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Logrolling affects the relative performance of alternative q-majority rules

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Logrolling affects the relative performance of alternative q-majority rules*

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Abstract

We consider a committee facing binary decisions on a number of proposals. If members vote sincerely and payoffs are symmetric in expectation, it can be shown that the simple majority rule is the best q-majority rule in an aggregate or expected payoff sense. We argue that this conclusion changes systematically if the committee faces multiple decisions and members engage in logrolling deals. In a simulation exercise, we find that unanimity rule outperforms majority rule when the number of proposals considered is large enough. We also conduct a laboratory experiment to investigate whether human subjects engage in logrolling deals and if so which ones. We find that subjects reach some, but not all, of the deals that the experimental situations admit. Deals associated with negative externalities are less likely to arise than others, as are "complex" deals involving many voters or proposals. These results suggest that the impact of logrolling on the relative performance of the decision rules considered may be mitigated by cognitive constraints and other-regarding preferences.

JEL codes: C92, D72, P16.
Keywords: logrolling, vote trading, majority rule, unanimity rule, experiment.

1 Introduction

Consider a group of individuals (e.g., a committee) that will make a number of binary (yes or no) decisions on proposals. Before knowing exactly what proposals will be considered, the members of the committee are faced with a fundamental constitutional question: what decision rule(s) will we use to decide on future proposals?

Real-life legislative institutions are governed by complex procedural rules that allocate proposal and amendment rights, restrict the set of admissible proposals, and specify voting rules to be applied in different circumstances. Abstracting from many interesting details, the large literature in economics and political science focuses on comparing alternative q-majority rules. That is, *how many members q of the committee should be required to vote "yes"* in order for a given proposal to be approved?

Perhaps the first mathematical approach to this question was developed by Condorcet (1785). Condorcet considered a setting in which the committee members' preferences are perfectly aligned,

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and differences of opinion reflect differences in the information available to each member. His famous conclusion was that the *simple majority rule* is the best way to aggregate this information.

Other authors have considered settings in which the committee members have heterogeneous interests. Here too, it can be argued that the majority rule is an attractive mechanism to aggregate heterogeneous preferences. These arguments come in essentially two varieties. Some authors follow May (1952) in arguing that the majority rule has attractive axiomatic properties (e.g. Dasgupta and Maskin (2008)). Others apply an aggregate welfare or expected utility criterion (e.g. Guttman (1998)).[1] The gist of this literature is that, under certain conditions, the application of simple majority rule maximizes the aggregate (or expected) payoff.

The conditions under which the majority rule maximizes aggregate payoffs are essentially two. First, committee members must (at least in expectation) have similar preference intensities. Second, committee members must vote sincerely on each proposal. These two conditions imply that the majority opinion, according to the votes cast, reflects (in expectation) the sign of the aggregate payoff from a given proposal.[2]

The assumption of sincere voting seems plausible if only a single proposal is considered, or proposals are considered in isolation. It is less plausible in contexts where the committee has multiple proposals to consider. In such a setting, there may exist opportunities for some members to engage in logrolling deals - mutually agreeing to vote contrary to their sincere preference on a specific set of proposals.

In this paper, we argue that the relative performance of alternative q-majority rules changes significantly and systematically when such logrolling deals are taken into account. The reason is that such deals, while mutually beneficial for the coalition of members engaging in them, can be associated with externalities. Furthermore, these externalities can be *negative* when the majority rule is applied, while they are always (weakly) *positive* when the unanimity rule is used.

We investigate the impact of logrolling on expected payoffs in a simulation exercise. The simulation involves payoffs on multiple proposed projects being randomly drawn from a symmetric distribution. Thus, preference intensities for members supporting or opposing a given project are symmetric in expectation. We assume that members sequentially and myopically make logrolling deals, choosing those associated with the greatest immediate increase in their own payoffs - with no regard to their aggregate impact. We compare the performance of simple majority and unanimity rule. Our results suggest that the unanimity rule outperforms the majority rule (in terms of expected payoffs) if the number of projects is sufficiently large.

As indicated, this reversal of relative performance is driven by the fact that logrolling can produce negative externalities under majority rule and that members do not take these externalities into account when making deals. In addition, it depends on the ability of members to identify and engage in such deals in the first place. If members systematically avoid making deals that harm others, or if they are unable to forge deals due to cognitive or other constraints, the predicted effects are mitigated.

The propensity for members to engage in logrolling deals, and how this depends on the associated externalities, is difficult to assess using naturally occurring observational data, as the direction and intensity of members' "true" preferences are unobservable.[3] We therefore complement our

[1] Feddersen and Pesendorfer (1997) present a hybrid approach with correlated values, substantively closer to Condorcet's original argument.

[2] In fact, this argument is substantively equivalent to Condorcet's approach in that each individual's preference constitutes a "signal" regarding the sign of the aggregate payoff.

[3] We will briefly discuss observational evidence on logrolling in the next section.

simulation exercise with an incentivized laboratory experiment in which these preferences are induced. The experiment involves groups of three voters voting on three projects. We vary the payoffs associated with the projects as well as the voting rule.

Our experimental results show that voters often, but not always, engage in the trades predicted by the logrolling algorithm used in our simulations. Complex agreements involving all three voters or projects occur less often than simple agreements involving two voters and two projects. Most significantly, agreements detrimental to aggregate payoffs are less often observed than those that increase the aggregate payoff. Overall, logrolling improves the payoffs of all members under unanimity rule in our experiment but does not always lead to the outcome that maximizes the aggregate payoff. Under majority rule, logrolling sometimes harms individual members, but more often leads to "utilitarian" outcomes. Under both rules, predicted outcomes are more likely to occur if they Pareto dominate the sincere outcome. However, predicted utilitarian outcomes (maximize aggregate payoffs) emerge more under majority rule. Thus, the experiment supports the importance of logrolling deals but suggests that their impact on the relative performance of the two rules may be mitigated by cognitive constraints as well as a reluctance to impose negative externalities.

