Decision costs in legislative bargaining: an experimental analysis

Luis Miller* Christoph Vanberg†

Abstract

We conduct an experiment to assess the effects of different decision rules on the costs of decision making in a multilateral bargaining situation. Specifically, we compare the amount of costly delay observed in an experimental bargaining game under majority and unanimity rule. Our main finding is that individual subjects are more likely to reject offers under unanimity rule. This higher rejection rate, as well as the requirement that all subjects agree, leads to more costly delay. This result provides empirical support for a classic argument in favor of less-than-unanimity decision rules put forth by Buchanan and Tullock (1962).

JEL codes: C78; C92; D71; D72

Keywords: Collective decision-making; Majority Rule; Unanimity; Legislative Bargaining; Experimental Economics

---

*Centre for Experimental Social Sciences, Nuffield College, University of Oxford, New Road OX1 1NF, Oxford, UK. E-mail: luis.miller@nuffield.ox.ac.uk.

†Department of Economics and King's College, University of Cambridge, Sidgwick Avenue, CB3 9DD, Cambridge, UK. E-mail:cav27@cam.ac.uk

1 Introduction

What proportion of a group or decision making body should be required to agree in order to arrive at a collective decision? This fundamental question is of great practical relevance in constitutional design. For example, the European Council currently uses either a qualified majority rule or a rule of unanimity, depending on the category of legislation being considered. One of the central reforms adopted in the Treaty of Lisbon was the expanded use of qualified majority rule. A principal argument in favor of this change was the alleged inefficiency of unanimity rule and the expectation that qualified majority rule promotes efficiency by encouraging compromise.[1]

While requiring unanimous consent protects individual members from adverse decisions, this rule may be associated with larger costs of reaching agreement than others, such as qualified or simple majority rule. According to a classic argument put forth by Buchanan and Tullock (1962), rational individuals may prefer to use less-than-unanimity decision rules in order to reduce these expected 'decision costs.' Their argument is reviewed in more detail in the next section.

The goal of the present paper is to compare the costs of reaching agreement under majority and unanimity rule in the context of an experimental bargaining game. Subjects in our experiment were asked to agree on a division of a given

[1] For a brief outline of the reforms, as well as a version of this justification, see the European Commission's statements published under (`http://europa.eu/scadplus/constitution/majority_en.htm`).

sum of money among three players. The rules of the game (explained in detail in section 3) specify that bargaining proceeds over several rounds. Failure to agree in a given round causes the available 'pie' to shrink by a certain amount. Thus, delay in bargaining is costly.

We investigate the extent of such costly delays under majority and unanimity rule. Our main finding is that individual subjects are more likely to reject offers under unanimity rule. This higher rejection rate, as well as the requirement that all subjects agree, leads to more costly delay. Thus, unanimity rule is associated with larger costs of reaching agreement. On the other hand, unanimity rule tends to produce more equal distributions, and all players receive a positive share of the available surplus. These results provide empirical support for the existence of the tradeoff assumed in Buchanan and Tullock's seminal analysis.

The remainder of the paper is organized as follows. Section 2 presents Buchanan and Tullock's argument in more detail. Section 3 describes our experimental design and relates it to previous experimental literature. We present a model of our experimental game and describe our hypotheses. Results are presented in Section 4, and Section 5 concludes.

2 Decision rules and decision costs

In their classic work, *The Calculus of Consent*, Buchanan and Tullock (1962) consider a rational, self interested individual who chooses a decision rule to be used by a decision making body such as a committee. The rule will be used to decide on collective action within some previously defined policy space.[2] The choice of decision rule is made at the constitutional stage during which the individual finds himself behind a veil of uncertainty. This means that he does not know precisely what his position on future issues will be, and believes himself equally likely to occupy any position within the relevant society. It is assumed that the individual seeks to select the rule that maximizes his expected utility from this constitutional perspective.

Buchanan and Tullock argue that the individual should consider two categories of "costs" to be expected under each decision rule. The first category includes costs resulting from collective decisions that change the status quo in a manner that runs counter to his own interests. The authors refer to these as "external costs." If the decision rule specifies that *any single* member of the society can unilaterally make a decision, the expected harm that such decisions will impose on the individual is maximized. On the other hand, if unanimous agreement is required for all decisions, no harm can be imposed on him. Thus, the expected external costs of future decisions are decreasing in the size of the majority required for agreement, reaching zero when unanimous agreement is required (See Figure 1, reproduced from Buchanan and Tullock 1962: 70).

[2] It is important to emphasize that the analysis assumes the existence of additional constraints on collective actions that may be decided upon. Buchanan and Tullock emphasize that the preferred decision rule is likely to depend on these constraints, i.e., it will differ depending on the kind of decision making body and the range of activities it has the power to undertake.

FIGURE 1 ABOUT HERE

Absent further considerations, this argument would imply that the use of unanimity rule maximizes the individual's expected utility from future collective choices. The reason is that (a) this rule guarantees that *only* Pareto improving group decisions will be undertaken, and in fact, (b) *all* Pareto improving actions can, in principle, be unanimously agreed upon. It follows that no opportunities for mutually beneficial agreements would be bypassed.[3]

This conclusion would rest, however, on the assumption that unanimous agreement, if possible in principle, will in fact be achieved *at no cost*. This would seem to require that any collective action that in principle could achieve unanimous support is in some way automatically proposed and voted on without requiring any active investment of time or other resources by any of the participants. Buchanan and Tullock emphasize that this line of reasoning neglects the importance of the *process*

[3]Guttman (1998) objects to Buchanan and Tullock's argument on the grounds that unanimity rule may prevent "efficient" projects (collective actions) from being undertaken. Specifically, a proposal to conduct a project which promises large benefits to a majority at a small cost to a minority would fail, even if the project increases "aggregate surplus." Guttman argues correctly that a rational (and risk neutral) individual who believes himself equally likely to occupy any position in society would prefer, on expected utility grounds, that all such "efficient" projects be undertaken. What Guttman's argument neglects, however, is the fact that the "efficiency" of such projects immediately implies that there must exist some proposal to undertake it (e.g., one which includes a compensation to the minority) which could, at least in principle, achieve unanimous support.

necessary to prepare and agree on mutually beneficial proposals.

The process of proposing and voting on proposals is bound to involve costs not only for logistical reasons. Another consideration emphasized by Buchanan and Tullock is that each opportunity to engage in an efficient project implies the existence of a surplus that can be distributed in any number of ways. Thus, each such opportunity raises a kind of "pie-splitting" problem, and each member will seek to secure as large a share of the available surplus as possible. According to Buchanan and Tullock, this leads the members of a decision making body to invest resources (e.g., time) in otherwise unproductive bargaining activities. They hypothesize that these wasteful investments in bargaining will tend to grow as the decision rule becomes more inclusive (1962: 68-69).

This hypothesized relationship is illustrated in Figure 2. When any single member of the society can make a decision, no bargaining is required, and the costs of decision making are minimized. In the extreme case of unanimity, each individual member has the power to veto any decision. This introduces a kind of hold-up problem: each member may withhold agreement in order to force others to make concessions. This maximizes each individual's incentive to invest in bargaining and therefore decision costs are maximized.

FIGURE 2 ABOUT HERE

To the extent that more inclusive decision rules increase the likelihood that individuals will withhold agreement, they will be associated with greater "decision costs" due to delays, haggling, and so on. A rational individual will perceive a trade off between the reduction in "external costs" associated with more inclusive collective choice rules and the resulting increase in "decisions costs". For this reason, she may prefer less-than-unanimity rules at the constitutional level.

In our view, Buchanan and Tullock's argument is based on important *empirical* hypotheses concerning the behavior of individuals in different institutional contexts. Specifically, they hypothesize that a rule of unanimity motivates individual members to withhold agreement and invest in wasteful bargaining activities.

