Bargaining in the Shadow of Uncertainty*

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Abstract

In bargaining environments with stochastic future surplus, failing to delay agreement can be inefficient when the expected future surplus is sufficiently high. Theoretically, such inefficiencies never arise under unanimity rule but can under majority rule. Using a laboratory experiment, we find support for these predictions, both when the unanimity rule is predicted to be more efficient and when there should be no difference between the two rules. We also find large point prediction deviations under the majority rule. We show these deviations can be explained by higher-than-predicted egalitarian sharing and a lower risk of being excluded from future agreements.

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1 Introduction

Since the seminal contribution of Baron and Ferejohn (1989), there has been an extensive literature on experimental legislative bargaining (see the surveys of Palfrey (2015) and Agranov (2022)).[1] These studies have focused on situations in which the size of a budget to be distributed is a fixed quantity. While this represents a certain class of situations, there are many cases in which the size of the surplus to be divided may change over time, and moreover players cannot write contracts addressing all future contingencies. This is rather commonplace even in the financial sector where many creative contracts are available. One such example lies in Chapter 11 bankruptcies. Claimants need to decide on whether to accept or reject proposals on how to restructure the firm. During this negotiation process, new information may arrive impacting the value of the firm, but nevertheless, the negotiated reorganization plans cannot, and in practice do not, reflect all the possible contingencies that might affect the value of the bankrupt firm after it emerges from bankruptcy (see Eraslan (2008)).

The bargaining rules in stochastic settings are far from uniform, in particular, there is variation in the voting threshold required to reach an agreement. An example can be found in the realm of sovereign debt restructurings (see Benjamin and Wright (2019) and citations therein). An interesting feature of sovereign debt negotiations is the cross country variations of the bargaining mechanism. Specifically, bonds governed by New York law require unanimous consent to change the core payment terms of the indenture, while bonds governed by English law require a majority of the creditors to agree.[2] This cross country variation in voting rules raises the question of the desirability of the unanimity rule vis-à-vis the majority rule. In this paper, we use laboratory experiments to answer this question in a multilateral bargaining setting with a stochastic surplus.

Our experimental design is grounded in the framework of Eraslan and Merlo (2002) who theoretically study a stochastic model of multilateral bargaining with complete information and risk-neutral players focusing on the comparison between unanimity and majority voting rules in terms of delays. They show that under unanimity rule, equilibrium outcomes are always efficient while under majority rule this need not to be the case. Intuitively, in a stochastic environment, when the current surplus is smaller than the discounted value of the expected future surplus, it is optimal to delay agreement until a larger surplus is realized. Under unanimity rule, the incentives of all players are aligned since each player has veto power. But under majority rule, agreement on a proposal does not require approval by all players. As such, some players receive nothing under the agreed-

[1] The first experiments of Baron-Ferejohn model are McKelvey (1991), Frechette, Kagel, and Lehrer (2003), and Diermeier and Morton (2005). For a meta-analysis, see Baranski and Morton (2021).

[2] About 45% of the outstanding international sovereign bonds are governed by English law and about 52% by New York law IMF (2020).

upon proposal in equilibrium.[3] Given the risk of receiving no payment in the future, the players who are offered a positive share when the surplus is relatively small may be induced to accept the proposal if they expect to be excluded from future agreements when the surplus is relatively large.

This mechanism explaining the potential inefficiency of the majority rule relative to the unanimity rule does not seem to depend on the missing complexities of the real world such as risk aversion. Indeed, we extend the theoretical analysis of Eraslan and Merlo (2002) and show that under risk aversion, continuation payoffs are weakly higher under the unanimity rule, and if there is a delay under majority there is a delay under unanimity, but the converse is not true.[4] Incorporating other real-life features in a theoretical framework could be challenging. For example, introducing asymmetric information in a multilateral bargaining model is difficult even with a deterministic surplus, and there are only a handful of papers that do so, even then, in highly stylized settings (see Eraslan and Evdokimov (2019) for a survey).

As the name implies, a stochastic model of multilateral bargaining is an economic model. As such it is "an artificial world that is designed to reveal connections that are otherwise hard to discern." Nonetheless, it is important to understand whether complexities left out of the model would change the key result on the different incentives affecting the timing of agreement under different voting rules in a stochastic environment. One way to address this robustness question is through lab experiments. Given the difficulty of fully controlling rationality, preferences, and information of the subjects, experiments are well suited to study if these missing details matter. In this paper, this is precisely what we do by experimentally comparing the unanimity and majority rules in a stochastic bargaining framework in terms of delays and the distribution of surplus.

Our experimental design consists of a series of bargaining experiments in which a committee with three members allocates a budget for a given voting rule and stochastic process that governs the evolution of the budget size. Specifically, we run several treatments that vary along two dimensions: (1) the voting rule which is either the simple majority (M) or the unanimity (U) rule; (2) the variation in the size of the budget: in the M48 and U48 treatments, the budget is $24 in the first bargaining round, but if an agreement is not reached, the budget can be either $24 or $48 with equal probabilities in each future round; in the M96 and U96 treatments, the budget is $24 in the first bargaining round, but if an agreement is not reached, the budget can be either $24 or $96 with equal probabilities in each future round. In addition to our stochastic treatments, in order to tie our paper to

[3]Their model normalizes the disagreement payoffs to zero for all players. Consequently, receiving zero surplus is equivalent to receiving the disagreement payoff. In the debt restructuring application, all creditors receive the same payment but different creditors might have different disagreement payoffs. As such, being excluded from an agreement is analogous to receiving a payoff equal to or below the disagreement payoff.

[4]See Proposition 1 in Appendix A.

existing literature, we also run two deterministic ones, the M24 and U24 treatments, in which the size of the budget is fixed at 24. As we describe in detail in Section 3, the three parameterizations are used to create three qualitatively different situations that differ in terms of whether or not delays are predicted to happen:[5] (a) both voting rules are expected to result in immediate agreement (U24 and M24 treatments), (b) both voting rules are expected to result in delays (U96 and M96 treatments), and (c) only the unanimity rule is expected to create delays (U48 treatment versus M48 treatment).

We find strong support for the main theoretical insight, namely, that in a stochastic environment, the unanimity rule leads to more delays compared with the majority rule when the expected future surplus is sufficiently higher than the current surplus,[6] and even when in the benchmark theory both rules should result in equal levels of efficient delays. As predicted, in the 48 treatments, the unanimity rule results in small budgets being delayed at a much higher rate than under the majority rule (80% versus 54% in the U48 and M48 treatments respectively). This difference also holds in the 96 treatment (95% versus 75% in the U96 and M96 treatments respectively), despite the theoretical prediction that both rules should result in equal levels of efficient delays. We note that in the U96 treatment, the levels of efficient delay are very close to the 100% point prediction.

The advantages of the unanimity rule in a stochastic environment that we document in this paper stand in contrast to prior laboratory experimental findings that compared the two voting rules in a deterministic setting, that is when the budget size is fixed. In these situations, while the theory predicts no differences across voting rules in terms of agreement, in practice the unanimity rule can result in more inefficient delays (Miller and Vanberg (2013)).[7] So although the drawback of the unanimity rule seems to exist in a deterministic world, our experimental results show the advantages of the unanimity rule over the majority rule in a stochastic one.

While the qualitative predictions of the model hold, we note deviations from point predictions, particularly in the Majority treatments. Indeed, subjects in the M48 treatment delay too often (by over 50 percentage points), but delay not often enough in the M96 treatment (by 25 percentage points). What might account for this seeming puzzle? Data from a separate investment task as well as our theoretical contribution that extends the model beyond risk-neutral players point to risk aversion as a likely explanation. While we find no difference across treatments in subjects' risk attitudes, we do find that on average subjects are risk averse. This pushes subjects away from delays regardless of the voting rule,

[5]These predictions are derived in the theoretical benchmark setting in which committee members have an identical single date payoff function which is linear in their surplus share, and discount future bargaining rounds at the rate of 20%. In the experiment, we implement discounting using the standard technique of random termination which occurs at the end of each bargaining round (see Roth and Murnighan (1978)).

[6]In what follows, we refer to delaying agreement when the budget is small as "efficient delays."

[7]The subjects in our deterministic treatments exhibit behavior that aligns with these past findings.

but in the Majority treatment the impact is stronger because, in addition to the exogenous risk of random termination, subjects face the endogenous risk of being left out of a future coalition. Thus risk aversion has a differential impact across voting rules and can explain why subjects delay less under the majority rule compared with the unanimity one, even in the 96 treatments. Regarding the M48 treatment, the risk-neutral benchmark already predicts no delays. Instead, we observe delays in excess of 50%. What is then countering the impact of risk aversion? As we discuss further below, in the laboratory, proposals are often more egalitarian than predicted, and subjects often discuss fairness, even in the Majority treatments, lowering the risk of exclusion. This works towards increasing delaying behavior. In short, the combination of risk attitudes, how big the size of the future budget may be, and how likely one is to be excluded from a future winning coalition can jointly explain the patterns in our data.

Next, we explore the origins of delays. In the game we analyze, delay can arise for one of two reasons: either the proposer does not submit a proposal, or, a proposal is submitted but does not receive the required number of votes. Regardless of the agreement rule, the theory is silent regarding the origins of delays when delays are predicted. In the experiments, we uncover interesting differences in the origins of delays for small budgets between the two voting rules. For the 48 treatments, the proposers behave largely the same under the two agreement rules: 51% of proposers forgo making a small budget proposal in the M48 treatment and 52% do so in the U48 treatment. The reason there are more delays in U48 than in M48 rests almost entirely on the voting behavior of the committee members: when a small-budget proposal reaches the floor in the M48 treatment, only 7% of them are rejected: voters go along with the proposal on the table. In the U48 treatment this fraction is significantly higher and reaches 58%. Further, we find that the rejection of these inefficient proposals in the U48 treatment is due to a single vote in almost half of the cases, showing the importance of the voting rule itself in reaching efficient delays.

The explanation behind the higher levels of efficient delays in U96 relative to the M96 treatment is two-fold. In addition to delays arising due voters' rejection of the proposals dividing the small budget more often in the U96 treatment compared with the M96 treatment (68% versus 15%), we see that proposers are significantly more likely to forgo making a proposal under the unanimity rule than under the majority rule (83% versus 68%).

After establishing that efficient delays occur more often in the Unanimity treatments than in the Majority treatments, we show that these findings are robust to controlling for proposal types. Specifically, we find that equal split proposals dividing the small budget are more likely to fail under U48 than under M48 treatments (43% versus 4%) and they are also more likely to fail under U96 than under M96 treatments (65% versus 3%). These rates are even more striking when compared with the passage rates of equal split proposals when surplus is not stochastic. Both in the U24 and M24 treatments, equal-split proposals almost always pass and there is no difference in the passage rates between these two treatments (97% versus 99%).

The next set of results focuses on the distribution of payoffs among the players. We show that under the unanimity rule, regardless of the size of the future budget, outcomes are more equal than under the majority rule. In fact, budgets are almost always equally split among all committee members in the former case, while in the latter the resources are shared by two of the three committee members between 39% and 57% of the time depending on the treatment and the size of the budget at hand. Thus, not only does the unanimity rule lead to more efficient delays, it also results in a more equal allocation of resources.

Finally, we explore the effect of communication on a decision to delay implementing a small budget. Under the unanimity rule, the only risk in delaying is the exogenous termination of the game. Under the majority rule a second risk is present: the risk of being excluded from a future budget proposal. We find that both of these elements are discussed in both treatments. However, they mostly impact decisions in the Majority treatment and the magnitude of this impact depends on the distribution of future surplus. In the M48 treatment, groups that discuss fairness and equality delay splitting the small budget more often than those that do not engage in such discussions. This effect is consistent with the re-assurance effect according to which conversations about fairness and equality reduce the risk of being excluded from future coalitions. Such re-assurance plays no role in the Unanimity treatment, in which three-way equal splits are considered a *fait accompli*. In the M96 treatment, groups that discuss the risk of game termination due to discounting are less likely to delay when the budget is small compared to groups that do not mention such risk. This last effect points to the fragility of efficient decision-making under majority voting rule.