The remainder of the paper is organized as follows. In Section 2, we briefly review prior literature on logrolling. In Section 3, we describe our theoretical framework and logrolling algorithm. Section 4 presents the results of our simulations. In Section 5, we describe our experimental design and hypotheses. In Section 6, we present our experimental results. Finally, Section 7 discusses the results and concludes.

2 Literature

Within economics, there has long been a discussion about the efficiency consequences of logrolling agreements. In a seminal contribution, Riker and Brams (1973) propose a myopic model of vote trading similar to the one we consider. They demonstrate that logrolling deals can produce negative externalities, and that multiple trades can lead to outcomes that are Pareto dominated by sincere voting. This "paradox of vote trading" arises under specific assumptions about the set of projects and corresponding payoffs. Naturally, it is equally possible to construct examples in which logrolling produces *positive* externalities and indeed Pareto improvements. Uslaner and Davis (1975) point out that logrolling will always be associated with (weakly) *positive* externalities under the unanimity rule, while both positive and negative externalities are possible under the majority rule.

A thorough review of the theoretical literature on logrolling is beyond the scope of this essay. The interested reader can see for instance Buchanan and Tullock (1962), Stratmann (1992), McKelvey and Ordeshook (1980) or Bernholz (1978) or the recent theoretical and experimental survey of Casella and Macé (2021) on the welfare implications of vote trading. In a recent contribution, Macé and Treibich (2024) study a model of a committee voting repeatedly on individual projects. Thus, their setting does not permit logrolling in the sense of explicitly trading votes across multiple projects. They show that members can sustain an efficient system of *"implicit"* inter-temporal logrolling, where all members support projects if and only if they are associated with positive aggregate payoffs unless their individual preferences are strongly at odds. This arrangement can be sustained because all members expect future benefits from doing so.

A number of scholars have used naturally occurring data to study logrolling in professional legislatures such as the European Parliament (Mattila and Lane (2001), König and Junge (2009) and Aksoy (2012)) and the US Senate and House of Representatives (Matter et al. (2016) and

Matter et al. (2017)). A significant challenge in this approach is that true preferences and logrolling agreements are not directly observable.

True preferences can be approximated through the politician's party or in situations where voters express opinions both before and after negotiations (Aksoy, 2012). This study shows fewer position changes under unanimity than majority voting. While "unexpected votes" can be observed, identifying the exact logrolls is harder. Matter et al. (2016) and Matter et al. (2017) apply network science to reveal reciprocal vote trading, which is bipartisan and strengthened by long Senate relationships. Cohen and Malloy (2014) finds that legislators' alumni networks allows to identify some agreements that significantly affect voting, particularly on "irrelevant votes."

Given the challenges associated with observational evidence, several researchers have turned to laboratory experiments to more directly observe logrolling. The first paper we are aware of is McKelvey and Ordeshook (1980), who investigate the predictions of Riker and Brams (1973). They compare behavior in two experimental contexts: one with unrestricted communication and another with a ballot system (where binding agreements are possible). They observe that Pareto inferior outcomes emerge (as predicted by Riker and Brams (1973)), but much less in the presence of communication that fosters cooperation.

Casella et al. (2014) examine how centralized decision-making impacts logrolling, comparing decentralized decisions with those coordinated by a party leader. They find that centralized logrolling can enhance efficiency. Later, Casella and Palfrey (2019) propose a dynamic model where voters trade ballots sequentially until reaching a stable vote allocation (Pivot stable). Casella and Palfrey (2021) test this with groups of five voters across three treatments, each with unique payoff structures. Voters can trade votes through bidding. Results show that the Pivot stability concept predicts final vote allocations well, though some trades deviate from strict gains for all voters. While the model assumes myopic gains, voters exhibit some farsightedness and prefer accumulating votes on favored proposals.

All the papers discussed thus far study logrolling under majority rule. To our knowledge, only one experimental paper considers both majority and unanimity rule. Lehmann-Waffenschmidt and Reina (2003) study logrolling under both rules in a three-person bargaining game. Each voter faces a table with 28 numbers. Each number corresponds to a certain value and these values differ from one voter to another. They have to coordinate on a number. The number and the corresponding values are applied if 2 voters agree on the same number (majority) or if the 3 voters agree (unanimity). Voters take multiple decisions, such that logrolling is possible. The authors analyze the bounded rationality and cognition of subjects by varying the decision rule and the complexity of the game. They find that under majority, sub-optimal outcomes emerge while subjects managed to find optimal outcomes under unanimity rule even when the game is more complex.

3 Model

In this section, we begin by defining the theoretical setting and analytically characterizing the outcomes and expected payoffs under sincere voting. We then describe the logrolling algorithm used in our simulations in general terms. A detailed describtion of the algorithm is relegated to the appendix.

3.1 Preferences and sincere voting

A group of $n \geq 3$ individuals is faced with a set of $L \geq 1$ binary choices. Each choice is interpreted as a 'project' which they may or may not undertake. Preferences over projects are assumed to be separable. The payoff that voter i obtains if project k is undertaken is denoted by $z_{ki} \in \mathbb{R}$. If $z_{ki} < 0$, we will say that voter i is 'opposed' and if $z_{ki} > 0$, we will say that voter i is 'in favor' of project k. A *preference profile* for all n voters is represented by an $L \times N$ matrix $Z = \{z_{ki}\}$, with rows corresponding to projects and columns corresponding to voters.

We denote by $s_{ki} = s(z_{ki}) \in \{-1, 1\}$ voter i's *sincere vote* on project k, where $s_{ki} = -1$ denotes a "no" vote and $s_{ki} = 1$ a "yes" vote. For simplicity, we assume that $s(0) = -1$, i.e. voters vote no when indifferent. This assumption is unimportant because the probability of indifference is zero when payoffs are continuously distributed, as will be the case in our simulations. That is,

$$s_{ki} = \begin{cases} 1 & \text{if } z_{ki} > 0, \\ -1 & \text{otherwise.} \end{cases}$$

We define the $L \times N$ *sincere vote matrix* $S(Z) = \{s(z_{ki})\}$. Under any q-majority rule, the *sincere voting outcome* on a given project k depends on the sum of the entries in the k^{th} row of $S(Z)$. This sum corresponds to the sincere *vote margin in favor* of the project. Under simple majority rule, a project passes under sincere voting if and only if that vote margin is greater than or equal to 1. Under unanimity rule, it passes if and only if the vote margin is n. More generally, each q-majority rule corresponds to a *required margin of victory*, denoted $m \geq 0$.