Absent further evidence, it is a priori not obvious that this should be the case. Granted, if individual group members were equally likely to consent to a given proposal under both rules, unanimous consent would be observed less often than majority consent. One might therefore argue that a rule of unanimity logically implies larger decision costs. However, this argument neglects the fact that both the proposals being made and the likelihood with which an individual gives her consent may depend on the decision rule being used. In particular, it is at least conceivable that an individual would be more likely to consent to a given proposal under unanimity than under majority rule, perhaps to avoid decisively causing the proposal to fail. If so, the probability that a proposal passes may be the same as (or larger than) it is under majority rule.

In contrast, Buchanan and Tullock hypothesize that individual group members will in fact be *less likely* to give their consent to a given proposal under unanimity rule. Their argument is that, by giving each member a veto, unanimity rule maximizes incentives to "act tough" and bargain for a larger share of the surplus created by an efficient action. If true, this greater "toughness" effect of unanimity rule would imply additional decision costs over and beyond those which are implied by the statistical calculation outlined above. The goal of the present paper is to investigate this claim experimentally in a controlled laboratory setting.

3 Experimental Design

Following an established experimental literature on multilateral bargaining, we base our experimental design on the classic legislative bargaining game introduced by Baron and Ferejohn (Baron and Ferejohn 1989). The Baron-Ferejohn (henceforth BF) game is an extension of the Rubinstein (1982) bargaining model to the case of more than two players.

3.1 The Baron Ferejohn Game

At the beginning of the game, a certain surplus is available to be divided among the players. The game consists of a potentially infinite number of bargaining rounds. In each round, one player is chosen randomly to propose a division of the currently available pie. If a required majority accepts the proposal, the game ends and each player receives his allocated amount. If not, the pie shrinks by a pre-determined amount and a new round begins. Thus, the costs of bargaining consist of the lost surplus if agreement is not reached in a given round.

Substantively, we interpret the BF game as a simple representation of the 'pie-splitting' problem that arises when a group is considering a potentially Pareto improving change in the status quo, such as an efficient project.[4] On this interpretation, a proposal within the experimental game represents a proposed distribution of the surplus that results from agreement on the collective action under consideration. The surplus lost if a proposed division fails represents various opportunity costs associated with prolonged bargaining over a given project or piece of legislation. Thus, we interpret the *entire game* as a model of bargaining over a single substantive proposal, and a proposal *within* the game as one step in that bargaining process.

The main theoretical predictions of interest in our context are the following (see Sections 3.3 for details). First, proposers form minimum winning coalitions, allocating positive payoffs only to the number of subjects required for agreement. Second, the distribution of proposals within a winning coalition is unequal, favoring the proposer. Third, the first proposal is immediately accepted.[5]

[4]In this game, no player can be allocated a negative payoff. That is, no 'external costs' can be imposed on any individual, even under simple majority rule. This reflects our interest in studying the costs of decision making, rather than possible external costs of collective action. However, if we consider the share an individual can expect to receive under unanimity as a benchmark, majority rule implies the risk of incurring an opportunity cost if one is excluded from a winning coalition. Thus, unanimity rule ensures that no individual can be forced to accept less than a given (e.g. equal) share, but it introduces the danger of costly delay.

[5]Baron and Ferejohn (1989) also derive hypotheses concerning behavior under closed versus

The main hypothesis we wish to test in this paper concerns the differences in behavior under majority versus unanimity rule. In particular, we want to test Buchanan and Tullock's argument that unanimity rule protects individuals from external costs imposed on them by others while leading to larger decision costs in the form of delays.

3.2 Previous Literature

There is by now a large literature testing the theoretical predictions of the Baron-Ferejohn model. The first experimental paper on the subject was McKelvey (1991). In this experiment, groups of three bargained over a distribution of odds for a chance to win a monetary prize. Failure to agree led to a loss of 5% of the stake.[6] He finds that coalition partners received larger shares than predicted by theory, and proposals passed more often than predicted. (That is, proposals off the path that would be rejected according to the predicted equilibrium strategies were in fact accepted.) Fréchette et al. (2003) use groups of five with a discount factor of 0.8 (i.e., 20% of the pie is lost when a proposal fails), repeating the game 15 times. Consistent with theory, they find that proposers form minimum winning coalitions and proposals pass immediately. However, distributions within the winning coalition are more equal than predicted. Fréchette et al. (2005a) use groups of three and compare

open amendment rules. These hypotheses are not directly related to our paper and will therefore not be discussed here.

[6] This method of payment is used to induce risk neutrality.

discount factors 0.5 and 1, repeating 10 times. (Note that $\delta = 1$ implies that bargaining costs consist only of the time that subjects spend in the laboratory until agreement is reached.) They find that first-round proposals are more likely to fail when the pie does not shrink. Fréchette et al. (2005b) use groups of five and no discounting. Fréchette (2009) proposes a learning model to account for the behavior observed in Fréchette et al. (2003). Diermeier and Morton (2005) use groups of three and play a finite horizon version (five rounds) with no discounting, repeated 18 times. They find that proposers allocate more money to other players than predicted, and a significant percentage of first round proposals above the theoretical continuation value are rejected. Diermeier and Gailmard (2006) introduce different reservation values into the game.

The paper most closely related to our own is Kagel at al. (2010). These authors use groups of three, with discount factors 0.95 and 0.5. The focus of their analysis is the effect of introducing a "veto player" into the interaction. As the term suggests, this player (who may be a proposer or a responder) has the right to block any decision that is passed by a majority. This modification is closely related to our use of a rule of unanimity, as it effectively means that every member of the group is a veto player. A key difference between this approach and ours is that veto power is asymmetric in Kagel et al.'s context. Accordingly, their focus is on the extent to which veto players can successfully convert this asymmetry in power into a more favorable bargaining outcome. One of their main results is that veto players indeed receive larger shares, both as proposers and as non-proposers. Another result of interest in our context is that introducing a veto player results in greater delay and therefore less efficient outcomes.

We build on this existing literature by introducing a rule of unanimity in the Baron-Ferejohn framework. Thus, we contribute to the previous experimental literature by comparing behavior under majority and unanimity rule. In addition, our main goal is to test the Buchanan-Tullock hypothesis stating that a rule of unanimity leads to more investment in costly bargaining. Specifically, we focus on differences in the frequency of rejections under the two rules. Section 3 describes our experimental game in detail and formulates the hypotheses to be tested.

3.3 Model and Benchmark Hypotheses

Our experimental design is based on the Baron-Ferejohn bargaining model introduced above. Specifically, we implement the following bargaining game involving three players, henceforth labeled A, B, and C. The game consists of a potentially infinite number of bargaining "rounds."[7] In each round, one player is chosen at random to propose a distribution (x_A, x_B, x_C) of the currently available "pie". Here, x_K denotes the share of the pie allocated to player K. All players are then informed of this proposal and vote either yes or no. Under majority rule, the proposal is passed if at least two players vote yes. Unanimity requires that all three players vote yes. If the proposal passes, the game ends and the players receive their allocated shares.

[7] The experimental version is actually a finite game. As will become clear, this does not affect the analysis and benchmark solution derived here.

If the proposal fails, the game moves to the next round and a new player is chosen to make a proposal. This delay is associated with a cost because the pie shrinks to δ times its previous size each time a round ends without agreement. (In the experiment, the pie is initially worth 20 GBP and shrinks by a factor of 10% at the end of each round, i.e., $\delta = 0.9$.)

Our benchmark hypotheses reflect the standard theoretical prediction for the BF game as applied to our parameters. More specifically, these hypotheses describe symmetric stationary subgame perfect equilibria of the game under the decision rules considered. The essential feature of these benchmark solutions is that a player chosen to propose will build a minimum winning coalition by allocating a positive share of the pie to as many other players as are required to secure passage. The specific amount allocated must make the other member(s) of the coalition at least indifferent between accepting or rejecting. (See Appendix I for a more detailed derivation.)