Related literature. Our paper joins the experimental literature on legislative bargaining, which is extensive (see the surveys of Palfrey (2015) and Agranov (2022)). Therefore, we focus our review on the subset of papers that compare the performance of various voting rules. Miller and Vanberg (2013, 2015) study how different voting rules affect delay in bargaining in small and large committees. Contrary to the predictions of stationary equilibria, committees take longer to reach agreements under the unanimity rule compared with the majority rule. This points to a weakness of the unanimity rule when the setting is deterministic in terms of future budget size.[8]

The papers discussed above consider bargaining with a fixed rather than a stochastic

[8] Allowing for communication between bargainers can improve the outcomes of the unanimity rule as shown in Agranov and Tergiman (2019), however, it does not eliminate them.

budgets.[9] This is an important distinction since delay in bargaining with a fixed budget leads to a sure loss of efficiency for impatient bargainers. The setup we study here, i.e., bargaining with stochastic budgets is different since efficiency balances the two opposing forces: the desire of the committee to wait for the realization of a large budget and the cost of such delay. The only paper that we are aware of that utilizes the Merlo and Wilson (1995) setting is Li and Houser (2020). The focus of their work is quite different from ours. They study a two-person two-stage bargaining game in which the budget either expands or shrinks deterministically between stages but the process determining the identity of the proposer is stochastic. In contrast to our focus on the comparison of voting rules, Li and Houser (2020) compare outcomes in bargaining over gains and with that of bargaining over losses. Their experimental results show that efficiency matters. In particular, the most common outcome in both cases is the equal split of the largest available resource.

Structure of the paper. The remaining paper is organized as follows. The first part of Section 2 presents the setup and derives broad equilibrium predictions focusing on the comparison of efficiency levels between the two voting rules. The second part of Section 2 outlines game parameters used in our experiments and specific predictions for each treatment. Section 3 details the experimental procedures. Section 4 presents our experimental results, starting with our main result on the levels of efficient delays and their origins across treatments, before describing the distribution of payoffs and the impact of communication chats between bargainers. Section 5 offers some conclusions. The appendices contain proofs, experimental instructions, additional material regarding how conversations were coded, and extend some of the data analyses present in the main text.

2 Setup

In this section, we start by presenting the game we use to study the efficiency of majority and unanimity voting rules. We then turn to the discussion of the main theoretical insights regarding this environment, focusing on both qualitative and quantitative predictions. Finally, we describe the parameters we use in our laboratory experiments and outline the theoretical predictions for the chosen parameters.

The Game. A group of n (odd) members is charged with distributing a budget among its members using a pre-specified voting rule denoted by q. The parameter q captures the

[9] There also exists a small experimental literature on dynamic bargaining. Most related to our study is Battaglini, Nunnari, and Palfrey (2012). The authors present a legislative bargaining model in which public and private goods are decided in each period over an infinite horizon. They show that the unanimity rule leads to higher long-run public investment than the majority rule. Thus, like us, they find support for the unanimity rule from an efficiency perspective.

number of votes required to agree on an allocation with $q = n$ indicating the unanimity voting rule and $q = \frac{n+1}{2}$ indicating the majority voting rule. The bargaining happens over a series of (potentially infinite) bargaining rounds. Within each bargaining round, members use the standard Baron and Ferejohn (1989) bargaining protocol. In particular, at the beginning of each bargaining round, all group members learn the budget size for the round, and one member is randomly selected to be the proposer. The proposer can either submit an allocation, which is a vector of non-negative shares to all members that sums up to the budget in the current round, or, alternatively, choose to bypass the round and move straight to the next bargaining round without making a proposal. If an allocation is submitted, then all group members vote on it. If the proposed allocation obtains at least the required number of votes (q) then the allocation passes, the game is over, and all members collect the shares specified in the passed allocation. If, however, the allocation does not get at least q votes, then it is defeated, and the group moves on to the next bargaining round, which has the same structure as described above.

The uncertainty in this setup is captured by the stochastic process that governs the realization of the budget size as well as the selection of the proposer. In the first bargaining round, the budget size is small and is denoted by $\underline{y}$. In every bargaining round after the first one, there is p percent chance that the budget will be small once more ($\underline{y}$) and a (1-p) percent chance that it will be large, $\bar{y}$, where $\bar{y} > \underline{y}$.[10] The group members have an identical von Neumann-Morgenstern stage utility function that is linear in the budget allocated to them, and discount the future at a rate $\delta \in (0,1)$. In the event that an agreement is never reached, all group members receive a payoff of zero.

General Predictions. It is well known that in multilateral bargaining games like the one considered here there is a continuum of subgame perfect equilibria even under the unanimity rule (e.g., Sutton, 1986). However, it has also been recognized that stationarity is typically able to select a unique equilibrium (e.g., Baron and Ferejohn (1989); Merlo and Wilson (1995)). Thus, we restrict attention to stationary subgame perfect (SSP) equilibria. In addition, given that the members are symmetric, we further restrict attention to symmetric and pure SSP equilibria in which all members have the same continuation payoff which we denote by v_q, and, conditional on not being the proposer, each player is included in a winning coalition with the same probability if an offer is made. This probability is equal to $\frac{q-1}{n-1}$ since each proposer needs to choose $q-1$ other players to include in his coalition out of the $n-1$ remaining players.

To gain some intuition on the trade-offs that our setting encompasses, consider two

[10]That the first bargaining round imposes a small budget is without loss of generality. Indeed, if instead the first round is also stochastic, then if a group obtains a large budget, an agreement is immediate, and for those groups who obtain a small budget, behavior is governed as described below.

cases:[11]

(i) Delay is so costly that the members are willing to split the small budget instead of waiting for the large budget to materialize. Assuming without loss of generality that a member accepts a proposal when indifferent,[12] this happens when $\underline{y}-(q-1)v_q \geq v_q$. In this case, the equilibrium continuation payoffs must satisfy:

$$v_q = \frac{1}{n}\Big[p(\underline{y}-(q-1)\delta v_q)+(1-p)(\bar{y}-(q-1)\delta v_q)\Big]+\frac{n-1}{n}\frac{q-1}{n-1}\delta v_q = \frac{p\underline{y}+(1-p)\bar{y}}{n}. \quad (1)$$

This case is possible if and only if $\bar{y} \leq c_1 \underline{y}$ where $c_1 = \frac{n-\delta q p}{(1-p)\delta q}$, that is, when the large budget is not too much larger than the small budget.

(ii) Delay is not so costly, and therefore, the members are willing to wait for the large budget to materialize instead of reaching an agreement on the small budget. This happens when $\underline{y}-(q-1)\delta v_q < \delta v_q$. In this case, the equilibrium continuation payoffs must satisfy:

$$v_q = \frac{1}{n}\Big[p\delta v_q+(1-p)(\bar{y}-(q-1)\delta v_q)\Big]+\frac{n-1}{n}\Big[p\delta v_q+(1-p)\frac{q-1}{n-1}\delta v_q\Big].$$

Collecting terms and rearranging, we obtain $v_q = \bar{y}\frac{1-p}{n(1-\delta p)}$. This case is possible if and only if $\bar{y} > c_2 \underline{y}$ where $c_2 = \frac{n(1-\delta p)}{(1-p)\delta q}$, that is, when the large budget is sufficiently larger than the small budget.

When the committee uses the unanimity voting rule, i.e. when $q = n$, we have $c_1 = c_2 = \frac{1-\delta p}{(1-p)\delta}$. Consequently, either the necessary and sufficient condition for case (i) is satisfied, or the necessary and sufficient condition for case (ii) is satisfied, but they cannot be satisfied simultaneously. As such, the equilibrium is unique for all possible values of $\bar{y}, \underline{y}$, δ and p under the unanimity rule. In this unique equilibrium, the committee never delays when the value of large budget is relatively small, i.e., $\bar{y} < \frac{1-\delta p}{(1-p)\delta}\underline{y}$ and otherwise the committee delays bargaining until the large budget is realized.[13] However, when a committee uses

[11] For more details, see Eraslan and Merlo (2002).

[12] See footnote 7 in Eraslan and Merlo (2017) for an an explanation of why this assumption is without loss of generality.

[13] Notice that the theory is silent regarding the mechanics of how delay in bargaining occurs. It can happen in one of two ways. In the first, the proposer can choose to forgo making a proposal, in which case the current bargaining round ends irrespective of the desires of the other committee members. In the second, the proposer can submit an allocation proposal, which can then be struck down by the committee members. In that case the current bargaining round ends following other members' behavior rather than because of the unilateral decision of the proposer. While in theory these two ways of inducing delay are identical in terms of the eventual outcomes they produce, there may be large behavioral differences across them. Our experimental design allows us to examine this point and investigate whether different voting rules tend to affect the 'type' of the delay.

any other voting rule with $q < n$, multiple equilibria might be supported since $c_1 > c_2$. Interestingly, if there is no delay under unanimity rule, the expected equilibrium payoffs do not depend on the voting rule used by the committee, and only depend on the parameters of the stochastic process that governs the evolution of budget, i.e., $(p, \underline{y}, \bar{y})$ and the discount factor δ. In this case, there is no-delay under the majority rule either, and because the players are symmetric, the expected equilibrium payoffs are identical. Likewise, if there exists a delay equilibrium under majority rule, then the expected equilibrium payoff in this equilibrium is equal to the (unique) expected equilibrium payoff under unanimity rule by the symmetry of the players.

The analysis above focused on the case when the committee members are risk neutral. In our framework, there are two sources of risk under the unanimity rule: the size of the budget and the identity of the proposer. Both of these are exogenous risks. Under the majority rule, however, there is an additional risk of not being included in the winning coalition. This endogenous risk is at the heart of the result that there might be inefficient agreements under majority rule even when the committee members are risk neutral. The inefficient equilibrium under majority arises when there is agreement on a proposal dividing the small budget even though it is efficient to wait. In this case, agreement when the budget size is small arises as a result of the acceptance by members who are included in the winning coalition. They do so to avoid the risk of being excluded from the winning coalition in the future when the budget is large. As one would expect, this incentive becomes stronger when the committee members are risk-averse. An extension in Appendix A illustrates this point.

Experimental Parameters. In choosing our experimental parameters, our goal was to design the simplest experiment in which uncertainty about the size of the future budget would lead to different behavior in committees which use different voting rules, and, consequently, to different efficiency levels. In particular, we focused on two voting rules commonly used in practice, the majority and the unanimity voting rules, and designed six treatments (three per voting rule), which we describe below.

In all treatments, groups of $n = 3$ members interacted over a (potentially infinite) number of bargaining rounds with a common discount factor of $\delta = 0.8$.[14] The budget size in the first round was $\underline{y}$ = \$24 in all treatments. The value of the large budget $\bar{y}$ in our stochastic treatments varied across treatments and was either $\bar{y}$ = \$48 or $\bar{y}$ = \$96. The probability distribution over budget sizes was uniform and was the same in all bargaining rounds after the first one and in all treatments. In addition to the stochastic treatments we included two deterministic ones in which the budget was always equal to 24 to link our

[14]In the next section we describe in detail how we implemented this potentially infinite horizon game in the laboratory.

findings to past literature. We refer to the six treatments as M24, M48, M96, U24, U48, and U96 indicating in the treatment label both the voting rule and the size of the large budget, which are the only differences between treatments.

Predictions Given Parameters. The sizes of the large budgets in different treatments ensure that there exists a unique equilibrium in the Majority treatments. Indeed, for our parameters, we obtain $c_1 = c_2 = 1.5$ for the Unanimity treatments and $(c_1, c_2) = (2.75, 2.25)$ for the Majority treatments. Thus, for the Unanimity treatments, theory predicts that players would delay splitting the small budget both in U48 and U96, while the same behavior is predicted only when the large budget is particularly large, as is the case in M96, for the Majority treatments. Irrespective of the treatment, if members find themselves in a bargaining round with a large budget, they agree on an allocation immediately without any further delay. These predictions are summarized in Table 1 in the Results section.

3 Experimental Procedures

All experimental sessions were conducted at the University of California, San Diego.[15] Subjects were recruited from a database of undergraduate students. Twenty-four sessions were conducted with 4 sessions per treatment and 12 subjects in each session, for a total of 288 subjects. Each subject participated in only one session. Each experiment session lasted about 90 minutes and average earnings were \$25.7, including a \$12 show-up fee.[16]

In each experimental session, subjects played twelve repetitions of the bargaining game with random re-matching between games, i.e., between repetitions. Before the beginning of each game, subjects were randomly divided into groups of three, i.e., each committee consisted of three members. Each bargaining game mimicked the extensive-form game described in Section 2. Specifically, in all sessions, committees started with a small budget of \$24 in the first bargaining round.[17] Each game had an unknown number of bargaining rounds. At the beginning of a bargaining round, the committee members learned the size of the budget for the round and one of the three committee members was randomly selected to be the proposer. The proposer could either submit an allocation proposal (a vector of non-negative payments to all three members that sums up to the budget in the current round) or, alternatively, the proposer could choose to bypass the round and move

[15]We are grateful to the UCSD Economics department for allowing us to use their experimental lab to conduct our experiments.