We define the *sincere passage vector* $p^S(Z, m) = (p_k^S)_{k=1}^L$ where the sincere outome on each project k is given by

$$p_k^S = \begin{cases} 1 & \text{if } \sum_i s_{ki} \geq m, \\ -1 & \text{otherwise.} \end{cases}$$

3.1.1 Expected payoffs under sincere voting (symmetric payoff distribution)

In order to quantify the expected payoffs under alternative voting rules, we assume that the individual payoffs z_{ki} are independently drawn from a distribution $F(z)$ that is symmetric about zero. (Our simulations will be based on a uniform distribution, but the following results do not depend on this assumption.) Without loss of generality, we normalize the average *positive* and *negative* payoffs to $+1$ and -1, respectively. Expected payoffs under sincere voting can then be calculated as follows.

Under unanimity rule ($q = N$), a project passes if and only if all $z_{ki} > 0$, which occurs with probability $(1/2)^N$. If so, the average payoff to an individual voter is 1. Thus for a payoff matrix involving N voters and L projects, the expected payoff to an individual voter is

$$EU_N(N, L) = L \cdot (1/2)^N.$$

Under any q-majority rule, a project passes under sincere voting if there are $s \geq q$ voters in favor. For each such s, the probability of exactly that many supporters is $(1/2)^N$ times N choose s. In each such case, the expected payoffs to individual supporters and opponents are $+1$ and -1, respectively. Thus the expected total payoff is $s - (N - s) = 2s - N$, and so the *ex ante* expected utility of an individual voter is

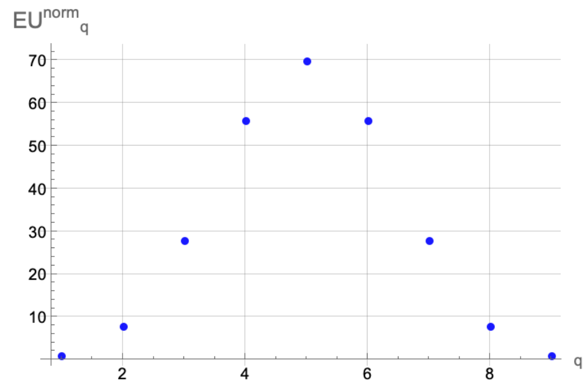


Figure 1: Normalized payoffs under sincere voting from alternative q-majority rules ($N = 9$)

$$EU_q(N, L) = L \cdot (1/2)^N \sum_{s=q}^{N} \binom{N}{s} \cdot \left(\frac{2s}{N} - 1\right)$$

In order to aid the comparison of these expected payoffs as well as those obtained in the simulations, we can *normalize* payoffs for each combination (N, L) by the expected payoff under unanimity rule and sincere voting. The expected values of this normalized average are given by

$$EU_N^{norm} = 1$$

(by definition) and (after additional simplification)

$$EU_q^{norm}(N) = \frac{q}{N} \binom{N}{q}$$

The latter is surprisingly simple but intuitive to interpret ex post. There are n choose q distinct sets of q voters. For each such set, there are events in which all its members have a positive payoff. The union of all of these events for all sets of q players are identical with the set of events in which the proposal passes. In each such event, the average payoff for voters in the set and its complement are 1 and 0, respectively. Therefore the average total payoff in each of these (sets of) events is exactly q/N.

As an example, Figure 1 depicts the normalized payoffs for the case of $N = 9$ voters, as a function of q. As can be seen, expected payoffs are maximized for $q = \frac{N+1}{2} = 5$. More specifically, payoffs under simple majority rule are 70 times as large as under unanimity rule when there are 9 voters. We summarize our conclusion as follows.

Theorem 1: *Assume that individual payoffs are drawn from a symmetric distribution. Under sincere voting, the ex-ante expected payoff under q-majority rule relative to unanimity rule is given by $EU_q^{norm}(N)$ above, and is maximized for $q = \frac{N+1}{2}$.*[4]

[4]Note that $EU_q^{norm}(N)$ is independent of L. This reflects the fact that, under sincere voting, the fate of each project is decided independently. Therefore the *relative* performance of alternative voting rules is independent of the number of projects.

For our simulations, the relevant relative payoff benchmarks are $EU_2^{norm}(3) = 2$ and $EU_3^{norm}(5) = 6$. That is, we should expect sincere voting payoffs to be *twice* as high under majority rule when $N = 3$, and 6 *times* as high when $n = 5$.

3.2 Logrolling algorithm

Our model of the log-rolling process assumes that members sequentially organize logrolling "deals", and each such deal is followed by immediate votes on the projects involved. Our approach is deliberately simplistic in order to facilitate a transparent description of the algorithm used in our simulation exercise. Its purpose is not primarily to deliver predictions as to logrolling deals reached in specific situations, but rather to illustrate *comparative statics* with respect to the degree of logrolling and the majority requirement.[5]

Our approach is based on the premise that voters perceive the sincere outcomes of all projects as the status quo. They then consider forming "deals": agreements among a subset of voters to vote contrary to their sincere preferences on a specific set of projects. We assume voters assess these deals by evaluating their utility impact compared to the outcomes resulting from sincere voting.

Voters can propose deals sequentially, according to an exogenous turn sequence. Each deal is followed by an immediate vote on the projects involved. All voters who are not involved in the deal are assumed to vote sincerely. After voting is completed, the next proposer can propose another deal as long as some projects have not yet been voted on. We assume that proposers and voters act *myopically* at each stage of this process, proposing, from among all deals that could be made at a given point in time, the one that offers them the largest payoff increment relative to the sincere outcome on the projects involved.