Benchmark Hypothesis 1 *Under simple majority rule, the first proposer offers a share* $\frac{\delta}{3}$ *(*30% *in our case) or* $\frac{\delta}{3} + \epsilon$ *(*31%*) to one other subject and keeps the remaining* 70% *or* 69% *for himself. This proposal is immediately passed. (Either the proposer and the included subject or all three subjects vote yes.)*

Benchmark Hypothesis 2 *Under unanimity rule, the first proposer offers a share* $\frac{\delta}{3}$ *(*30%*) or* $\frac{\delta}{3} + \epsilon$ *(*31%*) to both of the other subjects and keeps the remaining* 40% *or* 38% *for himself. This proposal is immediately passed.*

The benchmark solution predicts a treatment effect when we compare simple majority and unanimity rule. In particular, we expect that the size of the coalition receiving positive amounts is two in the first case and three in the second. Second, we expect that the distribution within the coalition is highly unequal in the first condition and approximately equal in the second.

3.4 Main hypothesis

Our main hypothesis concerns *delay*, which is actually not predicted in the theoretical benchmark. We hypothesize that unanimity rule will more often lead to proposals being rejected. More precisely, we conjecture that individual participants are more likely to reject a given proposal when unanimity rule is in effect than they are under majority rule. As explained above, the reason is that unanimity rule creates incentives for subjects to "act tough" in order to get a larger share of the pie, while majority rule creates incentives to be "modest" in order to be included in a minimum winning coalition.

Main Hypothesis *Non-proposers are more likely to reject a given proposal under unanimity rule than under majority rule. More specifically, let the proposer's share be* x_P *and consider a responder being offered a share* x_R*. Then, controlling for* x_P *and* x_R*, the responder is more likely to reject a proposal under unanimity rule than under majority rule.*

Note that this hypothesis is stronger than the related (and equally important) idea that a given proposal may be more likely to *pass* under majority rule. The latter statement would be true even if the individual likelihood of rejection were the same under both rules, simply because two subjects are more likely to accept than are three. Evidence to support our main hypothesis would therefore indicate an *additional* source of decision costs, over and beyond that which is directly implied by the tougher requirement that all subjects agree. We interpret Buchanan and Tullock's argument as referring to this additional cost, which follows from a greater tendency to bargain for a larger share of the surplus.

3.5 Experimental Procedures

The experiment was programmed using the software z-Tree (Fischbacher 2007) and conducted at the laboratory of the Nuffield Centre for Experimental Social Sciences in Oxford. The participants were undergraduate and graduate students from different disciplines at the University of Oxford. Participants were recruited using the online recruitment system ORSEE (Greiner 2004). Participants were not informed about the purpose of the experiment. Each subject was allowed to participate only once. For each treatment there were two sessions involving 12 subjects per session.

We used the strategy method (Selten 1967) to record both proposers' and voters' behavior. Every participant in a group made a proposal, and each proposal was voted on. Finally, one proposal was chosen randomly to be counted.[8] If the chosen proposal passed, bargaining ended. If it failed, the pie shrank and a new round of bargaining began. Bargaining also ended if the amount remaining to be

[8]The advantage of this procedure is that we observe three proposals being made and voted on in each round, rather than just one. It does not affect the benchmark predictions derived above.

distributed fell below two GBPs. After each round of bargaining, subjects received feedback that consisted of the three submitted proposals, the number of participants that accepted/rejected each proposal, whether the proposals had been passed, as well as which proposal had been selected randomly for votes to count.

Each session consisted of 16 periods, one practice period and 15 cash periods. Subjects were re-matched randomly before each period. At the end of the experiment, one of the 15 cash periods was randomly selected to be paid. Subjects' total earnings in the experiment consisted of the amount allocated to them in the period chosen for payment and a participation fee of four GBPs. Sessions lasted one hour, on average. Earnings ranged from 4 GBP to 16 GBP, with an average of 10.3 GBP and a standard deviation of 2.8 GBP. Instructions are reproduced in Appendix 2.

4 Results

The data comprise four experimental sessions involving a total of 48 subjects. Each session lasted for 15 periods. Half of these decisions were made under majority rule and half under a rule of unanimity.

Depending on the proposal selected to be voted on, the length of a period was in part a random occurrence. As a consequence, we do not have many observations for second and later rounds, despite the fact that many first round proposals did in fact fail.[9] Moreover, observations in rounds one and two are not directly comparable.

[9]In particular, 25% of all proposals failed in round one. By chance, however, only 13% of those

Our analysis will therefore focus on behavior in round one only. Given that each subject makes a first round proposal in each of the 15 periods, we have a total of $4 \cdot 12 \cdot 15 = 720$ proposals. Each proposal is voted on by all three members of the group, giving us a total of $3 \cdot 720 = 2160$ voting decisions made in round one. Our analysis of voting behavior will focus on the 1440 decisions made by non-proposers.[10]

4.1 Rate of passage

Figure 3 reports the proportion of proposals which passed in round one. Pooling the data from all 15 periods, 87% of proposals were passed in the first round under majority rule.[11] When unanimity was required, only 70% of proposals were passed in round one. There were no trends in the acceptance rate over the course of the experiment. The difference in passage rates between majority and unanimity rules is significant at the 5% level ($Z = 2.0475$, $p = 0.0406$).[12]

---

selected to count failed. As a result, only 13% of the experimental groups moved to a second round of bargaining.

[10]Due to a program glitch, 12 proposals and 27 voting decisions were not recorded. As a consequence, our empirical analysis uses only 684 proposal and 1386 non-proposer voting decision observations. The program error was not noticeable to subjects and did not affect the progress of the experiment.

[11]This high rate of passage is in line with results reported in the literature. For instance, Frechette et al. (2005a) find a 89% acceptance rate in round one for inexperienced subjects and $\delta = 0.5$.

[12]We use a two-group test of proportions that uses the result of the vote in a period as the unit of observation. This test may overestimate the significance level because it assumes independence

This result provides initial support for the conjecture that there is more delay and therefore the decision cost is higher under unanimity rule than under majority rule. Below we test the even stronger prediction, posited in our main hypothesis, of a greater propensity, at the individual level, to reject offers when unanimous consent is required. Before turning to this hypothesis, we present evidence on the types of proposals made under the different rules.

FIGURE 3 ABOUT HERE

4.2 Types of Proposals

Figure 4 plots the share proposers demand in round one. Under the unanimity rule, 99% of proposers demand shares within the range of 31% to 40%. Only 11% of proposer's demands are, however, at the equilibrium prediction of 38% to 40%. Thus, proposals under unanimity rule are less favorable to the proposer than predicted by the theory.

Under majority rule, less than one-fourth of the decisions fall in the 31% to 40% range, and there are peaks at 50% and 60%. Thus, it appears that proposers typically try to assemble minimum winning coalitions. However, very few proposers demand the predicted share; less than 5% of proposers demand more than 68%.

Under both rules, we find patterns very similar to those reported in the existing literature. Proposers demand a larger share than they allocate to non-proposers, but

of sample observations. As a robustness check, we replicate this result using a linear regression model and controlling for the period ($p = 0.043$).

the difference is still far from the equilibrium prediction.

Next, we look at the differences between unanimity and majority rule. Using a random effect linear regression, and controlling for the period, proposers' demands under the two voting rules differ statistically at any conventional significance level.

FIGURE 4 ABOUT HERE

These differences between the rules emerge over time. Under majority rule, it takes a few periods for proposers to learn to demand bigger slices of the pie. Figure 5 plots the period average share the proposer demands for herself in round one. The difference between the average proposer's demand in period one and the average proposer's demand in period 15 is more than 15%. In contrast, we do not observe a similar change in proposers' demands when unanimous consent is required.

