	3	2	3	3	3	3	4	3	3	3	3
12	4	3	3	3	3	4	3	3	3	3	3	2	2	3	3
13	3	2	2	4	4	3	2	2	4	4	3	2	2	4	4
14	3	1	1	1	1	3	1	1	1	1	3	1	1	1	1
15	2	2	1	1	1	2	1	1	1	1	1	1	1	1	1
16	4	3	3	3	3	2	2	2	3	3	2	4	4	4	4
17	3	3	2	2	2	3	4	4	2	2	1	2	2	2	2
18	3	2	3	3,4	3,4	3	1	1	3,4	3,4	2	3	3	4	4,3
19	2	1	2	2	2	2	1	1	2	2	2	2	2	3	3
20	1	4	3	3,4	3,4	3	4	4	3,4	3,4	2	3	3	2	2
21	3	2	2	1	2	1	1	1	1	2	3	4	4	4	4
22	3	4	4	4	4	3	4	4	4	4	1	1	1	1	2
23	2	4	3	4	4	2	4	3	4	4	3	4	4	4	4,3
24	3	2	2	2	2	3	2	2	2	2	2	1	1	2	2
25	2	3	2	3	2	2	3	3	3	2	1	3	3	4	4

[a]Naive voting
[b]Strategic voting
[c]Median voter decisive
[d]Highest common payoff: the option to maximise the common payoff
[e]Highest total payoff: the option to maximise the total group payoff

Table 5: Theoretical predictions (rounds 1-25)

Round	No rotation					Equal rotation					Unequal rotation				
	NV[a]	SV[b]	MV[c]	CP [d]	TP[e]	NV[a]	SV[b]	MV[c]	CP[d]	TP[e]	NV[a]	SV[b]	MV[c]	CP[d]	TP[e]
26	3	4	4	4	4	3	4	4	4	4	3	2	2	2	2
27	3	2	2	1	2	3	2	2	1	2	3	2	2	1	2
28	3	3	4	4	4	3	3	3	4	4	3	3	3	4	4
29	1	3	2	2	2	3	2	2	2	2	3	2	2	2	2
30	1	3	3	3	3	3	3	3	3	3	3	4	4	4	4
31	2	3	3	3	3	2	3	3	3	3	3	2	2	2	2
32	1	3	3	4	4	3	4	4	4	4	3	3	3	3	3
33	1	2	2	2	2	1	2	2	2	2	2	3	3	3	3
34	1	2	2	2	2	3	2	2	2	2	4	3	3	4	3
35	2	3	3	4	3	2	3	3	4	3	1	2	2	2	2
36	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
37	4	2	2	1	1	3	2	2	1	1	1	4	4	1	1
38	2	3	2	1	1	1	4	4	1	1	3	2	2	1	1
39	3	2	3	2	2	3	2	2	2	2	4	4	4	4	4
40	1	2	2	2	2	3	2	2	2	2	3	3	3	3	3
41	4	4	4	4	4	4	4	4	4	4	3	2	2	2	2
42	2	3	3	3	3	2	3	3	3	3	2	3	3	3	2
43	4	2	2	2	2	1	1	1	2	2	1	2	2	2	2
44	1	3	2	2	2	2	3	3	2	2	3	2	2	2	2
45	3	2	1	1	1	3	2	2	1	1	3	1	1	1	1
46	4	1	1	1	1	1	1	1	1	1	3	1	1	1	1
47	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
48	1	3	3	3	3	3	3	3	3	3	1	3	3	3	3
49	3	2	3	4	4	3	1	1	4	4					
50	1	2	1	1	1	1	2	2	1	1					

[a]Naive voting
[b]Strategic voting
[c]Median voter decisive
[d]Highest common payoff: the option to maximise the common payoff
[e]Highest total payoff: the option to maximise the total group payoff

Table 6: Theoretical predictions (rounds 25-50)

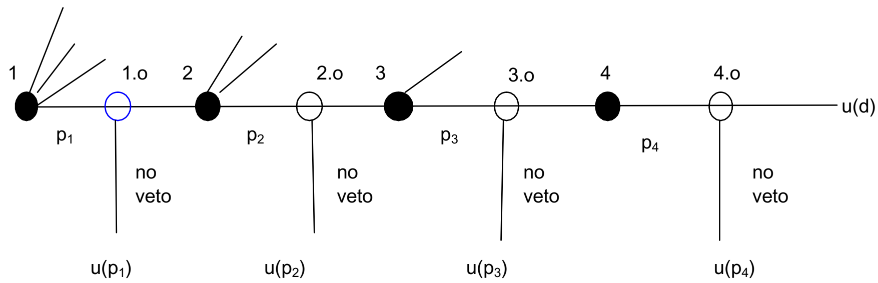

Figure 7: Game tree

of generality let country 1, 2 and 3 be respectively the first, the second and the third country to propose an option. We derive subgame perfect equilibria using backward induction.