[16]In Appendix B we present the instructions for the U96 treatment. The instructions for the other treatments are similar except for the obvious differences in voting rule and the size of the potential future budget.

[17]The purpose of this choice is two-fold. First, it allows us to normalize initial settings across groups and more easily compare behavior in the different treatments. Second, when faced with a large budget, there shouldn't be any delays, rendering such rounds ineffective at asking whether voting rules and stochastic bargaining lead to inefficiencies.

straight to the next bargaining round without making a proposal. If the proposer chose to submit an allocation proposal, then all committee members observed it and voted on it. If the allocation received the required number of votes, then the bargaining game was over and the committee members received the payoffs specified in the allocation that passed. If the allocation did not receive the required number of votes, or if the proposer chose to bypass the round, then the current bargaining round was over. In that case, there was a 20% probability that the bargaining game was exogenously terminated, in which case payoffs for all group members were zero. With the remaining 80% chance the bargaining game continued to the next bargaining round where the proposer was once more randomly selected. In other words, we implemented the discounting with random termination of the game, which is one of the common ways to study infinitely repeated games in the laboratory (see Frechette and Yuksel (2017)).

To help players recall the events in the current game, a table on the screen kept track of all the information pertaining to the current game including the proposer ID, her choice (delay or allocation), and the votes of all group members in each bargaining round.[18]

Finally, after the proposer was selected at the beginning of a round but before she made her choice, committee members had the opportunity to communicate with each other using an unrestricted chat tool. This chat tool allowed group members to send any message they wanted to any subset of the group including private messages to just one member and public messages that were delivered to all group members.[19] There are two reasons we allowed subjects to communicate with each other. First, it is hard to imagine a real-life dynamic bargaining environment in which members of the same committee cannot communicate with each other. Second, communication in multilateral bargaining games has been shown to bring the distribution of resources closer to theoretical predictions (see Agranov and Tergiman (2014), Baranski and Kagel (2015), and Agranov and Tergiman (2019)), suggesting that communication channels are crucial to understanding how committees function.

At the end of the experiment, one of the twelve games that the subjects played was randomly chosen for payment, and subjects were paid the amount they earned in this randomly selected game. In addition, after the twelve games, subjects played two investment games that we use to evaluate subjects' risk attitudes.[20]

[18] We present the screenshots of the interface in Appendix C.

[19] The chat option was on for at least 20 seconds and lasted until the proposer submitted her allocation or chose to delay. This 20-second period was implemented to make sure that if a group member wanted to communicate with others, she could do so and not be interrupted by the proposer who might otherwise have quickly entered the allocation and/or clicked delay. The instructions made the structure of the communication process clear.

[20] Appendix D includes the instructions for these investment games and presents summary statistics for the two tasks across treatments. We find no statistical differences across treatments in this game, which is why we reject that treatment differences are due to differences in risk attitudes of our participants as measured by

4 Results

As the novelty of our paper lies in the stochastic nature of the budget size, our analysis focuses on our four stochastic treatments, and we compare these outcomes with those from our two deterministic treatments, namely M24 and U24, when relevant. We present the results of our experiments in the following order. We begin with our main result and study game dynamics, focusing on delays across treatments and the exploration the origins of delays. Second, we document the distribution of resources within a committee and the implied inequality levels across treatments. Finally, we explore the dialog between committee members.

Approach to Data Analysis. We use all twelve repetitions of the bargaining game in our analysis and data from all bargaining rounds, since we see limited learning across these repetitions and rounds.[21] All statistical tests are performed using regression analyses. In all regressions, we cluster observations by session to account for the interdependencies that come from re-matching subjects between bargaining games. To compare average outcomes between treatments we regress the variable of interest on the constant and an indicator for one of the two treatments. The p-values that we report are those associated with the estimated coefficient on the dummy for one of the treatments.

Finally, given that the theory predicts corner values for delay, i.e, no delay for small budgets in the M48 and 100% delay for small budgets in the remaining three treatments, any noisy behavior would necessarily produce outcomes which are not in line with the theory. We therefore mainly focus on the qualitative predictions of the theory.

4.1 Game Dynamics

Frequency of delays. We start by describing the frequency of delays in our stochastic treatments, which are shown in Table 1.

Delays when facing a small budget are frequent, and more so in committees under the unanimity voting rule than in committees under the majority voting rule: the fraction of efficient delays is 80% in U48 compared with 54% in M48 ($p < 0.001$) and these numbers are 95% and 73% ($p < 0.001$) for the M96 and U96 treatments, respectively.[22]

While our deterministic treatments show that disagreements also happen more frequently under unanimity than under the majority rule (26% in U24 and 10% in M24, $p < 0.001$), we note that the gap between delays in the M48 and U48 treatments is 26 percentage points compared with the 16 of the deterministic treatments, indicating that

this game.

[21]Learning and time trends are presented in Appendix F in Tables 8 and 9.

[22]We replicate this table using only first-round data in Table 6 in Appendix F. The conclusions are no different.

Table 1: Frequency of delays

	Majority	Unanimity	Maj vs Un
48 treatment			
Large budget	2% (n=50)	9% (n=82)	$p = 0.159$
Prediction	0%	0%	
Small budget	54% (n=247)	80% (n=289)	$p = 0.001$
Prediction	0%	100%	
96 treatment			
Large budget	4% (n=79)	3% (n=111)	$p = 0.772$
Prediction	0%	0%	
Small budget	73% (n=270)	95% (n=344)	$p < 0.001$
Prediction	100%	100%	

Notes: This table shows the total frequency of delays separately for small and large budgets at the group level. This frequency encompasses cases in which the proposer chose to delay and those in which the proposal was rejected by the committee. The last column shows the p-values from regression analyses comparing across voting treatments for each row.

delaying *per se* in the stochastic treatments does not arise under the unanimity rule more often simply because of behavioral frictions that make it inherently harder to reach agreements when everyone has to agree, but rather because of the stochastic budget interacted with this voting rule. Also supporting this claim is the fact that statistical tests detect no difference between the frequency of disagreement between the two voting rules when the budget is large ($p = 0.159$ for M48 vs U48 and $p = 0.772$ for M96 vs U96).

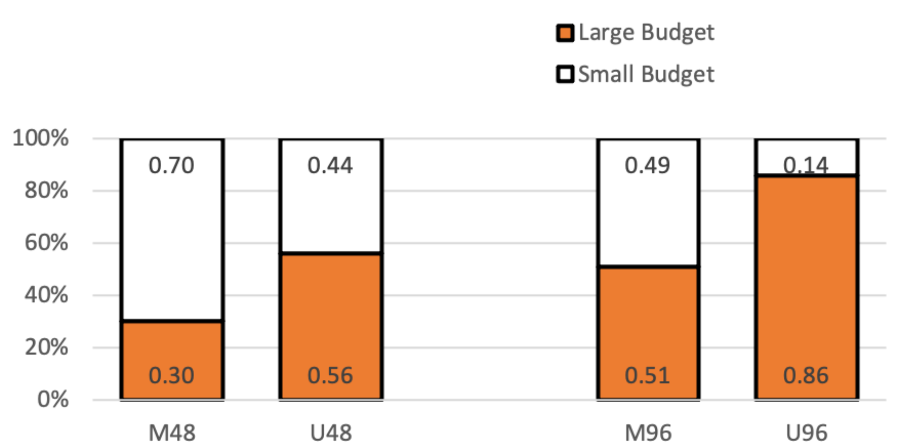
Relative to the theoretical predictions, we note that while the unanimity rule produces more delays than the majority rule in the 48 treatment as the theory predicts, the frequency of efficient delays in the M48 treatment for small budgets is substantial (more than 50%) and, thus, should not be ignored. However, and perhaps surprisingly given behavior in the M48 treatment, we observe significantly fewer delays in the M96 committees compared with the U96 committees, going against the theory that predicts equal levels of efficient delays in these two treatments.

Although not predicted by the benchmark risk-neutral theory, data from a separate investment task as well as our theoretical contribution that extends the model beyond risk-neutral players point to risk aversion as a likely explanation for these patterns.[23] While we find no difference across treatments in subjects' risk attitudes, we do find that on average subjects are risk averse (see Table 5 in Appendix D). This pushes subjects away from delays regardless of the voting rule. However, risk aversion has a differential impact across voting

[23]See Appendices A and D.

rules: in the Majority treatment subjects face the endogenous risk of being left out of a future coalition in addition to the exogenous risk of random termination if a delay is implemented. This can explain why subjects delay less under the majority rule compared with the unanimity one, even in the 96 treatments. Regarding the M48 treatment, the risk-neutral benchmark already predicts no delays. Instead we observe delays in excess of 50%. As we discuss further below, in the laboratory, proposals are often more egalitarian than predicted, and subjects often discuss fairness, even in the Majority treatments, lowering the risk of exclusion. This force works towards increasing delaying behavior, pushing against the impact of risk aversion. In short, the combination of risk attitudes, how big the size of the future budget may be, and how likely one is to be excluded from a future ruling coalition can jointly explain the patterns in our data.

Figure 1: The proportion of small versus large budgets among budgets that are implemented in stochastic treatments.

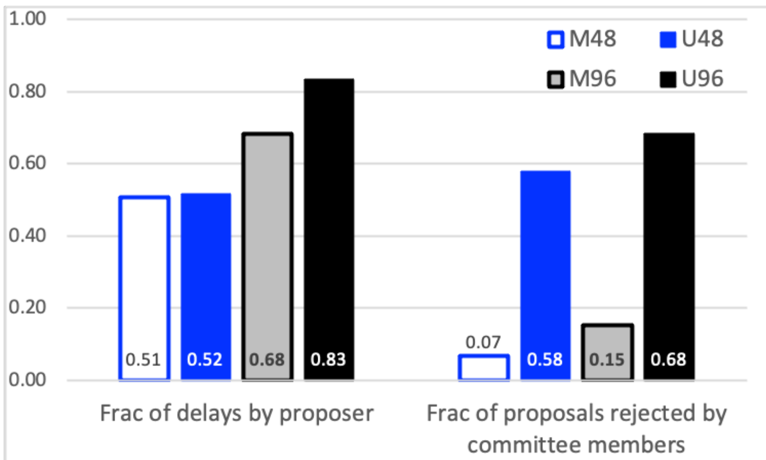


Implemented Budgets. Aggregate outcomes in terms of the relative frequency of large versus small budgets that are implemented among all budgets that are passed are a direct consequence of delaying behavior. These outcomes are shown in Figure 1. Among all budgets that are passed, large budgets are adopted 56% of the time under U48 compared with 30% under M48 ($p = 0.01$); under U96 and M96 these numbers are 86% and 51% ($p < 0.001$), respectively. The conclusion is straight-forward: the unanimity rule leads to higher levels of large budgets being distributed relative to the majority rule, both when it is expected (as in the 48 treatments), but also when both rules should lead to the same levels of large budgets passing (as in the 96 treatments).[24]

[24] These same patterns persist if we look at more generalized outcomes that include games in which no budgets were passed because of the random termination. In this case, the fraction of large budgets passed in

Origins of Delays. Why are small budgets are rejected? In the game we analyze, not implementing a budget can come for one of two reasons: either the proposer decides to forgo submitting a proposal, and consequently moves the group to the next bargaining round without a voting stage, or, a proposal is submitted but does not receive the required number of votes. The figures presented in Table 1 do not distinguish these two scenarios. Figure 2 unpacks these two situations.

Figure 2: Origins of delay for small budgets in treatments with uncertainty



Notes: This figure depicts the frequency of delays and rejected proposals in M48, M96, U48, and U96 treatments conditional on the budget being small.

Figure 2 uncovers interesting differences between the two voting rules. For the 48 treatments, there is no difference in delaying behavior on part of the proposers: the fraction of delays implemented by proposers is about 50% in both voting rules ($p = 0.815$). The reason there are more delays overall in U48 relative to M48 comes from the fact that under the unanimity rule, when a proposer does submit a proposal, it is rejected with a much higher frequency than under the majority rule (58% in U48 versus 7% in M48, $p < 0.001$). This points to the fact that departures from theory in the M48 treatment are largely due to proposers' choices, not voter behavior. In other words, voters tend to go along with the proposal when one is on the table.