FIGURE 6 ABOUT HERE

The fact that proposers learn under majority rule can also be seen when we look at the type of offers they make to non-proposers. Figure 6 shows the proportion of proposers offering zero to one of the non-proposers, as well as the proportion of roughly equal splits,[13] in the 15 periods. Interestingly, approximately half of the proposals in period one are three-way equal splits and only one out of five allocates zero to one of the non-proposers. In the last 10 periods, more than 75% of proposals include a zero-offer and the proportion of three-way equal splits is consistently below

[13] Here we consider proposals where two subjects receive 33% and one subject receives either 33% or 34%.

15%. Thus, it looks as though many subjects were inclined initially to propose equal splits and learned over time to form minimum winning coalitions.

FIGURE 6 ABOUT HERE

In sum, under majority rule proposers form minimum winning coalitions. The participant not included in the coalition receives a zero-offer (78% of the offers in the last 10 rounds), and the two coalition members receive a more equal share than predicted. The average share of a non-proposer coalition member in proposals that include a zero-offer is 42%. Thus, proposers approximately demand 60% for themselves, which is slightly less than the equilibrium prediction of 69% or 70%.

Proposals under unanimity rule are closer to the equilibrium prediction. Virtually all proposals are at or slightly above the theoretical continuation value of 30%. Although consistent with the equilibrium analysis, this result may also be due to fairness considerations. Interestingly, however, it appears that fairness 'survives' only in the context where it also corresponds approximately to equilibrium play.

4.3 Rejection patterns at the individual level

We now turn to our main hypothesis, which concerns the likelihood that an individual voter rejects a given offer under the different rules. Figure 7 shows votes of non-proposers, by shares offered, in round one. According to the theoretical prediction, the expected share of a non-proposer is the same under majority and unanimity rule, and it is the same in every single period. Thus, non-proposers theoretically should accept offers above 30% or 31%. This is indeed what we find in our data. Under both rules, 90% of non-proposers accept offers above 31%. Using a random effect probit model, we compare acceptance rates for offers above this level. We find no differences between the rules when we control for the proposer's share, the subject's own share, and the period (see regression 1 in Table 1).

FIGURE 7 ABOUT HERE

In contrast, we do see a significant difference in the rates of acceptance of offers at or below the theoretical continuation value. When offers are smaller than or equal to 31%, and controlling for the same set of variables, we find a greater propensity to reject an offer under unanimity than under majority rule (see regression 2 in Table 1). More specifically, 100% of the offers below the equilibrium level and 64% of the offers at the equilibrium level are rejected when unanimity is required. Under majority rule, only 92% and 48% of offers below or at the equilibrium level are rejected, respectively. We also study differences in rejection rates at exactly the equilibrium level and find the same result. Participants reject an offer at the equilibrium level significantly more often under unanimity than under majority (see regression 3 in Table 1).

TABLE 1 ABOUT HERE

4.4 Summary of Results

We find that under majority rule proposals consist of a minimum winning coalition and are accepted without delay most of the time. This is in line with Baron and Ferejohn's original predictions under a closed voting rule.[14] We also find a deviation from their predictions that has been replicated several times in the literature: distributions within the coalition are more equal than predicted. When unanimous consent is required, virtually all proposers offer others at least their theoretical continuation value. Results under unanimity are closer to the equilibrium predictions. However, they are also consistent with "fairness" motivations.[15]

Our main hypothesis concerned delay under both rules. At an aggregate level, we show that proposals under unanimity rule fail more often than under majority rule and, therefore, there are more delays under unanimity. We additionally show that non-proposers are more likely to reject an offer under unanimity rule than under

[14] A "closed" rule in this context means that only a single proposal is considered in a given round, with no opportunity to make immediate counter-proposals.

[15] As noted above, it is interesting that behavior consistent with "fairness" survives only in the setting where the "fair" proposal is also close to the equilibrium prediction. A possible interpretation is that subjects have learned, outside of the laboratory, that "fairness" is an advantageous strategy in social interaction. Such behavior is adopted initially under both treatment conditions. The treatment differences in behavior emerge as subjects in the majority treatment revise their initial strategies. Thus it is possible that subjects in the unanimity treatment continue to act on proximate "fairness" motives, while the decision rule and the associated incentives may ultimately explain why those motives survive.

majority rule if the offer is not larger than their continuation value of 31%. Under unanimity, most non-proposers exert their veto power to turn down proposals that do not offer them strictly more than their expected value in the next bargaining round.

5 Conclusion

The goal of this paper was to investigate experimentally the relationship between the inclusivness of voting rules and the costs of decision making in a multilateral bargaining situation. Understanding this relationship is of great practical importance, for example when considering proposed changes in the decision rules used by the European Council of Ministers.

Our research question is motivated by Buchanan and Tullock's (1962) classic argument in support of less-than-unanimity rules in collective decision making. Their argument is based on the hypothesis that individual investments in wasteful bargaining activities will rise as the majority required for collective agreement increases. When compared to simple majority rule, unanimity rule may therefore be associated with inefficient delays. Although unanimity rule protects each member of a decision making body against adverse decisions, a rational individual may therefore prefer to use a less demanding decision rule.[16] We investigate the hypothesized

[16]It is important to emphasize that Buchanan and Tullock do not support the use of less-than-unanimity decision rules for all areas of collective choice. As was mentioned above (see footnote 2), constitutional agreement on any such rule requires that constraints are placed on the decisions that

relationship between decision rules and decision making costs in the context of the Baron-Ferejohn legislative bargaining game.

Our results provide support for the existence of a tradeoff of the kind hypothesized by Buchanan and Tullock. Unanimity rule indeed protects individuals from adverse decisions in the sense that proposals are consistently more "fair" than under majority rule. Under majority rule, subjects are exposed to a significant risk of being excluded entirely from a winning coalition and leaving the experiment with only the show-up fee. This risk was effectively absent under unanimity rule, where almost all proposals give at least 30% of the available pie to each of the three group members. However, this greater "security" against the tyranny of the majority may come at the price of efficiency. Thus, we find that a significantly smaller proportion of proposals is passed in the first round under unanimity rule. In fact, we find support for the even stronger hypothesis that individual members are more likely to reject a given share of the pie under unanimity rule than under majority rule. The latter pattern in particular provides support for the hypothesis underlying Buchanan and Tullock's argument. It appears that unanimity rule motivates subjects to be more "bullish" in their bargaining behavior.

---

it can be used for. It is conceivable that the constitution specifies several different voting rules to be used for different kinds of decisions. Buchanan and Tullock's argument is therefore fully consistent with the use of qualified majority rules for tax increases and other proposals that might generate substantial external costs. In the limit, decisions not constrained by the constitution (such as decisions to change the constitution) may optimally require unanimous consent.

The primary goal of the experimental analysis was to test a behavioral hypothesis, and not necessarily to provide or test theories as to the underlying psychological or strategic mechanisms responsible. None the less, we are inclined to interpret this pattern as follows. Under majority rule, rejecting a given share of the pie is associated with the risk of being excluded completely from future proposals. Therefore rejection is potentially very costly. This risk of being entirely excluded is absent under unanimity rule. Therefore subjects are more likely to reject, expecting correctly that they will receive a more attractive offer in the following round.[17]

A limitation of our approach lies in the fact that the interaction is extremely structured and the actions available to subjects are severely limited. This makes the situation somewhat unnatural when compared to "real world" situations to which Buchanan and Tullock's argument was meant to apply. Such doubts regarding external validity apply to much of experimental research in economics and political science. The advantage of such structured environments lies in the fact that we can clearly formulate hypotheses in terms of quantifiable behavioral patterns (e.g., rejection rates). The disadvantage is that we exclude elements of what Buchanan and Tullock may have meant by "investments in costly bargaining." Bargaining activities in real-world legislatures include, for example, verbal exchanges between

[17]We explore this conjecture using the only 22 observations under unanimity where a non-proposer voted against a proposal, and that proposal was selected randomly to be implemented. In the first round, the average rejected proposal was 28%. In the second round, participants that rejected an offer in the first round were offered 32% on average.

members and meetings with lobbyists, voters, and other interested parties. In our context, the only means by which subjects could engage in costly bargaining was to reject a given proposal (interpreted as a proposed distribution of the surplus resulting from an action under consideration). Future research in planning includes attempts to introduce communication into the interaction. For example, subjects may be given the opportunity to state "demands" prior to bargaining. We expect that such opportunities may lead to *additional* delays under unanimity rule.