Figure 7 shows the game tree (at some given round). Suppose that at node i, $i \in \{1, 2, 3\}$ country i makes a proposal $p_i \in I \backslash \{p_j, j = 1..i-1\}$, that is country i makes a proposal from the set of feasible proposals (the set I without the proposals that have been vetoed when the game reaches node i). Next move will be at node $i.o$: voting country c, which is not the country that made a proposal at node i and which is in the committee, i.e. $c \in C/\{i\}$, makes a decision on accepting or not proposal p_i. If proposal p_i at node $i.o$ is accepted by all voting countries, then the game ends. Proposal p_i is implemented, each country (in or out of the committee) receives his payoff determined by the state of nature at p_i. Let $u(p_i) = (u_j(p_i))_{j=1..5}$ denote the vector of utilities[34] that each country gets when option p_i is implemented. If proposal p_i at node $i.o$ is rejected by at least one country $c, c \in C/\{i\}$ the game continues to the next node. At node 4, the game rule 'an option can be proposed only once' implies that there is only one option which is not yet proposed. That option becomes the proposal at that node, and all countries in the committee have the right to vote. If the left option receives at least one veto then the state d of 'no agreement' is reached. This is a state in which all countries receive the same money payoff, i.e. $\pi_j(d) = D$ for all $j = 1..5$.

To solve using backward induction suppose that the game is at some node 4.[35] Let the left option be p_4, $l \in I \backslash \{p_i : i = 1, 2, 3\}$, where p_i is the option

[34]For example, country j utility may equal his monetary payoff, i.e. $u_c(p_i) = \pi_c(p_i)$.

[35]Note that there are 24 possible nodes 4. These nodes differ from each other by the path of proposals made and rejected up to node 4. Remember, however, that we have 6 nodes of type 4 with the same proposal i left on the floor since the size of the options set is 4. Hence, there is more than one path ending up at winning option i. We will be looking for the shortest paths assuming all players prefer to agree on an option sooner rather than later.

proposed by country i. At node $4.o$, the veto strategy of country $c \in C$ is: accept option p_4 iff utility at p_4 is not smaller than at d. Formally, this is written as

$\forall p_4 \in I \backslash \{p_i\}, \forall c \in C$

$$\begin{aligned} v_c^4(p_4) &= \mathit{accept}, \text{ if } u_c(p_4) \geq u_c(d), \\ &= \mathit{veto}, \text{ otherwise} \end{aligned} \tag{1}$$

where d is the state where no agreement is reached.[36] This implies that the outcome at node 4, the game outcome $f_4(p_i|i = 1, 2, 3)$ is

$$\begin{aligned} f_4(p_i) &= p_4, \text{ if } \forall c \in C, \ u_c(p_4) \geqslant u_c(d), \\ &= d, \ \text{ if } \exists c \in C, \ u_c(p_4) < u_c(d). \end{aligned}$$

Denote $f_4^* = f_4(p_i|i = 1, 2, 3)$. Now consider node 3. Proposals that are feasible at this node belong to $I \backslash \{p_1, p_2\}$. Suppose that country 3 at that node 3 proposes option p_3. At node $3.o$, country $c \in C \backslash \{3\}$ veto strategy is: accept option p_3 iff utility at f_4^*, (which is the final outcome if the game reaches node 4) is not larger than at p_3. Formally,

$\forall p_3 \in I \backslash \{p_1, p_2\}, \forall c \in C \backslash \{3\}$

$$\begin{aligned} v_c^3(p_3) &= \mathit{accept}, \text{ if } u_c(p_3) \geq u_c(f_4^*) \\ &= \mathit{veto}, \text{ otherwise} \end{aligned} \tag{2}$$

Hence, the outcome at node $3.o$, $f_3(p_3 \mid p_1, p_2)$ is given by

$$\begin{aligned} f_3(p_3 \mid p_1, p_2) &= p_3, \text{ if } \forall c \in C \backslash \{3\}, \ u_c(p_3) \geqslant u_c(f_4^*) \\ &= f_4^*, \text{ if } \exists c \in C \backslash \{3\}, \ u_c(p_3) < u_c(f_4^*) \end{aligned}$$