In the 96 treatments, proposers are significantly more likely to forgo making a proposal under the unanimity rule than under majority rule: 83% of the proposers delay in the U96 treatment and 68% in the M96 ($p = 0.015$).[25] When proposals dividing the small budget

the U48 and M48 treatments are 39% versus 26%, respectively ($p = 0.001$). These numbers are 56% and 40% when comparing the U96 and M96 treatments ($p < 0.001$). In the non-stochastic environment of the U24 and M24 treatments, these numbers are understandably 0 in both cases.

[25]Individual propensities to delay show similar results and are presented in the Appendix F.

are submitted, they fail to pass in the U96 treatment close to 70% of the time, while they fail to pass only 15% of the time in the M96 treatment ($p = 0.001$). That is, in the U96 treatment, in a large majority of groups, voters "correct" mistakes that proposers might make (submitting a small budget proposal). On the other hand, under the majority rule voters fail to correct these mistakes. Given that in both treatments the risk of exogenous termination is the same, as is the probability of a future large budget, differences in voting behavior cannot be ascribed to these elements. On the other hand, the treatments do differ in terms of the probability that a player who receives a positive share in a particular proposal may be excluded from a future one: this risk exists in the Majority treatment, while it is nonexistent in the Unanimity treatment (an element that is the result of the theory but that also finds strong support in the data as shown in the next subsection). While the unanimity rule is often seen as risky in the sense that one voter can impede the smooth functioning of a committee, what the data in our experiment point to is that it also only takes a single committee member to (potentially) reach a larger budget and correct mistakes that stem from proposer behavior. Specifically, if the proposer fails to bypass making a proposal, that single voter can rectify the situation. This is not the case under the majority rule. Our data show that small budget proposals are rejected by a single deciding vote in 47% and 74% of the cases in the U48 and U96 treatments, respectively. Thus, this correction happens thanks to a single voter.[26]

Although the proposals dividing the small budget are not necessarily the same under the two voting rules, this distinction is not crucial in understanding the aggregate statistics on rejection rates. Indeed, we next show that proposals dividing the small budget are rejected by voters not because of the proposals per se (for example, they offer voters too little) but because of the possibility that the next bargaining round's budget might be large.

In order to show this we focus on cross-treatment differences in terms of how identical small budget proposals are treated by voters. The natural candidate for such a comparison is the equal split allocation where all committee members receive an identical share (such proposals are frequent in all treatments, see Table 2). Our data shows that the fraction of passage rates of small budget proposals that equally split the small budget among three members is significantly smaller in the Unanimity treatments than in the Majority treatments. Indeed, such proposals are much more likely to be accepted in the M48 compared

[26] We also rule out that delays are more frequent under unanimity because subjects happen to experience fewer random terminations due to the realizations of random draws. In fact, the data point to the opposite. After small budgets were either delayed or rejected, committees in the U48 treatment experienced twice as many delays due to discounting (random termination) as compared with the M48 treatment: 30.2% vs 15.1% ($p < 0.001$). Similarly, the fraction of random terminations in the U96 treatment is significantly higher than that in the M96 treatment: 34.4% vs 22.4% ($p = 0.001$). The qualitative differences hold even after conditioning on groups facing a delay at least once, or controlling for the number of bargaining rounds. In other words, players in the Unanimity treatments delay more often despite having been particularly unlucky and experienced a higher likelihood of early termination. We refer the reader to Appendix F where we use these random termination fractions to explain the differences in average total earnings across treatments.

with the U48 treatment, 96% versus 57%, and this difference is statistically significant ($p < 0.001$). Similar behavior is observed in the 96 treatment, in which 97% of equal split three-person coalitions splitting the small budget are accepted in the M96 treatment compared with only 35% in the U96 ($p < 0.001$). These results are even more striking given that these three-way equal split proposals of small budgets are almost always accepted in *both* voting rules in the 24 treatment (99% in M24 and 97% in U24 with $p = 0.398$).

Result 1: *Unanimity committees are more likely than majority committees to delay and attempt to reach large budgets, both when the unanimity rule is predicted to lead to more delays, and when both rules should lead to identical levels of delays. As a result, large budgets are implemented more often under the unanimity rule than under the majority rule. When delays happen in the majority committees, they primarily occur because proposers decide to forgo the current stage and wait for the next stage. In the unanimity committees, in addition to proposers delaying in anticipation of a larger budget (and doing it more often, weakly speaking, than under the majority rule), group members also often strike down the inefficient small-budget allocations at a significantly higher rate than under the majority rule (both statistically and in magnitude) leading to more efficient delays. These results are robust to controlling for proposal types.*

4.2 Distribution of Resources within a Committee

We now turn to the question of how committees distribute resources among members conditional on the budget size. In this section we focus on passed proposals, or in other words, the final payoffs of committee members.

Table 2 shows the frequencies of passed coalition types and the corresponding shares of the proposers depending on the size of the final budget appropriated. When committees require a unanimous vote to pass a proposal, irrespective of the budget size, proposers include all three members in the coalition and divide the resources equally among them in all but a few instances (see the last three rows of Table 2). However, when only a simple majority is enough to pass a proposal, both two-person and three-person coalitions are frequent. Moreover, many of the final allocations are equal splits within the coalitions, with the fraction of equal split being generally higher in the three- than in the two-person coalitions.[27,28] Tables 10 and 11 in the Appendix present frequencies of coalition types in submitted proposals for small budgets and their likelihood of passing, i.e., obtaining the required number of votes. These tables show that both two-person and three-person coalitions are commonly proposed in the M48 and M96 treatments.[29] Conditional on the

[27] The p-values on Probit regressions are 0.039, 0.015, and 0.320 in the M24, M48, and M96 treatments, respectively.

[28] Generally speaking, the results from the U24 and M24 treatments are aligned with past work on the topic. See Miller and Vanberg (2013), Agranov and Tergiman (2014) and Agranov and Tergiman (2019) for example.

[29] Previous experimental work on the Baron-Ferejohn bargaining model suggest that the presence of all-

Table 2: Distribution of resources within a coalition

	Small Budget Appropriated					Large Budget Appropriated				
	Two person		Three person		Proposer's	Two person		Three person		Proposer's
	freq	eq split	freq	eq split	share (av)	freq	eq split	freq	eq split	share (av)
M24	44%	48%	56%	68%	10.7	.	.	.	.	.
M48	57%	66%	43%	90%	11.0	39%	53%	61%	100%	19.5
M96	44%	50%	56%	71%	10.4	50%	53%	50%	74%	42.8
U24	0%	.	100%	92%	8.1	.	.	.	.	.
U48	0%	.	100%	93%	8.1	0%	.	100%	88%	16.2
U96	0%	.	100%	100%	8.0	0%	.	100%	97%	32.2

Notes: The table shows data for only proposals that passed, distinguishing between two-person and three-person coalitions. For each coalition size, we list the frequency of observing it and how often these coalitions divide resources exactly equally between its members.

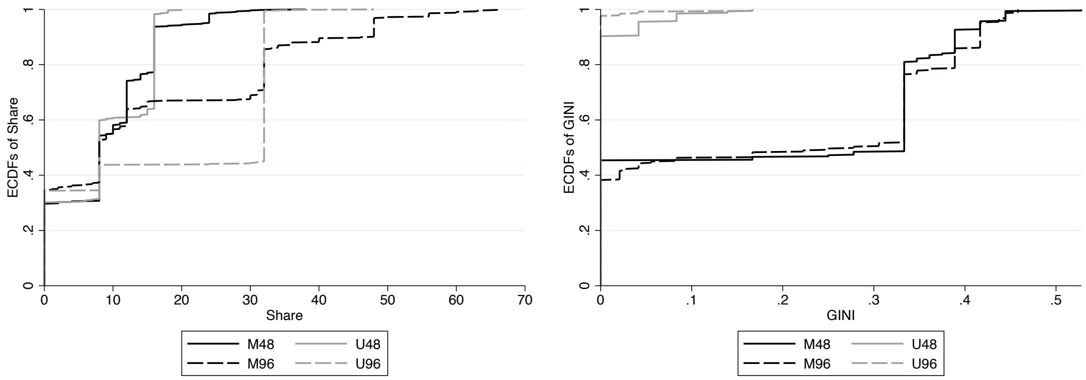
coalition size, some proposals feature equal splits, while others unequal split of resources. However, for each coalition size, equal split proposals have a higher chance of passing compared to unequal ones.

The prominence of all-inclusive coalitions with large shares to all three members in the M48 treatment explains in part why committees in this treatment are willing to delay until they reach the large budget despite the theoretical prediction that they should appropriate the small budget in the first bargaining round. Indeed, the theory predicts that only two-person coalitions should be observed in this treatment, which makes waiting risky, as one never knows whether one will be included in the future coalition or not. This uncertainty is the main difference between the unanimity and the Majority treatments. Contrary to these predictions, since in our data more than 60% of all coalitions are all-inclusive and in their majority divide shares in three equal parts among members of the majority committee, waiting for the big budget becomes less risky. Put differently, the presence and the frequency of all-inclusive coalitions partially mitigates the uncertainty that members face in the majority committees but not in the unanimity ones. As a result, in the 48 treatment, the empirical efficiency of majority committees is higher than theoretically predicted.

Figure 3 complements Table 2 by depicting the empirical CDFs of members' payoffs (Panel (A)) and the empirical CDFs of the Gini coefficients (Panel (B)) in the 48 and the 96 treatments. For a fixed size of the future large budget (48 or 96), the majority committees have much more variation in payoff distributions across committee members compared with the unanimity committees. This echoes the results presented in Table 2, in which we show that majority committees feature both two- and three-person coalitions with either equal or unequal distribution of resources conditional on the coalition size, while the

inclusive grand coalitions may be due to the understanding that proposers of rejected allocations face a lower continuation value than non-proposers (see Agranov et al. (2020), Baranski and Morton (2021), and Lee and Sethi (2021))

Figure 3: Final payoffs of players



Panel (A): Empirical CDFs of Payoffs

Panel (B): Empirical CDFs of GINI coefficients

Notes: Panel (A) depicts the CDFs of players' payoffs in each treatment, where zero payoff is associated with the game termination or a zero share in the MWC. Panel (B) depicts empirical CDF's of GINI coefficients. Here we focus on games that did not terminate due to discounting.

unanimity committees naturally result in only three-person coalitions with mostly equal splits among members. The voting rule also has a strong effect on the inequality of payoffs within a committee, as the Gini coefficients show. In both 48 and 96 treatments, members of unanimity committees all earn the same payoffs, while those in the majority committees experience different payoffs, most of which come from two-person coalitions as described in Table 2.

Result 2: *Unanimity committees divide resources equally among their members irrespective of the budget size. Majority committees feature both two-person and three-person coalitions and proposals often result in an equal split of resources within a coalition. The prominence of three-person equal split coalitions in the M48 treatment reduces the endogenous risk of being excluded in future winning coalitions which otherwise is present in two-person coalitions both empirically and in theory. This reduction in endogenous risk provides a behavioral explanation for the delays observed in the M48 treatment.*

4.3 Communication and Bargaining Dynamics.

For each session, two independent coders read through all the conversations. At the bargaining round level they identified whether a conversation pertained to one of eleven different content categories in the Majority treatments, and one of eight different content categories in the Unanimity treatments.[30] Agreement across our coders was very high,

[30] These categories are described in Appendix E. There are more categories in the Majority treatment because we also recorded whether there were conversations related to minimum winning coalitions and the division

ranging from 80.5% to 99.5%, depending on the question and the treatment.[31] In our analyses below, a conversation is counted as having broached a particular topic only if both coders agreed that such content occurred.

The vast majority of groups engage in meaningful conversations at least once over the course of each bargaining game: 97.9%, 92.7%, 96.3% and 91.7% of groups for the M48, M96, U48, and U96 treatments, respectively.[32]

Since the main feature of our setup is the uncertainty about the size of the future budget, we focus on it and explore the link between the content of the chats and bargaining outcomes.[33] Specifically, we ask whether subjects discuss the potential future budget size and the risk associated with delaying, and whether these conversations affect the frequency of delays across voting treatments.