A second issue worth exploring in our context concerns the effect of group size on decision cost, as well as the interaction of this effect with the decision rule. Buchanan and Tullock conjecture that (a) for a given decision rule, the costs of decision making increase with the overall size of the decision making body itself, and that (b) decision costs rise more sharply with the inclusiveness of the decision rule, the larger is the group. Together, these hypotheses lead them to conclude that unanimity rule may be appropriate in small groups, while less stringent rules may be preferred in larger groups.[18] Ongoing research tests these hypotheses in our context by increasing group size but otherwise keeping the experimental setup constant.

To conclude, the experimental results reported here provide support for Buchanan and Tullock's (1962) classic argument supporting the use of less-than-unanimity decision rules in certain areas of collective choice (see footnotes 2 and 16). In particular, we have shown that while unanimity rule protects individuals from adverse collec-

[18]Testing these conjectures may be of special relevance to the case of the European Union, where expanded use of (qualified) majority rule is often seen as a necessary consequence of enlargement.

tive decisions, it leads to greater delay as subjects more often reject proposals in an attempt to gain larger shares of the available surplus. While further research will be needed before broader conclusions can be drawn, we believe that this result lends support to arguments in favor of adopting simple majority rule in real-world decision making bodies such as the European Council of Ministers.

Acknowledgements We are grateful to the editor and two referees for constructive advice that induced major revisions of the article. We also thank James Andreoni, Daniel Diermeier, Guillaume Frechette, Rebecca Morton and various conference, workshop and seminar participants for their helpful comments on earlier versions of this paper. Luis Miller acknowledges the financial support received from the Spanish Ministry of Education (CSO2009-09890/CPOL and CSD 235 2010-00034). Christoph Vanberg acknowledges funding provided by the Alfred Weber Institute, University of Heidelberg.

Appendix 1: Derivation of benchmark hypotheses

We derive a symmetric stationary subgame perfect equilibrium of the Baron-Ferejohn game described in Section 3.3. Denote the size of the pie in round t by $P_t = \delta^t \cdot P$. Let v_t be the expected continuation payoff if the proposal is rejected in round t. (Note that this value is the same for all players in a symmetric equilibrium.) Assuming that players vote "yes" when indifferent between accepting and rejecting, the proposer in round t must give a share worth v_t to another player in order to secure her vote. Under majority rule, the best he can do is to give this amount to one of the other players and keep $P_t - v_t$ for himself. Under unanimity, he must give v_t to both of the other players and keeps $P_t - 2v_t$. In each case, the entire pie will be distributed, and the proposal will be accepted. Since each player is equally likely to receive any given share of tomorrow's pie, the expected continuation payoff after round t is $v_t = \frac{1}{3}P_{t+1} = \frac{\delta}{3}P_t$. It follows that under majority (unanimity) rule, the proposer offers a share $\frac{\delta}{3}$ to one (both) of the other players and keeps the remainder for himself, and this proposal is passed. (Under majority rule, the player excluded from the coalition can vote either yes or no.) In particular, this is true for round one, implying that the equilibrium involves no delay in bargaining under both majority and unanimity rule. If instead we assume that players vote "no" when indifferent between accepting and rejecting, the proposer must raise his offers by the smallest available increment. In our context, this is 1% of the available pie. This analysis leads us to formulate the two benchmark hypotheses in the main text.

Appendix 2: Experimental instructions

The following six pages contain facsimiles of the experimental instructions as provided under the majority rule treatment. Instructions for the unanimity treatment are identical except that on page 2 the words "if a majority has voted yes" are replaced by the words "if 3 out of 3 voters have voted yes," and the example screen on p. 6 is changed to reflect votes being counted according to unanimity rule.

Dear participants,

Welcome and thank you for participating in this experiment. Before we describe the experiment, we wish to inform you of a number of rules and practical details.

Important rules

- The experiment will last for about **90 minutes**.
- Your participation is considered **voluntary** and you are free to leave the room at any point if you wish to do so. In that case, we will only pay you the show-up fee of £4.
- **No writing**: You are not allowed to use a pen or take notes during this experiment.
- **Silence:** Please do remain quiet from now on until the end of the experiment. Those who do not respect the silence requirement will be asked to leave the experimental room. You will have the opportunity to ask questions in a few minutes.

What will happen at the end of the experiment

Once the experiment is finished, please remain seated. We will need around 10 minutes to prepare your payment. You will be called up successively by the number on your table; you will then receive an envelope with your earnings and you will be asked to sign a receipt.

Description of the experiment

The experiment consists of **15 periods**. At the beginning of each period, **groups of three participants** will be randomly formed. Thus, you will be randomly grouped with two other participants in this room. **New groups are formed in each period**, i.e. you will be interacting with a different set of participants in each period. No participant will know with whom he or she has been grouped during the experiment.

Each period consists of several rounds. Since new groups are formed at the beginning of each period, **you will be interacting with the same two participants for the duration of each period**, i.e. your group will remain fixed for all rounds within a given period.

After all groups have completed a given period, new groups are formed and a new period begins. After all 15 periods have been completed, the computer will randomly choose one period to be paid. Your earnings in the experiment will consist of the show-up fee (£4) plus your earnings in the period chosen for payment.

In each period, you will interact with two participants. Each participant will be randomly assigned an ID (“A”, “B”, or “C"). These ID's will remain fixed for all rounds throughout the period.

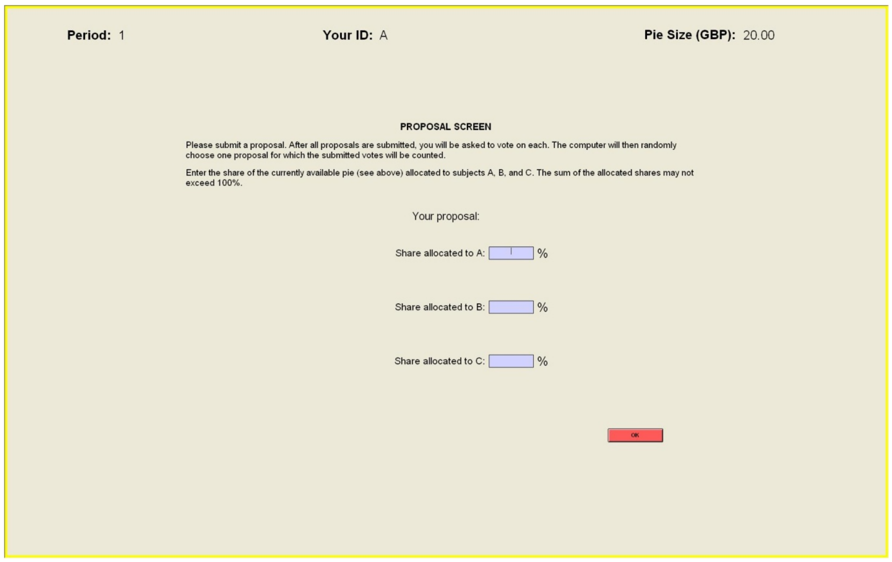
You will be acting as members of a committee that will bargain over the allocation of funds between them. The three members of the group decide how to split a “pie” initially worth £20 among them. Decisions are made by majority rule, using the following procedure.