The common knowledge information setting of the game and rationality imply that at node 3 country 3 proposes an option $p_3(p_1, p_2)$ that maximizes his own utility. Formally,

$$p_3^* \equiv p_3(p_1, p_2) = \arg\max\{u_3(f_3(p_3 \mid p_1, p_2)) : p_3 \in I \backslash \{p_1, p_2\}\} \tag{3}$$

Let $f_3^* \equiv f_3(p_3^* \mid p_1, p_2)$ denote the outcome of the reduced game at node 3 (see figure 2). Given that, the veto strategy at node $2.o$ is as follows:

[36]Including the equality in the first row assumes that all countries prefer to reach an agreement earlier than later. Thus, countries do not like to veto an option in case of indifference which seems plausible.

$\forall p_2 \in I\backslash\{p_1\}, \forall c \in C\backslash\{2\}$

$$\begin{aligned} v_c^2(p_2) &= \textit{accept}, \text{ if } u_c(p_2) \geq u_c(f_3^*) \\ &= \textit{veto}, \text{ otherwise} \end{aligned} \tag{4}$$

Hence, the outcome at node $2.o$, $f_2(p_2|p_1)$ is

$$\begin{aligned} f_2(p_2|p_1) &= p_2, \text{ if } \forall c \in C\backslash\{2\},\ u_c(p_2) \geqslant u_c(f_3^*) \\ &= f_3^*, \text{ if } \exists c \in C\backslash\{2\},\ u_c(p_2) < u_c(f_3^*) \end{aligned}$$

Similarly as for country 3, we have that country 2 at node 2 proposes

$$p_2^* \equiv p_2(p_1) = \arg\max\{u_2(f_2(p_2|p_1))) : p_2 \in I\backslash\{p_1\}\} \tag{5}$$

Let $f_2^* \equiv f_2(p_2^*|p_1)$ denote the outcome of the reduced game at node 2. Writing the same derivations for node $1.o$ and node 1 one has:

- the veto strategy at node $1.o$ is given by $\forall p_1 \in I, \forall c \in C\backslash\{1\}$

$$\begin{aligned} v_c^1(p_1) &= \textit{accept}, \text{ if } u_c(p_1) \geq u_c(f_2^*), \\ &= \textit{veto}, \text{ otherwise;} \end{aligned} \tag{6}$$

- the outcome at node $1.o$, $f_1(p_1)$ is

$$\begin{aligned} f_1(p_1) &= p_1, \text{ if } \forall c \in C\backslash\{1\},\ u_c(p_1) \geqslant u_c(f_2^*), \\ &= f_2^*, \text{ if } \exists c \in C\backslash\{1\},\ u_c(p_1) < u_c(f_2^*); \end{aligned}$$

- the proposal of country 1 at node 1 is determined by

$$p_1^* \equiv \arg\max\{u_1(f_1(p_1) : p_1 \in I\} \tag{7}$$

Summarising, in a subgame perfect equilibrium:

1. The winning proposal is $f_1(p_1^*)$;
2. Country 1 proposes option p_1^*; if rejected then country 2 proposes $p_2^* = p_2(p_1^*)$; if rejected then country 3 proposes $p_3^* = p_3(p_1^*, p_2^*)$;
3. Country i's proposal strategy at each node i is given by (3), (5) and (7);
4. Country c's veto strategy at each node $i.o$ is given by (1), (2), (4) and (6).

Example

As an example consider round 6 in the experiment. The matrix of total individual payoffs at this round is

$$
\begin{array}{l}
\textit{Option} \\
\textit{Country } 1 \\
\textit{Country } 2 \\
\textit{Country } 3 \\
\textit{Country } 4 \\
\textit{Country } 5
\end{array}
\begin{array}{c}
\begin{array}{cccc} \quad 1 \quad & \quad 2 \quad & \quad 3 \quad & \quad 4 \quad \end{array} \\
\begin{pmatrix}
201.25 & 407.5 & 580 & 432.5 \\
126.25 & 307.5 & 430 & 582.5 \\
201.25 & 407.5 & 580 & 432.5 \\
126.25 & 307.5 & 430 & 582.5 \\
301.25 & 557.5 & 430 & 332.5
\end{pmatrix}
\end{array}
$$

and the payoff vector in case of 'no agreement reached' is $[10, 10, 10, 10, 10]$. In that round, country 4 was the first to make a proposal, country 1 was the second one and country 5 was the third proposer.