To model limits as to the ability of members to engage in logrolling, we place an upper bound, denoted K, on the number of projects that can be included in a given deal. Thus, $K = 2$ limits deals to be of the form "I (or we) will vote for project A if you vote for project B", but also "I (or we) will vote *for* project A if you vote *against* project B", etc. More complex deals such as "We will vote for A and against B if you vote for C and against D" require larger values of K. Finally, $K = 1$ corresponds to sincere voting. Additional details about the logrolling algorithm are presented in Appendix A.1.

We conduct simulations for $N = 3$ and $N = 5$ and $L = \{3, 5, 9, 12, 15, 18\}$. For each of these parameter constellations, we created 10000 payoff matrices randomly, each entry uniformly distributed on $[-2, 2]$. The parameter limiting the size of logrolling deals, K, was limited to $K \leq 6$. The next subsection summarizes the results.

3.3 Example

As an example, consider Table 1. Each row of the table represents a project that a committee of three voters might undertake. The numbers in each column represent the payoffs that voters obtain if a given project passes. Thus, this table corresponds to the matrix Z described above.

Project A produces net losses. Behind a veil of uncertainty, a representative individual would want Project A to fail, as it would under both majority and unanimity rule. Project B and C are both associated with positive net benefits; a representative individual would want both projects

[5] We acknowledge that other ways of modeling the process might be more elegant or "realistic". We opt for simplicity because we believe that the comparative statics we focus on are robust to alternative approaches. We have experimented with several such alternatives, as we briefly describe in the concluding remarks.

Table 1: Example preference profile

Project	Voter 1	Voter 2	Voter 3	Net benefits
A	-4	-4	2	-6
B	5	-2	-1	2
C	-4	4	3	3

to pass. However, both of these projects fail under unanimity and only Project C passes under majority rule with sincere voting. Under sincere voting, majority rule would produce an aggregate payoff of 3 (only Project C passes), with individual payoffs being $(-4, 4, 3)$ and unanimity rule would produce an aggregate payoff of 0 as no project passes. Thus, majority rule outperforms unanimitz rule in an aggregate payoff sense in this example.

Now, consider what might happen if voters engage in logrolling agreements. Under majority rule, voters 1 and 3 could agree to vote yes on Projects A and B. As a consequence, all three projects would pass, yielding an aggregate payoff of -1, with individual payoffs being $(-3, -2, 4)$. Voters 1 and 3 are better off compared to sincere voting, but logrolling imposes external costs on voter 2 and leads to a decline in aggregate net benefits. Under unanimity rule, all three voters could agree to vote yes on Projects B and C, yielding a total benefit of 5, with the following individual payoffs: $(1, 2, 2)$. Thus, logrolling reverses the relative performance of the two rules in this example.

Table 2: Impact of logrolling under both rules

Rule		Sincere outcome	Logrolling outcome	Impact of logrolling
Majority	Projects	C passes	A, B and C pass	Agreement on A and B
	Indiv. payoffs	$(-4, 4, 3)$	$(-3, -2, 4)$	$\Delta = (+1, -6, +1)$
	Aggr. payoff	3	-1	
Unanimity	Projects	Nothing pass	B and C pass	Agreement on B and C
	Indiv. payoffs	$(0, 0, 0)$	$(1, 2, 2)$	$\Delta = (+1, +2, +2)$
	Aggr. payoff	0	5	

Naturally, the effect of logrolling in this example depended on the specific payoffs associated with the projects. To assess whether the reversal of relative performance is a more general phenomenon, we must consider various payoff constellations. To this end, we conduct simulations in which we consider a large number of payoff matrices. In constructing these matrices, we assume that individual payoffs are symmetrically distributed, such that the theoretical argument favoring majority rule under sincere voting applies.

4 Simulation results

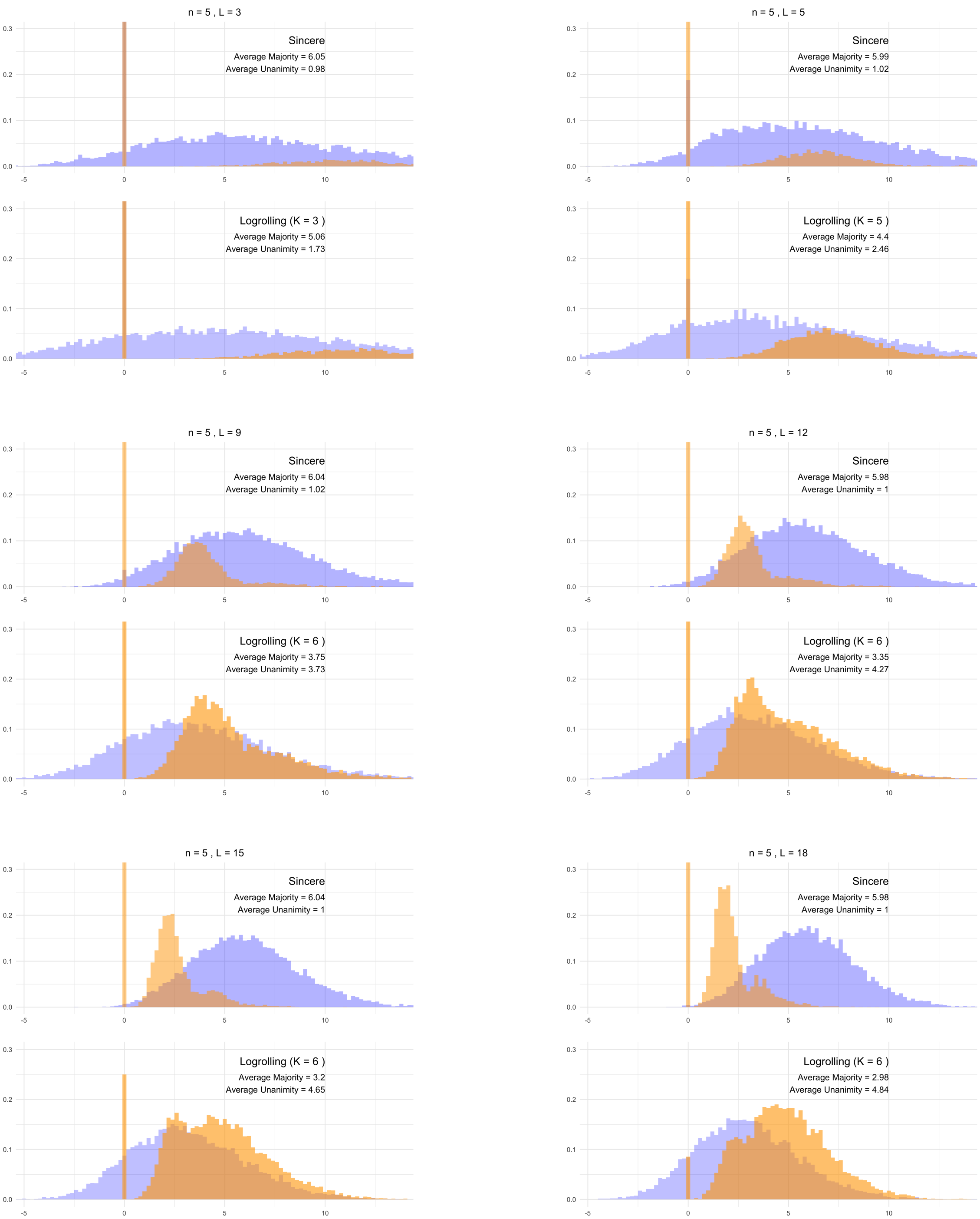
The following figures summarize the distributions of the normalized average payoffs achieved. That is, for each matrix we calculate the normalized average payoff among the N voters. This statistic is observed 10000 times per condition, and we summarize its distribution. In addition, each subfigure contains information about the overall average payoff over all 10000 matrices.