First, **every participant makes a proposal** as to how much “A”, “B” and “C” will receive. Next, **each proposal is voted on**. Finally, **one proposal is randomly chosen to be counted**. If a majority has voted yes on the chosen proposal, it **passes** and the period ends. In case this period is later chosen for payment, each member of the group is paid the amount allocated to her by the chosen proposal. If a majority has rejected the randomly chosen proposal, it **fails**. In this case, the “pie” to be distributed shrinks by 10% and a new round of bargaining begins. I.e. each member makes a new proposal, etc. Thus, if the first proposal is rejected, the next round will involve splitting £18 among the 3 members. And if this proposal is rejected in round 2, then in round 3 £16.2 will be split, etc. Once a simple majority approves a proposal and it is chosen to be counted, the bargaining phase ends and the accepted proposal is implemented. The period will also end if the amount remaining to be distributed falls below £2.

The following pages provide more detailed information about the computer program used during the experiment.

Here is an example of what you will see on the **proposal screen:**

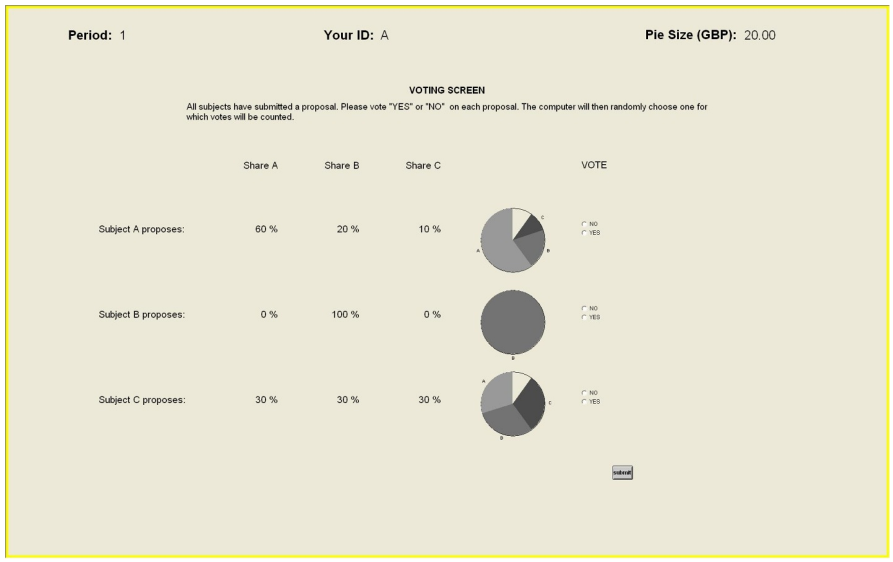
- Displayed on the top part of the screen are the period, your type and the pie size.
- Below, you will find three boxes into which you must type your proposal. You must type the share of the pie (%) you wish to allocate to "A" (upper box), the share of the pie (%) you wish to allocate to "B" (middle box), and the share of the pie (%) you wish to allocate to "C" (lower box).



After all three participants in the group have submitted a proposal, you will move to the **voting screen**.

Here is an example of what you will see on the **voting screen:**

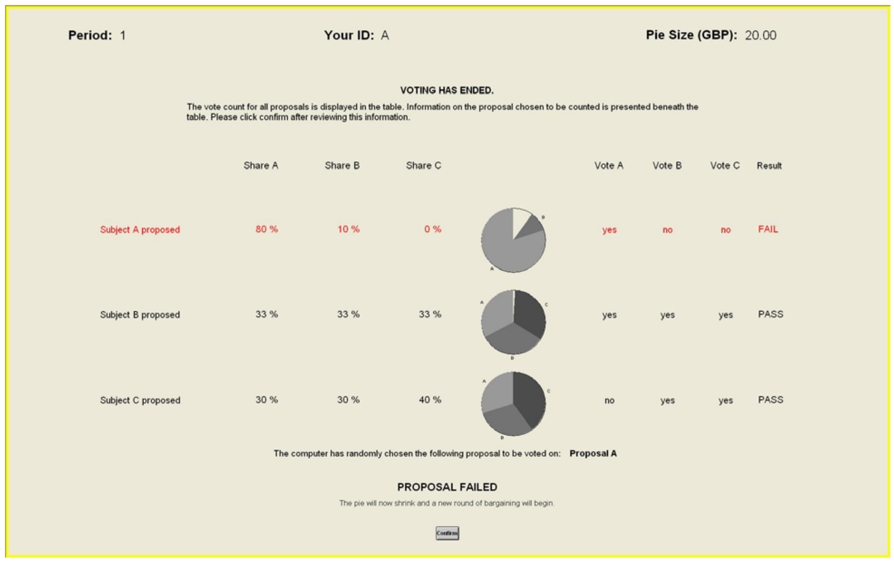
- The top part of the screen contains the same information as the proposal screen.
- Below, you will now see each of the submitted proposals displayed both numerically and graphically.
- To the right of each proposal, you will find the buttons used to vote on the proposals.
- After selecting yes or no for each proposal, click submit to cast your votes.



After all participants have voted, you will move to the **results screen**.

Here is an example of what you will see on the **results screen:**

- On the results screen there are three new pieces of information: the number of participants that accepted/rejected each proposal, whether the proposals have been passed, as well as which proposal has been randomly selected to be voted on / for votes to be counted. The selected proposal is highlighted in red.



If the selected proposal is passed, the period ends. In this case you will see a waiting screen until all groups have finished the period and new groups are formed. If the selected proposal is rejected, you will move back to the proposal screen for a new round of bargaining. In this case, the "pie" to be distributed will shrink by 10%. (Recall that you can always see the current size of the pie in the upper right hand corner.)

Your total earnings

Your total earnings in this experiment comprise the amount allocated to you in the bargaining and the £4 of the show-up fee.

		THE PERIOD CHOSEN FOR PAYMENT		SHOW-UP FEE
Total earnings	=	Amount allocated to you in the period chosen for payment	+	£4

If you have any questions, please raise your hand now and wait for the experimenter to come to you.

Please leave these instructions on your table when you leave the room.

References

Baron, D.P. and J.A. Ferejohn. 1989. "Bargaining in legislatures." *American Political Science Review* 83(4): 1181-1206.

Buchanan, J.M. and G. Tullock. 1962. *The Calculus of Consent: Logical Foundations of Constitutional Democracy.* Ann Arbor: University of Michigan Press.

Diermeier, D. and S. Gailmard. 2006. "Self-Interest, Inequality, and Entitlement in Majoritarian Decision-Making." *Quarterly Journal of Political Science* 1: 327-350.

Diermeier, D. and R. Morton. 2005. "Proportionality versus perfectness: experiments in majoritarian bargaining." In *Social choice and strategic behavior: essays in honor of Jeffrey S. Banks*, ed. David Austen-Smith and John Duggan. Berlin: Springer, 201-226.

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

Fréchette, G.R., J.H. Kagel, and M. Morelli. 2005a. "Nominal bargaining power, selection protocol and discounting in legislative bargaining." *Journal of Public Economics* 89: 1497-1517.

Fréchette, G.R., J.H. Kagel, and M. Morelli. 2005b. "Behavioral identification in coalitional bargaining: an experimental analysis of demand bargaining and alternating offers." *Econometrica* 73: 1893-1938.

Fréchette, G.R. 2009. "Learning in a Multilateral Bargaining Game." *Journal of Econometrics* 153: 183-195.

Fischbacher, U. 2007. "Zurich toolbox for readymade economic experiments." *Experimental Economics* 10(2): 171-178.

Greiner, B. 2004. "An online recruitment system for economic experiments." In *Forschung und wissenschaftliches Rechnen 2003. GWDG Bericht 63. Ges. für Wiss. Datenverarbeitung*, ed. Kurt Kremer and Volker Macho. Göttingen: Gesellschaft fuer Wissenschaftliche Datenverarbeitung, 79-93.