Assume that country's preferences over options are represented by the following utility function:

$$u_j(i) = \pi_c(i), \forall c \in C, \forall i \in I$$

where $\pi_c(i)$ is the individual monetary payoff that country j receives if option i is implemented. Applying backward induction and shortest path criteria gives:

Rotation 'Country 4 proposes option 3, which is accepted by both countries 1 and 5.'

Option 3 is the first best option for country 1. For country 5 the first best option is option 2, whereas option 3 is the second best. But country 5 can do no better than option 3 since if he vetos option 3 then for both other two countries, 4 and 1, option 4 becomes the most attractive one. Those two countries will ally and at the next turn (node 2) country 1 proposes option 2 and country 4 rejects it. After that, the best left option for all three countries is option 4. But country 5 preferres option 3 to option 4 and therefore he will not veto that option at node 2.*o*. Similarly, one can verify that country 4 can not do any better than option 3, given the preferences of two other countries, and assuming that he likes the option to be chosen sooner than later he proposes that option at his turn.

No rotation 'Country 4 proposes option 3, which is rejected by country 2; country 1 proposes option 2 which is rejected by for e.g., country 4; country 5 proposes option 4 which is accepted by all countries.'

References

Beniers, K. J. and Swank, O. H.: 2004, On the composition of committees, *Journal of Law, Economics, and Organization* **20 (2)**, 353–378.

Blinder, A. S.: 1998, *Central Banking in Theory and Practice*, MIT Press, Cambridge.

Blinder, A. S. and Morgan, J.: 2005, Are two heads better than one? An experimental analysis of group vs. individual decisionmaking, *Journal of Money, Credit and Banking* **forthcoming**.

Blinder, A. S. and Shiller, R. J.: 2004, *The Quiet Revolution: Central Banking Goes Modern*, Yale University Press.

Bulkley, G., Myles, G. D. and Pearson, B. D.: 2001, On the membership of decision-making committees, *Public Choice* **106 (1-2)**, 1–22.

Chappel, Jr., H. W., McGregor, R. R. and Vermilyea, T.: 2004, Majority rule, consensus building, and the power of the Chairman: Arthur Burns and the FOMC, *Journal of Money, Credit, and Banking* **36 (3)**, 407–422.

Condorcet, M.: 1785, *Essai sur l'application de l'analyse à la probabilité des decisions rendues à la pluralité des voix*, L'imprimerie royale, Paris.

Fréchette, G. R., Kagel, J. H. and Lehrer, S. F.: 2003, Bargaining in legislatures: An experimental investigation of open versus closed amendment rules, *American Political Science Review* **97 (2)**, 221–232.

Gerling, K., Grüner, H. P., Kiel, A. and Schulte, E.: 2003, Information acquisition and decision making in committees: A survey, *European Central Bank Working Paper* **256**.

Gilligan, T. W. and Krehbiel, K.: 1990, Organization of informative committees by a rational legislature, *American Journal of Political Science* **October**.

Johnson, R. T.: 1995, *Historical Beginnings. The Federal Reserve*, Federal Reserve of Boston.

Kagel, J. H. and Roth, A. E.: 1995, *The Handbook of Experimental Economics*, Princeton University Press, Princeton.

Li, H., Rosen, S. and Suen, W.: 2001, Conflicts and common interest in committees, *American Economic Review* **91 (5)**, 1478–1497.

Lombardelli, C., Proudman, J. and Talbot, J.: 2002, Committees versus individuals: An experimental analysis of monetary policy decision-making, *Bank of England Working Paper* **165**.

Maier, P., Bierut, B. and Berben, R.-P.: 2003, Information accuracy and the optimal representation of regions in a currency union, *The Netherlands Central Bank Working Paper Series* **2003-08**.

Meade, E. E. and Sheets, D. N.: 2005, Regional influences on U.S. monetary policy, *Journal of Money, Credit, and Banking* **forthcoming**.

Mueller, D. C.: 2003, *Public Choice III*, Cambridge University Press, Cambridge.

Robinson, M. D. and Clore, G. L.: 2002, Belief and feeling: Evidence for an accessibility model of emotional self-report, *Psychological Bulletin* **128**, 934–960.

Sefton, M., Shupp, R. and Walker, J.: 2002, The effect of rewards and sanctions in provision of public goods, *CeDEx Working Paper, University of Nottingham* **2-2002**.

Waldner, V., Kocher, M. and Sutter, M.: 2003, Rotation schemes in politics: An experimental examination, *mimeo* .