In each subfigure, the histograms at the top summarize the distribution of normalized average

Figure 2: Average payoffs from simulations with $N = 3$ voters

The blue distribution is for majority rule, the orange for unanimity rule.

Figure 3: Average payoffs from simulations with $N = 5$ voters



The blue distribution is for majority rule, the orange for unanimity rule.

payoffs under sincere voting. The blue distribution is for majority rule, the orange for unanimity rule. Under unanimity rule, the most common average payoff is 0. The histograms at the bottom of each subfigure display the distribution of normalized average payoffs produced by the logrolling algorithm. In each case, we display results for $K = 6$ or for $K = L$, whichever is smaller. See below for more information on how K matters.

Figure 2 displays results for $N = 3$. As expected, the overall averages under sincere voting are 1 for unanimity and 2 for majority rule. As the number of projects L increases, these averages remain the same, but the distributions exhibit less variance. For each L, the relative performance of unanimity rule improves with logrolling. For example, when there are $L = 3$ projects, the average (normalized) expected payoff is 1.24 under unanimity rule and 1.84 under majority rule. Thus, logrolling *improves* the payoff under unanimity rule by appoximately 24%, while the payoffs under majority rule *decline* by roughly 8% as compared to sincere voting. As the number of projects L increases, this effect becomes stronger, and indeed unanimity rule outperforms majority rule for $L \geq 9$. For $L = 18$ projects, the normalized expected payoffs under logrolling are 1.87 under unanimity and 1.52 under majority rule.

Figure 3 displays results for $N = 5$. Consistent with our derivation above, the overall averages under sincere voting are 1 for unanimity and 6 for majority rule. Again, the relative performance of unanimity rule improves with logrolling. For example, when there are $L = 9$ projects, the average (normalized) expected payoffs are 3.73 under unanimity rule and 3.75 under majority rule. Unanimity rule outperforms majority rule for $L \geq 12$. For $L = 18$ projects, the normalized expected payoffs under logrolling are 4.84 under unanimity and 2.98 under majority rule. We summarize these results as follows:

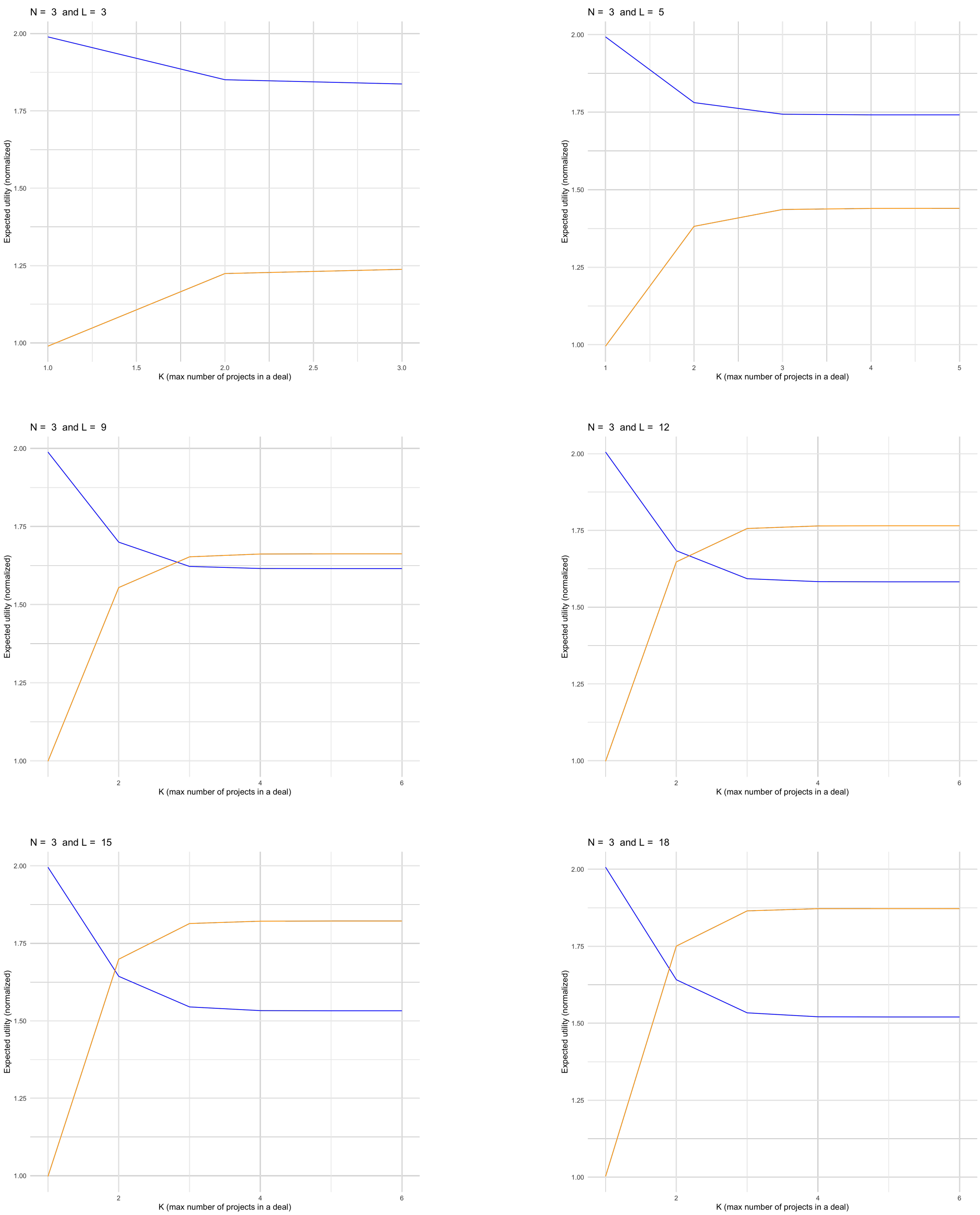
Simulation Result 1: *When payoffs are independently and uniformly distributed, majority rule is associated with larger average payoffs under sincere voting. Logrolling improves average payoffs under unanimity rule and lowers average payoffs under majority rule, such that the relative performance of unanimity rule improves. When the number of projects L is large enough, unanimity rule is associated with greater average payoffs than majority rule under logrolling.*

In order to get a sense of how the relative performance of the two voting rules depends on the "degree" or "ease" of logrolling, we can inspect how the average (normalized) payoffs depend on parameter K. Recall that this is the upper bound on the number of projects that can be included in a logrolling deal. Thus, $K = 1$ corresponds to sincere voting, $K = 2$ allows only vote trades on two projects, and $K = 6$ (the maximum value considered) allows for "complex" deals involving up to 6 projects.

Figure 4 shows these results for $N = 3$ voters. For each of the subfigures, the payoffs start at 1 for unanimity and 2 for majority rule, when $K = 1$ (sincere voting), and end at the logrolling payoffs already reported in Figure 2, for the largest value of K. In addition, these curves show that the simulation results are relatively stable for $K \geq 3$. Thus, we do not lose information by not considering larger K and our conclusions would be the same if we restricted ourselves to $K \leq 3$. In particular, we see that the relative performance of unanimity rule improves as we move from $K = 1$ to $K = 2$ and again from $K = 2$ to $K = 3$. We summarize this finding as follows.

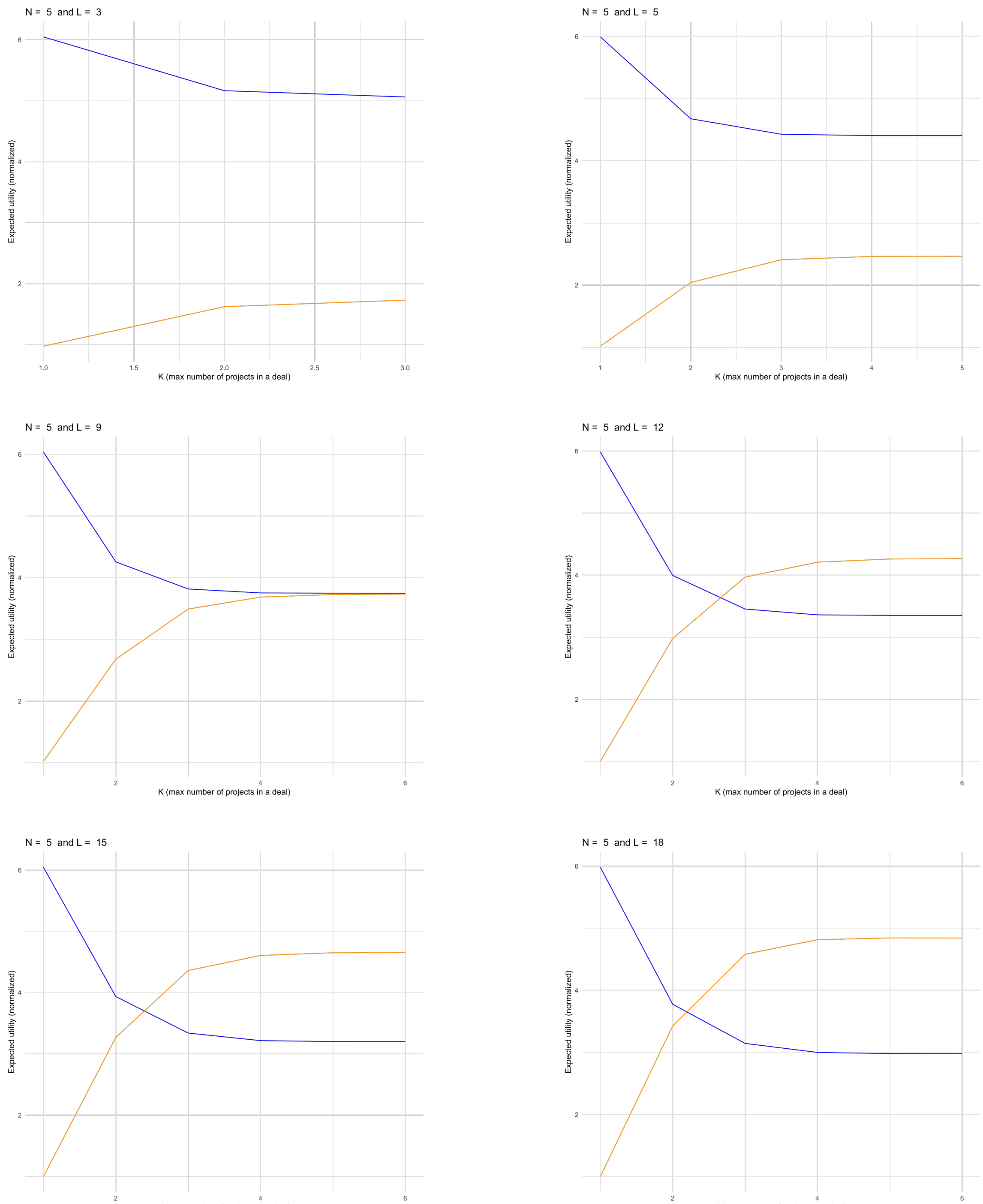
Simulation Result 2: *The relative performance of unanimity rule increases with the "degree" or "ease" of logrolling, as measured by the parameter K. Payoffs under both rules are relatively stable for $K \geq 3$.*