Guttman, J.M. "Unanimity and Majority Rule: A Reconsideration of the Calculus of Consent." *European Journal of Political Economy* 14: 189-207.

Kagel, J.H., H. Sung, and E. Winter. 2010. "Veto power in committees: an experimental study." *Experimental Economics* 13(2): 167-188.

McKelvey, R.D. 1991. "An Experimental Test of a Stochastic Game Model of Committee Bargaining." In *Laboratory Research in Political Economy*, ed. Thomas R. Palfrey. Ann Arbor: University of Michigan Press, 139-168.

Rubinstein, A. 1982. "Perfect Equilibrium in a Bargaining Model." *Econometrica* 50(1): 97-109.

Selten, R. 1967. "Die Strategiemethode zur Erforschung des eingeschränkt rationalen Verhaltens im Rahmen eines Oligopolexperiments" In *Beiträge zur experimentellen Wirtschaftsforschung, Vol. I*, ed. Heinz Sauermann. Tübingen: Mohr (Siebeck), 136-168.

Figures and Tables

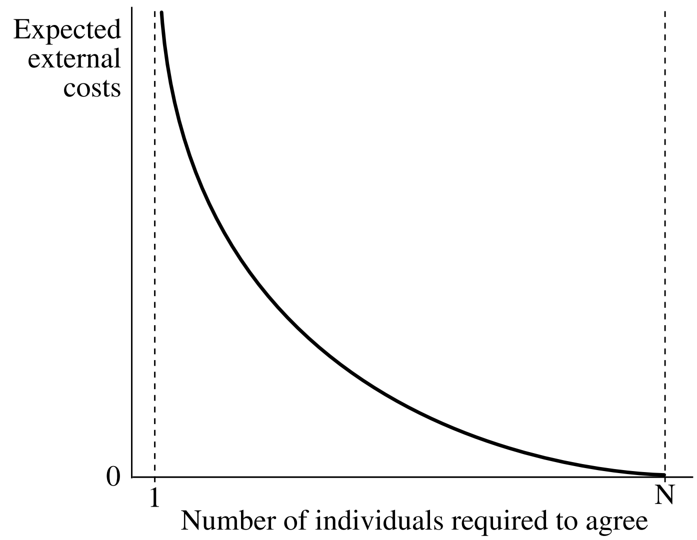


Figure 1: Decision rule and external costs (based on Buchanan and Tullock 1962)

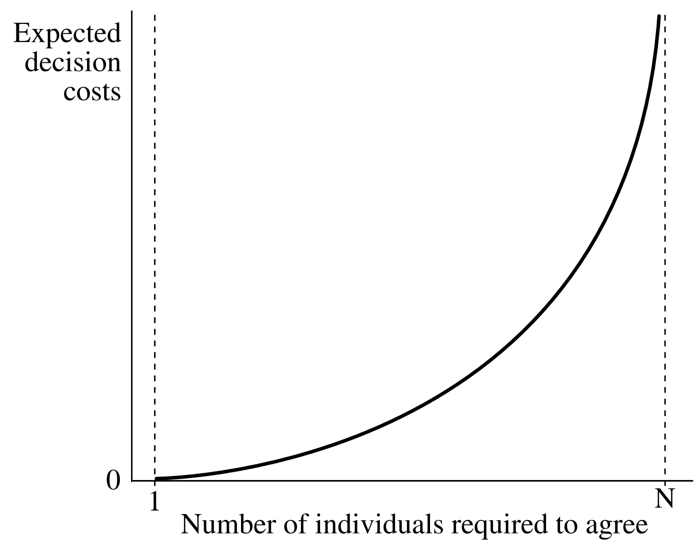


Figure 2: Decision rule and decision costs (based on Buchanan and Tullock 1962)