Table 3: Topics of conversation across treatments

	Majority	Unanimity	Majority vs Unanimity
48 treatment			
Size of future budget	70.6%	78.2%	$p = 0.423$
Support for delaying	57.2%	59.0%	$p = 0.894$
Talk about equality/fairness	49.2%	74.3%	$p = 0.012$
Threats to vote no if not equal	2.1%	6.7%	$p = 0.228$
Threats to vote no if small budget	0.0%	1.7%	n.a.
Risk of game termination	6.3%	41.4%	$p < 0.001$
Talk about equality within winning coalition	72.2%	n.a.	n.a.
Talk about unequal split within winning coalition	23.7%	n.a.	n.a.
96 treatment			
Size of future budget	88.6%	82.7%	$p = 0.431$
Support for delaying	75.8%	75.5%	$p = 0.971$
Talk about equality/fairness	43.8%	54.4%	$p = 0.369$
Threats to vote no if not equal	6.9%	11.3%	$p = 0.474$
Threats to vote no if small budget	6.2%	9.3%	$p = 0.580$
Risk of game termination	13.3%	20.3%	$p = 0.229$
Talk about equality within winning coalition	63.8%	n.a.	n.a.
Talk about unequal split within winning coalition	53.9%	n.a.	n.a.

Notes: The table reports the fraction of chats that contain discussions of topics specified in each row. We use 'n/a' indicates chat categories which are not relevant to the unanimity voting rule. The last column depicts the p-values comparing the frequencies between the majority and the unanimity voting rules for each row.

Table 3 shows the fraction of groups which engage in various topics of conversation. There are many similarities in how often topics are discussed across treatments. For the 48

of resources within those. The coders were not privy to our research questions and their payment depended on how well their coding matched up with each other.

[31] Further, the average Cohen Kappa score across all sessions was 0.78 for the majority sessions and 0.73 for the unanimity ones.

[32] A conversation is meaningful if group members discuss the game or anything pertaining to how to play the game.

[33] We refer the reader to the survey of Agranov (2022) for a detailed discussion of the effects of communication in experimental bargaining games with majority and unanimity voting rules.

treatments, the main difference in chat content between two voting rules is how frequently subjects discuss equality and fairness issues as well as the risk of game termination; both of these topics are more frequently raised in groups that use the unanimity voting rule than those that use the majority voting rule. At the same time, in the 96 treatments, we observe no significant differences in the topics of discussion. Nevertheless, the interesting question is whether conversations about specific game features explain variation in delays across voting rules, which is what we explore next.[34]

Table 4: Impact of chats on delay

	Delay in 48 treatment	Delay in 96 treatment
Constant	0.35 (0.31)	1.58** (0.40)
Majority voting rule	-1.28** (0.44)	-1.21** (0.45)
Chat about risk of game termination	0.19 (0.21)	0.28 (0.45)
Majority x Chat about risk of termination	-0.15 (0.46)	-1.36** (0.53)
Chat about equality	-0.38* (0.26)	-0.15 (0.34)
Majority x Chat about equality	1.04** (0.35)	0.42 (0.43)
Session dummies	yes	yes
Number of observations	329	297
Number of participants	94	94
Pseudo R-sq	0.1037	0.1434

Notes: The table presents the coefficients from panel probit regressions of delaying on treatment dummies, conversation topics and their interactions with voting rules. Standard errors are clustered at the participant level. To control for interdependencies of observations that come from the same session, we include session fixed effects. Observations are restricted to the second half of the bargaining games (and the first bargaining round within those).** and * indicate $p < 0.05$ and $p < 0.10$, respectively.

Table 4 presents regression analyses that explore the link between the content of conversations and delay frequencies across voting rules, separately for 48 and 96 treatments. These regressions show a few interesting patterns. First, regardless of the distribution of future surplus, conversations that precede formal bargaining correlate with the frequency of delays in the Majority treatments but not in the Unanimity treatment.[35]

Second, different types of conversations have different effects on delay frequencies depending on the distribution of future surplus. In the M48 treatment, proposers delay significantly more often when group members discuss equality and fairness topics. This

[34] We note also that the content of conversations changes as one moves from the 48 to 96 treatments, conditional on a voting rule. (See Table 12 in Appendix F.) In particular, for the majority voting rule, increase in potential future budget is associated with more talks about the future budget ($p = 0.001$), delaying ($p = 0.093$), risk of game termination ($p = 0.025$), and splitting resources unequally within minimum winning coalition ($p = 0.025$). Similarly, for the unanimity voting rule, an increase in potential future budget is associated with more conversations about delays, even though the increase is not statistically significant ($p = 0.201$) and fewer conversations about both the risk of game termination ($p = 0.005$) and equality within a group ($p = 0.017$).

[35] This can be seen by the statistically significant interaction effects between an indicator for the Majority treatment and the content of the conversation.

effect is consistent with the intuition that chats about equality reduce the risk associated with being excluded from the minimum winning coalition in the Majority treatment. This provides group members 'reassurance' that they will benefit from future budgets and results in more delays in anticipation of a large budget. The same reassurance effect is not present in the Unanimity treatment, since the vast majority of all allocations feature three-way splits of the resources. This may explain why discussions about equality have very little effect on proposers' behavior in the Unanimity treatment.

At the same time, in the M96 treatment, proposers who have been privy to discussions about the risk of game termination delay less often than those who have not discussed this issue. Interestingly, this effect is only present in the Majority treatment, despite the fact that the same risk is present in the Unanimity treatment.

Result 3: *Group members engage in meaningful conversations before making bargaining decisions and discuss both issues of fairness and equality among committee members as well as the risk of game termination due to delays. Conversations' content is only significantly correlated with proposers' behavior in the Majority treatments. In the M48 treatment, conversations about equality may reduce the risk of being excluded from a future coalition, and, as a result, may generate more delays. Contrary to that, in the M96 treatment, conversations about game termination are associated with less delays.*

5 Concluding Remarks

In this paper we experimentally explore the performance of majority and unanimity voting rules in multilateral bargaining environments with uncertainty. In our setting, the budget to be allocated changes stochastically over time. Because the size of a future budget can be large relative to the present one, delays can be efficient even under complete information with impatient bargainers. However, whether it is an equilibrium to wait for larger budget to be divided depends on the voting rule: if it is worth delaying the decision under the majority rule, it is also true in the unanimity rule, but the opposite direction does not hold. Furthermore, under the unanimity rule, the outcome is always efficient. In other words, the unanimity rule achieves weakly higher efficiency levels compared with the majority rule.

Using the level of efficient delays as the criterion along which we rank the two voting rules, we find that the unanimity rule leads to better outcomes. Indeed, efficient delays occur more frequently under the unanimity rule than under the majority rule, even when the theory predicts that both rules should lead to equally efficient outcomes. The difference in the voting rules is especially large in magnitude when reaching agreements too soon entails large efficiency losses. Under the majority voting rule, both current proposers and coalition partners vote in favor of small budget proposals, perhaps out of fear of being excluded from the coalition in the future. Indeed, under the majority rule, minimum winning coalitions do not include all the committee members and our results highlight its failure to lead to efficient outcomes even when the potential future budget is so large that efficiency is theoretically predicted. On the contrary, under the unanimity voting rule, this fear is absent as no proposal can pass without unanimous agreement, which guarantees that all members will be allocated a positive share of the surplus.

While the unanimity rule has been viewed with suspicion because it gives “a minority a negative upon the majority" (Hamilton, The Federalist 22), our results show little support for the hypothesis that under unanimity a minority imposes costly delays on the majority.

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A Effects of risk attitudes

Suppose now the payoff of a committee member from receiving a surplus of x is given by $u(x)$ where u is a strictly increasing concave function with $u(0) = 0$. As before, let v_q denote the continuation payoff of a committee member under voting rule q. Thus, to induce acceptance from another committee member, the proposer needs to offer a surplus of $u^{-1}(\delta v_q)$ to that committee member. The proposer needs $(q-1)$ votes in addition to her vote for the proposal to be accepted. Thus, if the proposer makes an offer that will be accepted when the budget is y, she receives a share of $y-(q-1)u^{-1}(\delta v_q)$. If $u(y-(q-1)u^{-1}(\delta v_q)) > \delta v_q$, then the proposer is strictly better of making a proposal that will be accepted. If $u(y-(q-1)u^{-1}(\delta v_q)) < \delta v_q$, then the proposer is strictly better of delaying (or making an offer that will not be accepted, which is payoff equivalent). Let $\alpha_{y,q}(v) \in [0,1]$ denote the probability that the proposer makes an offer that will be accepted when the budget is y and the continuation payoff is v. From the discussion above, we have

$$\alpha_{y,q}(v) = \begin{cases} 1 & \text{if } y > qu^{-1}(\delta v) \\ 0 & \text{if } y < qu^{-1}(\delta v). \end{cases} \tag{2}$$

When there is a delay, all players receive their continuation payoffs. When there is an agreement, conditional on not being the proposer each player receive their discounted continuation payoff with the same probability. In equilibrium, the continuation payoff v_q must be consistent with the strategies. Thus, we have

$$v_q = \sum_y p_y \left[\frac{1}{n}\max\left\{u(y-(q-1)u^{-1}(\delta v_q)), \delta v_q\right\} + \frac{n-1}{n}\left(\alpha_{y,q}(v_q)\frac{q-1}{n-1} + (1-\alpha_{y,q}(v_q))\right)\delta v_q\right] \tag{3}$$

where p_y is the probability that the budget size is y.

As before, assume there are two possible budget sizes, i.e. $y \in \{\underline{y}, \bar{y}\}$ with $\bar{y} > \underline{y}$, $p_{\underline{y}} = p$ and $p_{\bar{y}} = 1-p$. It is straightforward to see that there can be no equilibrium in which there is a delay with strictly positive probability when the budget size is large, i.e. there cannot be any equilibrium with $\alpha_{\bar{y},q} < 0$. If it were the case, $u(\bar{y}-(q-1)u^{-1}(\delta v_q)) \leq \delta v_q$ and $\alpha_{\underline{y},q} = 1$. Substituting in (3), we obtain $v_q = 0$. But since u is strictly increasing, we obtain a contradiction to (2). In light of this observation, equation (3) can be written as

$$\begin{aligned} v_q = p&\left[\frac{1}{n}\max\left\{u(\underline{y}-(q-1)u^{-1}(\delta v_q)), \delta v_q\right\} + \frac{n-1}{n}\left(\alpha_{\underline{y},q}(v_q)\frac{q-1}{n-1} + (1-\alpha_{\underline{y},q}(v_q))\right)\delta v_q\right] \\ &+(1-p)\left[\frac{1}{n}u(\bar{y}-(q-1)u^{-1}(\delta v_q)) + \frac{q-1}{n}\delta v_q\right]. \end{aligned} \tag{4}$$

But notice that $\alpha_{\underline{y},q}(.)$ can take any value between 0 and 1 when the proposer is indifferent between delaying and making an offer that will be accepted when the small budget is realized. As a consequence, the operator whose fixed points characterize the equilibrium continuation payoffs is a correspondence, not a function. Intuitively, except under unanimity rule, whether the proposer delays or makes an offer that will be accepted makes a difference in the continuation payoff of the proposers since those who are excluded from the winning coalition receive a payoff of zero in the event of an agreement but receive their continuation payoffs when there is a delay. Define the functions f_q and g_q as

$$f_q(v,\alpha) = \frac{1}{n}\max\left\{u(\underline{y}-(q-1)u^{-1}(\delta v)),\delta v\right\} + \frac{n-1}{n}\left(\alpha\frac{q-1}{n-1}+(1-\alpha)\right)\delta v$$

and

$$g_q(v) = \frac{1}{n}u(\bar{y}-(q-1)u^{-1}(\delta v)) + \frac{q-1}{n}\delta v,$$

and define the correspondence Γ as

$$\Gamma(v) = \left\{v' \in \mathbb{R} : \exists \alpha \in [0,1] \text{ such that } \alpha = \alpha_{\underline{y},q}(v) \text{ and } v' = pf_q(v,\alpha)+(1-p)g_q(v)\right\}. \quad (5)$$

It follows that v_q is an equilibrium continuation payoff if and only if $v_q \in \Gamma(v_q)$.[36]

Since $u(0) = 0$ and u is strictly increasing, equilibrium continuation payoffs must be strictly positive: $v_q > 0$ for all q. Otherwise, if $v_q = 0$, then the right hand side of (4) is strictly positive while the left-hand side is zero.

The existence of equilibrium can be established using Kakutani's Fixed Point Theorem along the lines of Theorem 3 in Eraslan and Merlo (2002) which proves existence when the players are risk neutral. Eraslan and Merlo (2002) also show that there may be multiple equilibria under majority rule but equilibrium is unique under unanimity rule when the players are risk neutral (Merlo and Wilson (1998)). Once risk aversion is allowed, the equilibrium payoffs need not be unique even under unanimity rule however. Merlo and Wilson (1995) show that the equilibrium payoffs are unique, provided that the utility functions satisfy a contraction property which is trivially satisfied when players are risk-neutral or when the cake process is deterministic. Given the difficulty of verifying this condition when players are risk-averse and the cake process is stochastic, Evdokimov (2020) provides another sufficient condition that is easy to verify. In particular, he shows that this sufficient condition is satisfied when the utility functions are isoelastic with a strictly positive minimum bound.