Figure 4: Normalized expected payoffs under logrolling ($N = 3$ voters)



The blue curve is for majority rule, the orange for unanimity rule.

Figure 5: Normalized expected payoffs under logrolling ($N = 5$ voters)



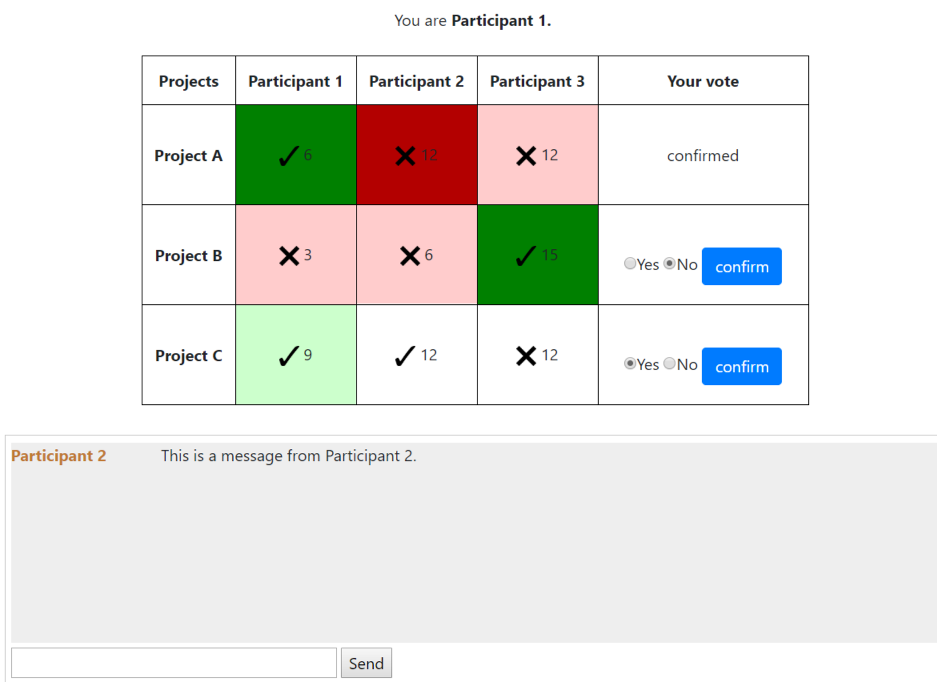
The blue curve is for majority rule, the orange for unanimity rule.

5 Experimental design and hypotheses

5.1 Experimental design

Our experimental games involve three participants evaluating three projects (A, B, and C) with preferences induced through monetary rewards. To avoid negative rewards, we offer positive payments when a project's outcome aligns with a participant's preference (either for or against); otherwise, they receive zero. This approach, termed "transformed payoffs," contrasts with "untransformed payoffs," which only reward project passage.[6]

Figure 6 illustrates a table used in the experiment. Cells display a check mark if a project yields positive payoffs to a participant or a cross if it does not. The number next to the symbol indicates the voter's preference intensity. For instance, "✓ 6" (Project A, Participant 1) means voter 1 earns 6 points if Project A passes, otherwise 0. Similarly, "✗ 3" indicates voter 1 earns 3 points if Project B fails, otherwise 0.



Notes: Cells in light green (resp. red) mean that the participant voted yes (resp. no) but has not confirmed his vote yet. Cells in dark green (resp. red) reflect confirmed yes (resp. no) votes.

Figure 6: Screenshot: Example of a table.

The voting process worked as follows: ticking "Yes" for a project turned the cell light green, while ticking "No" turned it light red. These changes were immediately visible to all group members, allowing participants to signal their (ostensible) voting intentions and view those of others.

[6]This method follows Hortala-Vallve (2009) and Casella and Palfrey (2021).

Intentions could be modified until confirmed by pressing the "Confirm" button, which locked the vote and changed the cell to dark green or dark red.

Group members could communicate through a public, unstructured chat box below the table, with no explicit instructions to trade votes (see Section A.4). They had three minutes to vote on all three projects. Any unconfirmed votes after this time, even if intentions were declared, were treated as No votes.[7] After voting, the round outcomes and associated payoffs were displayed for up to 20 seconds (see Figure 10 in Appendix).

Groups played 18 rounds with different payoff matrices: 9 original games and 9 equivalent variants.[8] Details of the tables and sequence for each group are in Section A.5 of the Appendix.