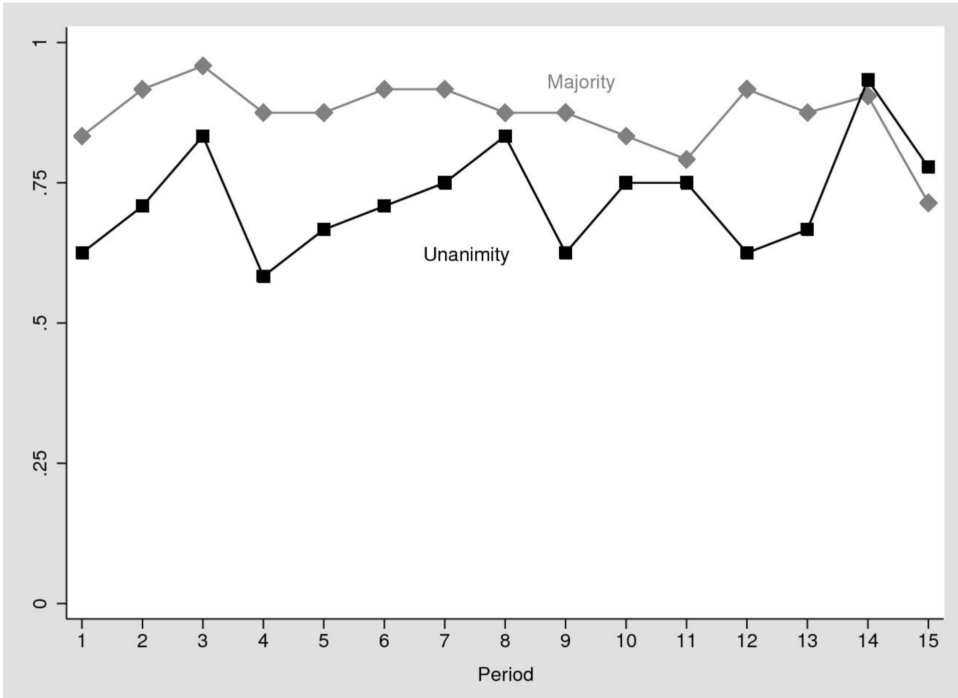


Figure 3: Proportion of proposals passed in round 1

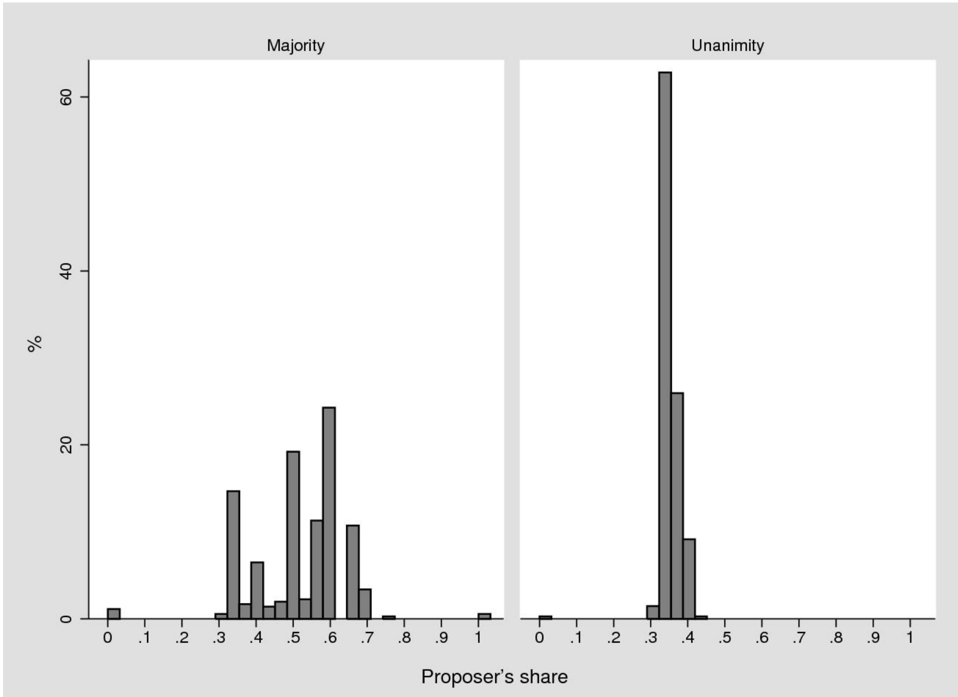


Figure 4: Proposer's share demanded in round 1

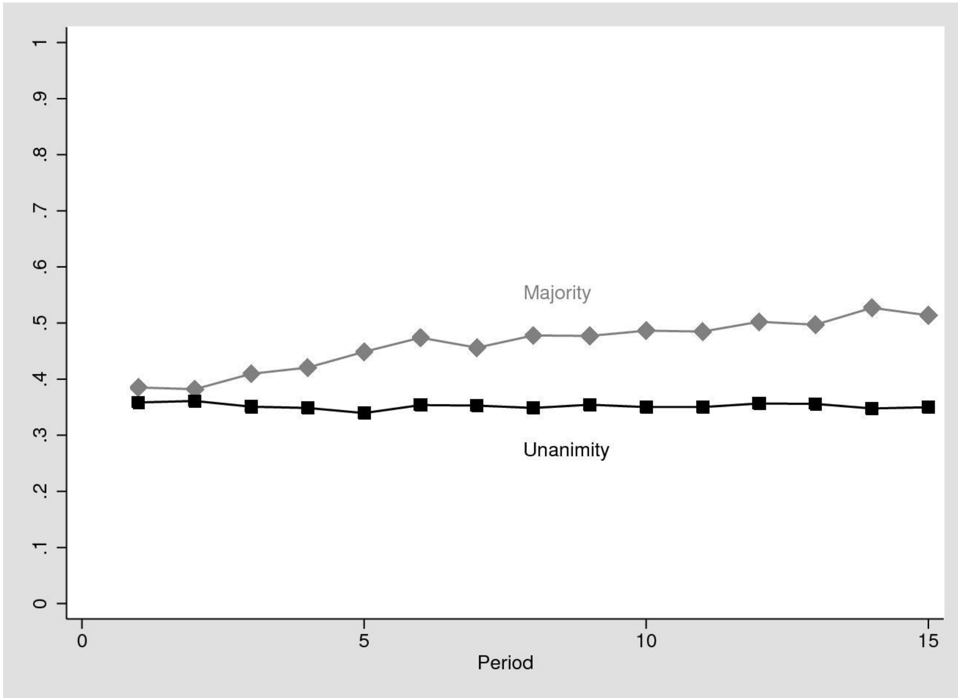


Figure 5: Average share the proposer demands for herself in round 1

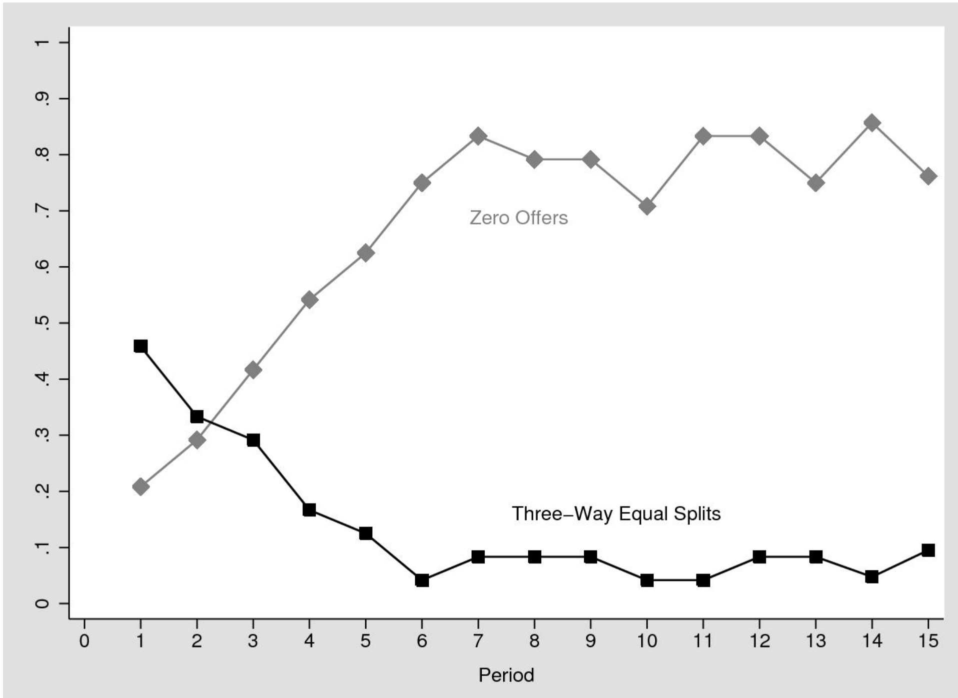


Figure 6: Proportion of subjects playing the zero-offer and equal-split strategies in round 1 under majority rule

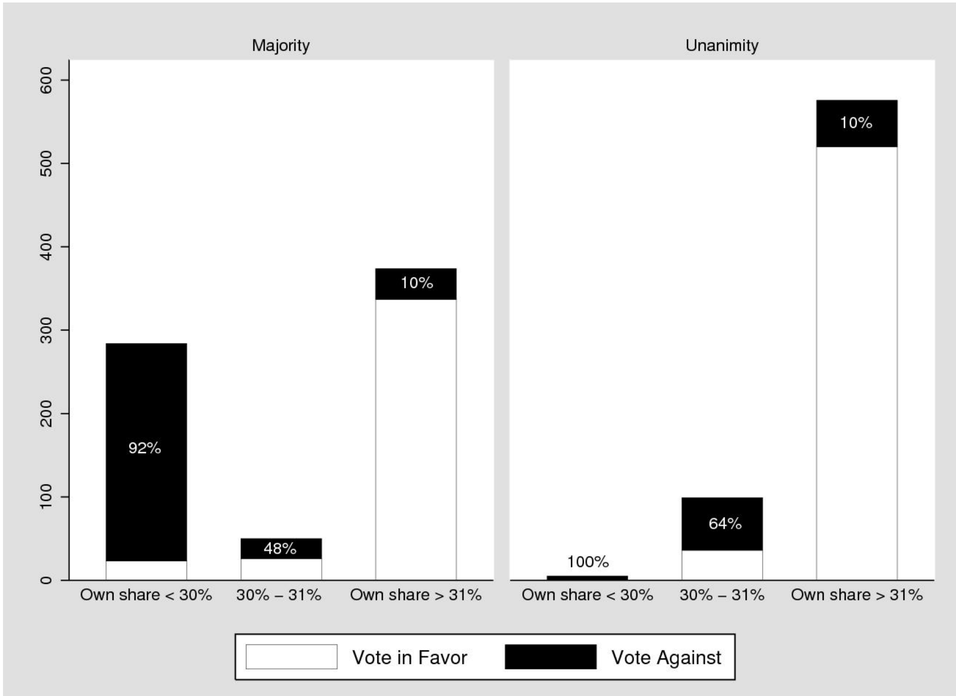


Figure 7: Accepted and rejected offers in round 1

	(1)	(2)	(3)
	$Ownshare > 31\%$	$Ownshare \leq 31\%$	$Ownshare \in \{30, 31\}$
Unanimity	0.177	-1.136	-1.148
	(0.298)	(0.492)**	(0.509)**
Proposer's share	-1.456	-4.750	-4.422
	(0.973)	(1.389)***	(1.841)
Own share	5.587	8.047	
	(1.956)***	(1.312)***	
Period	0.021	0.058	0.074
	(0.016)	(0.028)**	(0.034)**
Constant	-.0171	-0.632	1.666
	(0.739)	(1.782)	(0.883)
Observations	948	438	149
Number of subjects	48	48	43

*** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

Table 1: Random Effect Probit Estimates of the Voting Decision (Standard Errors in Parentheses)