Even when the equilibrium is not unique, our main result is robust:

Proposition 1. *If v_q is an equilibrium continuation payoff for the q-quota game, then there exists an equilibrium continuation payoff v_n for the unanimity game such that $v_n \geq v_q$.*

[36] The arguments above establish that if $v_q \in \Gamma(v_q)$, then v_q is a stationary subgame perfect continuation payoff. The converse follows using the one-shot deviation principle.

Proposition 1 shows that equilibrium continuation payoffs are weakly higher under unanimity rule in the sense that for any equilibrium in the q-quote game, there exists an equilibrium in the unanimity game with a higher equilibrium continuation payoff. One implication of this is that the unanimity rule is (weakly) more efficient. Also, note that any player (including the proposer) votes to accept the proposal only if she receives at least her continuation payoff. Thus, a second implication of the proposition is that, if there is an equilibrium with delay under majority rule, there is also an equilibrium with delay under unanimity rule but not vice versa.

Proof of Proposition 1: We use the following lemma throughout the proof.

Lemma 1. *If $b > \max\{c, a\} > 0$, then $\frac{u(b)-u(c)}{b-c} < \frac{u(a)}{a}$.*

Proof. Since u is a strictly increasing concave function with $u(0) = 0$, we have $u(b)/b < u(a)/a$. Likewise we have $u(b)/b < u(c)/c$. The latter inequality implies that $\frac{u(b)-u(c)}{b-c} < \frac{u(b}{b}$. ||

Since the equilibrium continuation payoffs must be strictly positive, it suffices to show that $f_n(v,\alpha) \geq f_q(v,\alpha)$ for any $v > 0$ and $\alpha \in [0,1]$ with $\alpha = \alpha_{\underline{y},q}(v)$ and $g_n(v) \geq g_q(v)$ for any $v > 0$. Note that $f_n(v,\alpha) \geq f_q(v,\alpha)$ if and only if

$$\alpha(n-q)\delta v \geq \max\left\{u(\underline{y}-(q-1)u^{-1}(\delta v)), \delta v\right\} - \max\left\{u(\underline{y}-(n-1)u^{-1}(\delta v)), \delta v\right\}. \quad (6)$$

There are three cases to consider:

Case 1: $u(\underline{y}-(n-1)u^{-1}(\delta v)) \geq \delta v$. Then, since $v > 0$ and u is strictly increasing, we have $u(\underline{y}-(q-1)u^{-1}(\delta v)) > \delta v$, $\alpha = 1$ and (6) reduces to

$$(n-q)\delta v \geq u(\underline{y}-(q-1)u^{-1}(\delta v)) - u(\underline{y}-(n-1)u^{-1}(\delta v)).$$

Let $a = u^{-1}(\delta v)$, $b = \underline{y}-(q-1)a$, and $c = \underline{y}-(n-1)a$. Then the above inequality is equivalent to $u(a)/a \geq [u(b)-u(c)]/(b-c)$. It is satisfied by Lemma 1.

Case 2: $u(\underline{y}-(q-1)u^{-1}(\delta v)) < \delta v$. Then $\alpha = 0$ and (6) is trivially satisfied.

Case 3: $u(\underline{y}-(n-1)u^{-1}(\delta v)) < \delta v \leq u(\underline{y}-(q-1)u^{-1}(\delta v))$. Then (6) reduces to

$$\alpha(n-q)\delta v \geq u(\underline{y}-(q-1)u^{-1}(\delta v)) - \delta v.$$

If the right hand side is zero, then the inequality is trivially satisfied. Otherwise, α must be equal to 1 and the inequality is satisfied since

$$u(\underline{y}-(q-1)u^{-1}(\delta v)) - \delta v < u(\underline{y}-(q-1)u^{-1}(\delta v)) - u(\underline{y}-(n-1)u^{-1}(\delta v)) \leq (n-q)\delta v$$

where the first inequality is satisfied by the conditions defining Case 3, and the second inequality is satisfied by Lemma 1 by choosing a, b and c as in Case 1.

It remains to show that $g_n(v) \geq g_q(v)$ for any $v > 0$. The proof of this is identical to the proof of Case 1 above. ||

B Instructions for U96 treatment

This is an experiment in the economics of decision making. The instructions are simple, and if you follow them carefully and make good decisions you may earn a CONSIDERABLE AMOUNT OF MONEY which will be PAID TO YOU IN CASH at the end of the experiment. In addition to what you will earn in the experiment, you will get a $12 participation fee if you complete the experiment.

In this experiment you will play 12 Matches. At the start of each Match you will be randomly divided into groups of 3 members each. In any Match you will not know the identity of the subjects you are matched with and your group-members will not know your identity. At the start of each Match, each member of the group will be assigned an ID number (from 1 to 3), which is displayed on the top of the screen. Since ID numbers will be randomly assigned prior to the start of each Match, all members are likely to have their ID numbers vary between Matches. In addition, since you will be randomly re-matched to form new groups of 3 at the start of each Match, it is impossible to identify subjects using their ID numbers.

Each Match consists of one or more Rounds. Your ID number will stay the same during all the Rounds of a Match. However, once the Match is over, you will be randomly re-matched to form new groups of 3 members each and you will be assigned a (potentially) NEW ID. Please make sure you know your ID number when making your decisions.

In each Match, each group will decide how to split a sum of money (the "budget"). One of the 3 members in your group will be randomly chosen to be the proposer. Each member has the same chance of being selected to be the proposer. The proposer can take one of two actions. The proposer can either submit an "allocation proposal" of how to split the budget among the 3 members, or the proposer can hit a "delay" button. In the first Round of a Match, the budget available to be split will be 24 dollars. We will describe the budget available in other Rounds as well as what happens if the proposer chooses to hit the "delay" button shortly.

Suppose the proposer chooses to make an allocation proposal. After the allocation proposal is submitted, it will be posted on your computer screens with the allocation to you and the other members clearly indicated. You will then have to decide whether to accept or reject the allocation proposal. Allocation proposals will be voted up or down (accepted or rejected) by unanimity rule. That is, if all three members approve the allocation proposal, the match ends and the earnings from this match are given by the approved allocation proposal. If at least one of three members rejects the allocation proposal, it is voted down.

If the allocation proposal is voted down (that is at least one member of your group votes against it), then one of two things can happen:

- With 20% chance the Match ends and all members of your group will earn 0 dollars for this Match.
- With 80% chance you move on to the next Round of this Match. In this case, one of the 3 members in your group will be randomly chosen to be the proposer for this round. After the proposer has been chosen, he will have the choice between hitting the "delay" button, or making an allocation proposal on how to split the budget. However, budget will either be 24 dollars or 96 dollars, with 50/50 chance of each. In other words, there is 50% chance that the proposer in Round 2 will be dividing 24 dollars between group members and 50% chance that the proposer in Round 2 will be dividing 96 dollars. The proposer in Round 2 and all group members will know the size of the budget available for division before making any decisions. If the proposer submits an allocation proposal and it is voted down, then again with 20% chance the Match ends and all members of your group will earn 0 dollars for this Match, and with 80% chance you will move on to the next Round of this Match. If the group moves on to the next Round, then, again, one of the 3 group-members will be randomly chosen to either hit the "delay" button, or make an allocation proposal on how to split budget among the 3 members with each member equally likely to be chosen as a proposer. The budget size will either be 24 dollars or 96 dollars, with 50/50 chance of each. In fact, for all Rounds after the first Round, the budget will either be 24 dollars or 96 dollars, with 50/50 chance of each. This process repeats itself until a Match ends, either because of the 20% chance it ends between Rounds, or because an allocation proposal has passed.

Recall that instead of submitting an allocation proposal, a proposer can choose to "delay." If a proposer chooses "delay", then the group goes through the same stages as if a proposal is rejected. That is, if a proposer chooses "delay" then with 20% chance the Match ends and all members receive 0 dollars for this Match. With 80% chance the group moves on to the next Round within the Match, one member of your group is randomly chosen to be the next proposer and the amount of money to split is either 24 dollars or 96 dollars with 50/50 chance of each etc.

To summarize, in any given round, if an allocation proposal is rejected, or if the proposer chooses "delay," then with 20% chance the Match ends and members of the group earn 0 dollars for this Match. With 80% chance a new Round starts, one member of your group is randomly chosen to be the proposer and the budget to be split is either 24 or 96 dollars, each with 50/50 chance. This continues until a Match ends, either because of the 20% chance it ends between rounds, or because an allocation proposal passes.

Communication: In each Round, after one voter is selected to propose a split but before he/she submits his/her allocation proposal, members of a group will have the opportunity to communicate with each other using chat boxes. The communication is structured as follows. On the top of the screen, each member of the group will be told her ID number. You will also know the ID number of the member who is currently selected to make a proposal. Below you will see three boxes, in which you will see all messages sent to either all members of your group or to you personally. You will not see the chat messages that are sent privately to other members. If you would like to send the message that will be delivered to the entire group, please type your message underneath the first chat box and hit SEND. If you would like to send a private member of your group, please type your message underneath the chat box that indicates the chat with that member and hit SEND.

There is a 20 second period of time at the start of each Round during which the proposer cannot submit his/her allocation or choose delay. During this time, any person in the group can choose to use the chat function on his/her screen. The chat option will be available as soon as the Round starts, and for at least 20 seconds. The chat option will become unavailable when the proposer either submits his allocation proposal or hits delay. You are not to communicate in any other way with any other subject while the experiment is in progress. This is important to the validity of the study.

Remember that in each Match subjects are randomly matched into groups and ID numbers of the group-members are randomly assigned. Thus, while your ID number stays the same during all the Rounds in a Match, your ID number is likely to vary from Match to Match, and therefore it is impossible to identify your group-members using your ID number.

At the conclusion of the experiment we will randomly select one of the 12 Matches to count for payment. The $12 participation fee will be added to your earnings in that randomly selected Match.

Review. Let's summarize the main points:

1. The experiment will consist of 12 Matches. There may be several Rounds in each Match.

2. Prior to each Match, you will be randomly divided into groups of 3 members each. Each subject in a group will be assigned an ID number.

3. At the start of each Match, in Round 1, one subject in your group will be randomly selected to be a proposer in this Round. The proposer can choose either to submit

an allocation proposal or to delay. The size of the budget in Round 1 is 24 dollars. Before the proposer chooses his/her action, all members of the group can use the chat box to communicate with each other. You may send public messages that will be delivered to all members of your group as well private messages that will be delivered to specific members of your group.

4. Proposals to each member must be greater than or equal to 0 dollars.

5. If all 3 members accept the allocation proposal, the Match ends.

6. If one or more members reject the allocation proposal, or if the proposer chose to hit the "delay" button, then one of two things can happen:

   - With 20% chance the Match ends and all members of the group earn 0 dollars.
   - With 80% chance the Match continues. In this case, one member of the group will be randomly selected to be the proposer in Round 2. The budget available for division in Round 2 will be either 24 or 96 dollars, each with 50/50 chance. The proposer can choose either to delay or to submit an allocation proposal, etc...

7. The process in step 6 repeats itself until a Match is over, either because of the 20% rule, or because an allocation proposal has passed. At the end of the experiment, the computer will randomly select one of the 12 Matches you played, and your earnings in this selected match will be paid to you in cash together with the participation fee of $12.

Are there any questions?

C Screenshots for U96 treatment

Before starting the experiment, we will show you a few screenshots so that you can familiarize yourself with the interface. After that, we will start the experiment, in which you will play 12 Matches. Please note that the numbers and decisions from the screenshots below are just examples and are not meant to indicate what you should do in this experiment.

The screenshot in Figure 4 is a typical screenshot that proposers see.

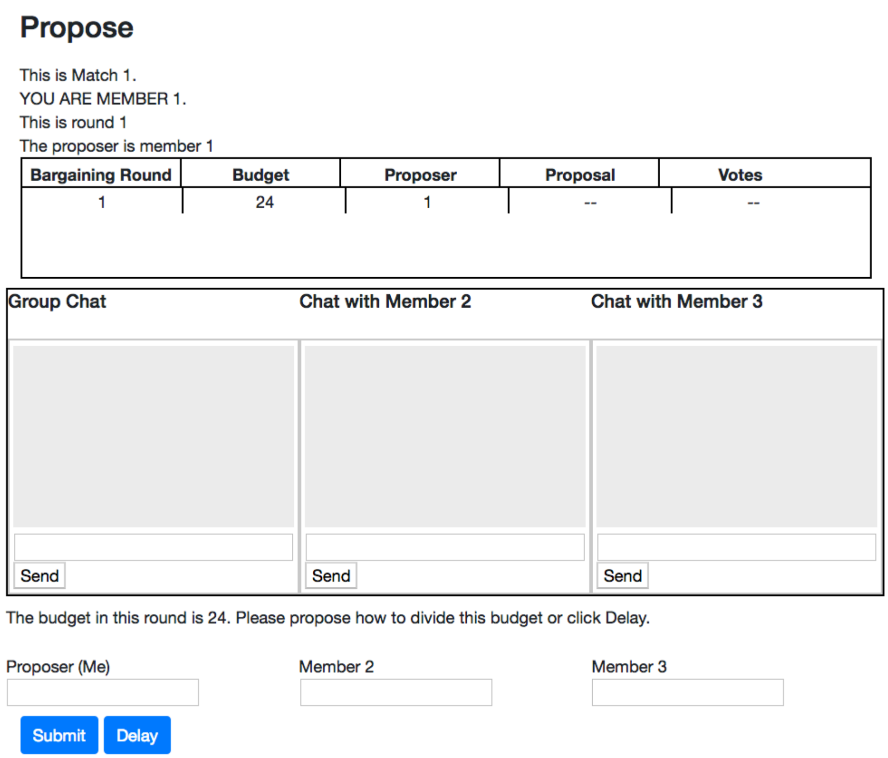


FIGURE 4: Screenshot of the Proposer

Please take a look at the bottom part of the screen depicted in Figure 5:

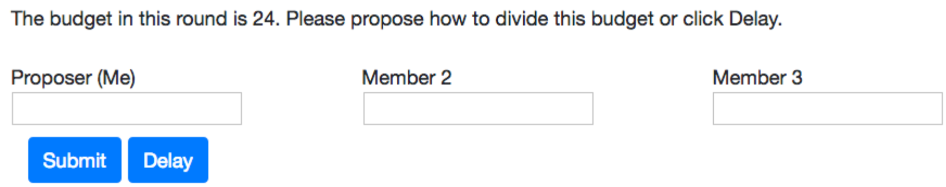


Figure 5: Bottom Part of Screenshot of the Proposer

Notice that there are three boxes labeled with the ID numbers of the members. This is where the proposer writes his/her allocation, corresponding to the amounts to members 1, 2 and 3, respectively. The proposer is the only member of the group who can choose to submit an allocation or “delay”. When you are done choosing an allocation, hit submit. If you choose to “delay”, hit Delay.

Let’s look at the rest of the screen. On the top left side you will be able to see the history of the current Match depicted in Figure 6:

Bargaining Round	Budget	Proposer	Proposal	Votes
1	24	1	--	--

Figure 6: History of Current Match

Take a moment to look at that. It will show you the budget size for each Round of the Match, the ID number of the proposer for that Round, and once the proposal has been submitted votes have taken place you will see those too. If the proposer chose to “delay” then you will see “DELAY” in the space under “proposal.”

Below the Match-history box, you will see the chat boxes depicted in Figure 7. The left chat box shows the group conversations, while the middle and the right box show the private conversations with the other two members. Below each chat box are the boxes you will use to send messages if you choose to do so.

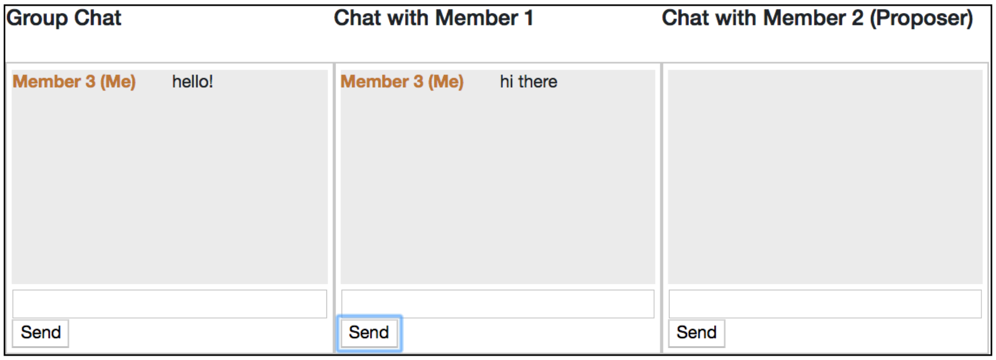


Figure 7: Chat Box

Below in Figure 8 is a screenshot of the non-proposers. It is identical to the proposer screens except for the right hand side since only proposer can choose to submit an allocation or "delay."

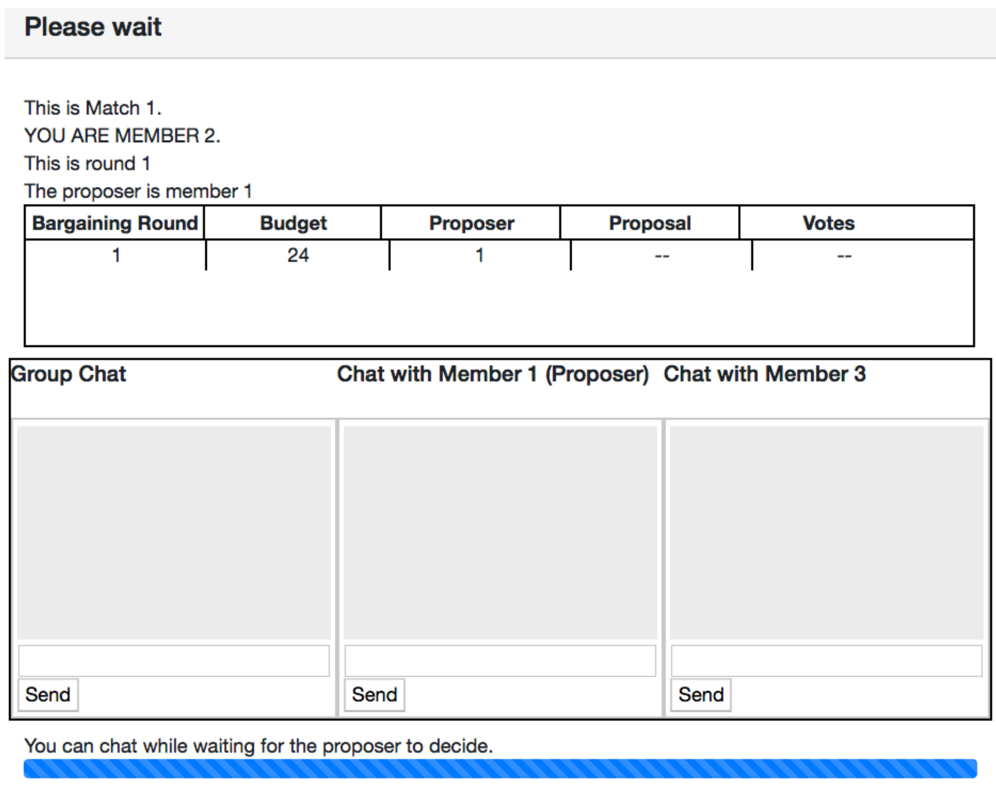


Figure 8: Screenshot of the Non-Proposer

Below is another example of a within Match history (see Figure 9). In this particular example, the proposer in Round 1 was member 1 and he/she chose to Delay. The match continued to the next round. In Round 2, the proposer was member 2, the budget was 96 dollars and the proposer chose to submit an allocation according to which member 1 gets 2 dollars, she (member 2) gets 50 dollars and member 3 gets 44 dollars. The proposal was rejected since it didn't not receive all 3 yes votes. The match continued to the next round. In Round 3, member 2 was again randomly chosen to be the proposer and she submitted another allocation according to which member 1 gets 90 dollars, member 2 (herself) gets 6 dollars and member 3 gets 0 dollars. Notice that in this table you can always see the size of the budget as well as who was proposer in every round, what action they took (propose an allocation or "delay") and the results of the votes.

Bargaining Round	Budget	Proposer	Proposal	Votes
1	24	1	Delay	None
2	96	2	2 50 44	No Yes No
3	96	2	90 6 0	--

Figure 9: Match History

If a proposer submits an allocation, all members of the group see the screen like the one in Figure 10. The proposal is clearly indicated, and your payoff if the proposal is approved is highlighted in red. You can then vote yes or no to the proposal. Please note that the numbers here are just examples and are not meant to indicate what you should do in this experiment.

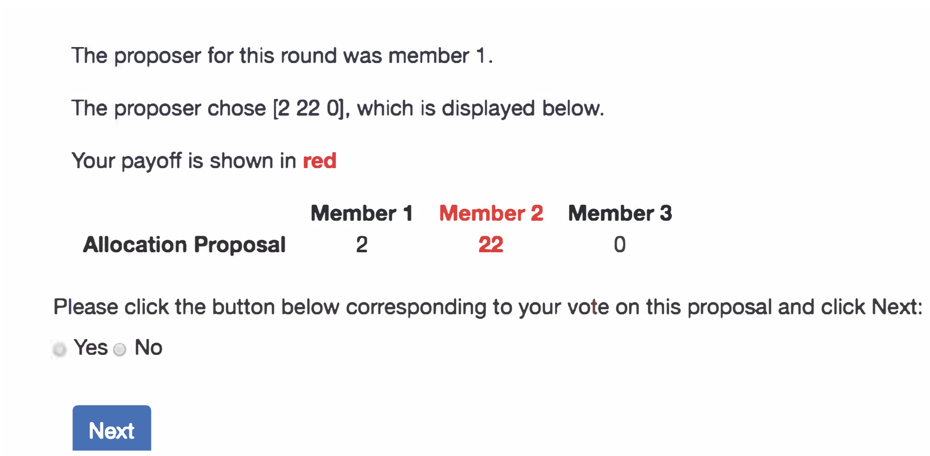


Figure 10: Voting Screen

After members vote all members see the screen like the one in Figure 11:

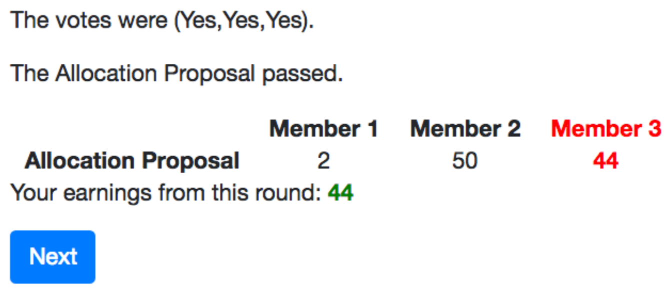


Figure 11: Summary of Votes

Your earnings are always highlighted in red. If the match randomly ends because of the 20% rule you, you will see the messages shown in Figure 12 on the right hand side of your screen.

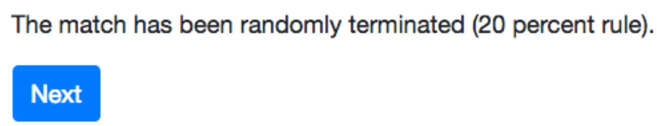


Figure 12: Termination Message

Are there any questions?

D Investment Tasks

Investment Task 1. You are endowed with 200 tokens (or \$2) that you can choose to keep or invest in a risky project. Tokens that are not invested in the risky project are yours to keep.

The risky project has 50% chance of success:

- If the project is successful, you will receive 2.5 times the amount you chose to invest.
- If the project is unsuccessful, you will lose the amount invested.

Please choose how many tokens you want to invest in the risky project. Note that you can pick any number between 0 and 200, including 0 or 200.

Investment Task 2. You are endowed with 200 tokens (or \$2) that you can choose to keep or invest in a risky project. Tokens that are not invested in the risky project are yours to keep.

The risky project has 40% chance of success:

- If the project is successful, you will receive 3 times the amount you chose to invest.
- If the project is unsuccessful, you will lose the amount invested.

Please choose how many tokens you want to invest in the risky project. Note that you can pick any number between 0 and 200, including 0 or 200.

In the experiment, one of the two investment tasks was randomly chosen to count for payment.

Table 5 presents summary statistics for decisions in Investment Tasks across treatments. There are no statistical differences across treatments in this game. We therefore reject that treatment differences are due to differences towards risk as measured in this game.

Table 5: Behavior in investment tasks across treatments.

	Investment Task 1		Investment Task 2	
Treatments	mean	median	mean (st dev)	median
M24	121.5	100	107.5	100
	($p = 0.544$)	($p = 1.00$)	($p = 0.983$)	($p = 1.000$)
U24	111.7	100	107.8	100
M48	125.4	100	100.8	100
	($p = 0.364$)	($p = 1.00$)	($p = 0.671$)	($p = 1.000$)
U48	113.5	100	108.1	100
M96	117.4	100	99.0	100
	($p = 0.593$)	($p = 1.00$)	($p = 0.252$)	($p = 1.000$)
U96	125.6	100	118.4	100

Notes: The p-values are the result of OLS and quantile regressions with clustering at the session level.

E Coding the free-form communication

For 48 and 96 treatments, the coders were asked to code conversations using the categories listed below. The last three categories are for Majority treatments only:

1. Is there any discussion relevant to the experiment (budget, how to split it, whether to delay or not, how often the game is terminated, what is fair, anything that happened in other rounds, clarifications on the experiment etc...)? Yes/No
2. Is there any talk about delay/big pie/big budget, anything about the fact that the budget can be "big"? Yes/No
3. Is there any talk risk of game being terminated? Yes/No

4. Is there any talk about equality and fairness among all group members? Yes/No
5. Are there threats to vote no if not equal division? Yes/No
6. Are there threats to vote no if small budget? Yes/No
7. Other threats? Yes/No
8. Is there any indication of support to wait for a big pie or delay? Yes/No
9. Is there a discussion of a minimum winning coalition, i.e., excluding one member and colluding among two members to divide the budget just among them? Yes/No
10. Is there a conversation about splitting budget equally between you and me? Yes/No
11. Is there a conversation about dividing resources unequally within minimum winning coalition? Yes/No

F Additional Analysis

Delays in first bargaining rounds only. Table 6 mirrors Table 1 in the main text, but focused only on the first stage of each game where the budget is small by design.

Table 6: Frequency of delays

	Majority	Unanimity	Maj vs Un
48 treatment			
Small budget	52% (n=192)	83% (n=192)	$p = 0.001$
Prediction	0%	100%	
96 treatment			
Small budget	76% (n=192)	96% (n=192)	$p < 0.001$
Prediction	100%	100%	

Notes: This table shows the total frequency of delays for small budgets at the group level in the first bargaining stage. This frequency encompasses cases in which the proposer chose to delay and those in which the proposal was rejected by the committee. The last column shows the p-values from regression analyses comparing across voting treatments for each row.

Total committee earnings. Table 7 show the predicted earnings and the average number of dollars that were distributed among committee members in each treatment with standard errors in parentheses.

Table 7: Predicted and observed total earnings of a committee, by treatment

	24 treatment	48 treatment	96 treatment	24 vs 48	48 vs 96
Predictions					
Majority	24	24	64		
Unanimity	24	32	64		
Experiment					
Majority	23.63 (0.24)	26.50 (0.82)	47.13 (0.69)	p = 0.008	p <0.001
Unanimity	22.75 (0.52)	26.13 (1.43)	56.25 (1.25)	p = 0.048	p <0.001
Majority vs Unanimity	$p = 0.143$	$p = 0.813$	$p < 0.001$		

Notes: We present the averages of total number of dollars appropriated by committees in expectation as well as in the experiment in each treatment. Robust standard errors are calculated based on regressions with clustering at the session level and presented in the parenthesis. The last line reports statistical tests comparing the two voting treatments obtained using regression analysis. The last two columns report statistical tests comparing the average surpluses in different treatment with the same voting rule.

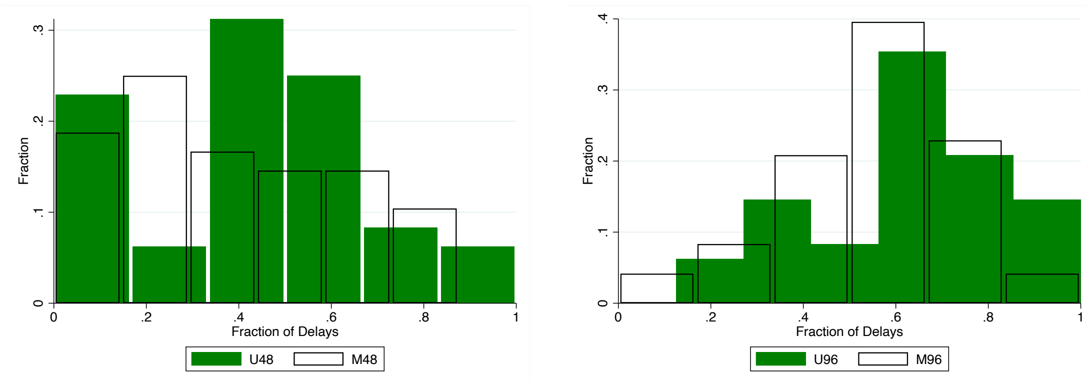
Table 7 shows that higher expected future surplus translates into higher average earnings of a committee. Indeed, for each voting rule separately, committees appropriate significantly higher surpluses in the 48 treatment compared with the 24 treatment and in the 96 treatment compared with the 48 treatment (see the last two columns with *p*-values).

Moreover, comparing the average surplus across voting rule for a fixed size of the future expected surplus, we note that two opposing forces determine this ranking. Under the majority rule, committees pass small budgets more often and large budgets less often than committees under unanimity rule, which gives unanimity rule committees an advantage compared with majority rule committees. On the other hand, as we described in Footnote 26, subjects under the unanimity rule were "unlucky" (statistically speaking) and experienced higher termination rates (controlling for delaying) compared with the majority rule. Empirically, in the M48 and U48 treatments, these two forces happen to exactly offset each other, which is why we observe similar average earnings in the two voting rules, *despite* the fact that subjects in the Unanimity rule choosing to delay small budgets significantly more often. In the M96 and U96 treatments on the other hand, where the gains from waiting to reach a round with a higher budget are the highest, the first force dominates the second, and the unanimity rule outperforms the majority rule.

Delays at the individual level. Figure 13 depicts the histograms of individual propensity to delay for each participant when he or she was selected to be the proposer conditional on the budget being small. These are average frequencies of delays per person across all twelve games played in a session.

The Figure 13 reveals that there is noticeable heterogeneity in individual propensity to delay in each treatment. However, despite this heterogeneity, the comparison across

Figure 13: Individual propensity to delay, by treatment



Panel (A): 48 treatment Panel (B): 96 treatment

Notes: For each participant, we compute the frequency with which she delayed splitting the small budget when she was selected to be a proposer over the course of the entire experiment.

voting rules is similar to those at the aggregate level. Indeed, proposers are more likely to delay splitting the small budget in the Unanimity treatment as compared with the Majority treatment. This effect is statistically significant for the 96 treatment ($p = 0.0074$) but not for the 48 treatment ($p = 0.7183$).

Learning. Table 8 below compares the fraction of small budget proposals that are passed in each treatment, separating the data between the first and second halves of the experiment. In both halves of the experiment, small budgets are much more likely to pass in the Majority treatments than in the Unanimity treatments that feature stochastic future budgets.

Table 8: Fraction of small budget proposals passed in the two halves of the experiment.

Treatment	First Half	Second Half
M48	93.7%	93.2%
	($p < 0.001$)	($p = 0.002$)
U48	40.9%	43.2%
M96	87.8%	81.1%
	($p < 0.001$)	($p = 0.026$)
U96	34.4%	28.0%

Notes: For each budget distribution we compare the outcomes in the Majority and Unanimity treatments using regression analysis, in which we regress the variable of interest on the constant and an indicator for one of the treatments, while clustering standard errors by session. We report the p-value associated with estimated coefficient on the dummy for one of the treatments.

In Table 9 we replicate material from the main text, but breaking it down by first and second halves of the game as well as by bargaining round. We focus on the rejection

Table 9: Rejection rates in the first and second half of the experiment by bargaining round

	Small budgets				Large budgets
	overall	1st round	2nd round	>3rd round	overall
FIRST HALF					
M48	51.2%	50.0%	52.9%	62.5%	0.0%
	$p < 0.001$	$p = 0.003$	$p = 0.005$	$p = 0.656$	.
U48	81.3%	83.3%	86.1%	50.0%	9.8%
M96	67.4%	65.6%	70.8%	75.0%	3.2%
	$p < 0.001$	$p < 0.001$	$p = 0.061$	$p = 0.004$	$p = 0.968$
U96	93.5%	93.8%	92.5%	94.1%	3.4%
SECOND HALF					
M48	56.4%	54.2%	68.2%	50.0%	3.9%
	$p = 0.025$	$p = 0.007$	$p = 0.587$	$p = 0.851$	$p = 0.465$
U48	77.9%	82.3%	75.0%	53.9%	7.3%
M96	78.3%	85.4%	61.3%	63.4%	4.2%
	$p < 0.001$	$p = 0.002$	$p < 0.001$	$p = 0.178$	$p = 0.477$
U96	96.0%	99.0%	97.8%	84.4%	1.9%

rates of small budgets in line with our analysis in the main text. We note no fundamental differences: small budgets are more likely to be rejected in the Unanimity treatments compared with the Majority ones (this is also generally true if we break it down by bargaining rounds). There is no cross-treatment differences in how large budgets are treated. This aligns with the conclusions obtained when grouping the data from all games and all bargaining rounds together as we did in the main text.

Proposed Allocations for Small Budgets. Table 10 shows which types of proposals are made when the budget to be split is of size 24 in each treatment.

In all of the Majority treatments, the modal proposal is an equal split among all three members of the group (this fraction is between 34.9% and 37.7%), though roughly half of the proposals are of size 2, and the other half of size 3. In the Unanimity treatments, a substantial majority of proposals provide an equal split of resources among all three members of the group. Cross-treatment differences in terms of proposal types have strong implications on inequality within groups.

Table 11 shows how frequently small budget proposals are accepted in each treatment, by the type of proposal. In the Majority treatments, regardless of the type of small budget proposal, a large majority pass (the fraction ranges from 66.7% to 100%). Strikingly, these fractions remain high even when delaying is an equilibrium, as in the M96 treatment. In the Unanimity treatment, however, the fraction of small budget proposals that pass range from 0% to 96.6%, and, in line with the theoretical predictions, far fewer of these proposals

Table 10: Distribution of proposal types in submitted allocations (small budget proposals).

Treatment	Coalition Size 2 Equal Splits	 Unequal Split	Coalition Size 3 Equal Split	 Unequal Split
M24	20.0%	25.4%	35.6%	19.0%
M48	35.3%	23.0%	37.7%	4.1%
M96	20.9%	27.9%	34.9%	16.3%
U24	2.4%	1.6%	70.73%	25.2%
U48	0%	0.7%	68.6%	30.7%
U96	0%	1.8%	89.5%	8.8%

Notes: Equal split coalitions of size 2 are proposals in which two members receive the exact same amount while the third receives nothing. Equal split coalitions of size 3 are proposals in which all three members receive the exact same amount.

pass when the cost of early agreement is high, as in the U48 and U96 treatments.

Table 11: Fraction of accepted proposals dividing the small budget.

Treatment	Coalition Size 2 Equal Splits	 Unequal Splits	Coalition Size 3 Equal Splits	 Unequal Splits
M24	97.6%	82.7%	98.6%	87.2%
M48	100%	78.6%	95.7%	100%
M96	88.9%	66.7%	96.7%	85.7%
U24	na	na	96.6%	22.6%
U48	na	0%	57.3%	9.3%
U96	na	na	35.3%	0%

Notes: Equal split coalitions of size 2 are proposals in which two members receive the exact same amount while the third receives nothing. Equal split coalitions of size 3 are proposals in which all three members receive the exact same amount. We report data for which we have at least 10 observations.

Conversation Topics Across Treatments Within a Voting Rule. Table 12 below shows the statistical tests comparing frequencies of conversation topics across budget size within the same voting rule.

Table 12: Topics of conversation across treatments

	M48 vs M96	U48 vs U96
Size of Future Budget	$p = 0.001$	$p = 0.679$
Support for Delaying	$p = 0.093$	$p = 0.201$
Talk about equality/fairness	$p = 0.681$	$p = 0.017$
Threats to vote no if not equal	$p = 0.120$	$p = 0.533$
Threats to vote no if small budget	n.a.	$p = 0.102$
Risk of Game Termination	$p = 0.025$	$p = 0.005$
Talk about equality within MWC	$p = 0.333$	n.a.
Talk about unequal split within MWC	$p = 0.025$	n.a.

Notes: We report the p-values comparing the frequencies of conversation topics across treatments with different potential budget sizes conditional on the voting rule.