The nine games and their predictions are summarized in Tables 3 (majority rule) and 4 (unanimity rule). The second column specifies the type of predicted agreement; bundles or mixed logrolls. *Bundling* is defined as merging two or more projects into a single proposal on which all voters are assumed to vote sincerely.[9] In the experiment, it reflects agreements where participants coordinate to pass two projects that would have failed if voted separately. *Mixed logrolling* is slightly more cognitively demanding, as it involves trades where one project passes despite lacking standalone support, and another fails despite being supported under sincere voting. Under majority, predicted agreements involve bundles or mixed logrolling, while only bundles are predicted under unanimity. Agreements also vary by the number of voters and projects involved, denoted as "2V" or "3V" (voters) and "2P" or "3P" (projects).

The third column outlines the agreement's effect on payoffs, with agreements under majority being more or less costly for minorities, whereas agreements under unanimity benefits all. Under majority rule, the fourth column shows whether agreements improve aggregate payoffs, depending on whether coalition benefits exceed minority costs.

The final two columns classify group outcomes into six categories:

- Empty outcome: no project passes (also called *status-quo*.
- Sincere outcome: the projects that pass (and fail) would have passed (and failed) under sincere voting.[10]
- Predicted outcome: the projects that pass (and fail) correspond to the predictions of our algorithm.
- Utilitarian outcome: the outcome maximizes the aggregate payoff.
- Core outcome: the outcome (weakly) Pareto-dominates the empty outcome, and is not Pareto dominated by any other outcome.[11] The core outcome(s) for each game are described in Table 28 in the Appendix.
- Other outcome: the outcome does not belong to any of the five categories described.

[7]Unconfirmed votes were rare: 3.42% overall, 2.08% under majority rule, and 4.76% under unanimity rule.

[8]In each variant, column and row sums (calculated with untransformed payoffs) match those of the original game, preserving the net benefit of each project.

[9]Such bundling deals can be either 'constructive' (causing projects that fail in isolation to pass as a bundle) or 'destructive' (causing projects that pass in isolation to fail as a bundle). We focus on the first type in the experiment.

[10]It does not mean that all the votes were sincere.

[11]That is, we are referring to the *unanimity* core in both cases.

Table 3: Games under majority

	Type of deal			Outcome	
	Type of agreement	Impact on payoff	Improves agg payoff	Core	Utilitarian
Game 1	Mixed	$\Delta =$(**-24**;6;6)	No	Yes	No
Game 2	Mixed	$\Delta =$(3;6;**-15**)	No	No	No
Game 3	Mixed	$\Delta =$(**-21**;3;3)	No	No	No
Game 4	Mixed	$\Delta =$(6;**-6**;12)	Yes	No	Yes
Game 5	Bundle	$\Delta =$(3;**-18**;3)	No	No	No
Game 6	Bundle	$\Delta =$(**-9**;6;9)	Yes	Yes	Yes
Game 7	Mixed	$\Delta =$(3;3;**-12**)	No	No	No
Game 7 (other)	Mixed	$\Delta =$(**-18**; 9;6)	No	No	No
Game 8	None	-	-	Yes	Yes
Game 9	Bundle	$\Delta =$(9;**-18**;12)	Yes	No	No

Table 4: Games under unanimity

	Type of deal		Outcome	
	Type of agreement	Impact on payoff	Core	Utilitarian
Game 1	3V2P	$\Delta =$(6;9;6)	Yes	No
Game 2	2V2P	$\Delta =$(18;6;3)	Yes	No
Game 3	3V3P	$\Delta =$(6;3;3)	Yes	No
Game 4	None	-	Yes	No
Game 5	3V2P	$\Delta =$(3;6;6)	Yes	Yes
Game 6	3V2P	$\Delta =$(6;9;9)	Yes	No
Game 7	None	-	No	No
Game 8	2V2P	$\Delta =$(3;6;18)	Yes	No
Game 8 (other)	2V2P	$\Delta =$(6;12;6)	Yes	No
Game 9	3V2P	$\Delta =$(6;3;9)	Yes	Yes

5.2 Procedures

The experiment was conducted using the o-Tree software (Chen et al., 2016) at Heidelberg University in Germany, with participants recruited from various disciplines via H-root (Bock et al., 2014). Before starting, participants read the instructions and completed a comprehension questionnaire. At the end of the experiment, they answered a few ex-post questions and demographic queries.[12]

We conducted 8 sessions with 18 participants each, totaling 144 participants. Within each session, participants were randomly divided into two matching groups of 9. After each game, participants were rematched within their group (stranger matching).[13] Participants were assigned ID numbers (1, 2, or 3), which changed each period. Five rounds were randomly selected at the end to calculate the final payoff (average points, conversion rate: 1 point = 1 Euro). The experiment

[12]Ex-post questions included: "Did you ever vote for a project despite receiving points if it fails? If yes, why?", "Did you ever vote against a project despite receiving points if it passes? If yes, why?", and "What do you think about the behavior of other participants?" Demographic questions covered age, gender, and field of study.

[13]The matching scheme was predetermined randomly, ensuring no group formed twice and that pairs met at most twice in a row.

lasted between 75 and 90 minutes, with participants earning an average of 21.11 euros (SD: 4.18).

5.3 Hypotheses

The detailed predictions of our logrolling model for each game are provided in Section A.5 of the Appendix. In this section, we present hypotheses regarding the likelihood of logrolling agreements and the resulting outcomes. These hypotheses are divided into two categories: those related to the logrolling agreements and those concerning the final outcomes.

5.3.1 Hypotheses on the logrolling agreements

Our first two hypotheses discuss the impact of the complexity of the predicted logrolling agreement.

Hypothesis 1 (Complexity under majority) *Because of their higher complexity, mixed logrolls, agreements to block one project and pass another project, are less likely than bundles.*

We assume that bundling two projects, and thus summing the payoffs associated to these projects, are less cognitively complex than logrolling votes to pass a project and block another one. Under unanimity, mixed logrolls are not possible as they would require a project to be unanimously supported. However, bundles may vary in their complexity level depending on the number of voters and/or projects involved.

Hypothesis 2 (Complexity under unanimity) *Because of their higher complexity, logrolling agreements involving more than two voters and/or more than two projects are less likely.*

The next two hypotheses focus on the impact of logrolling agreements on payoffs.

Hypothesis 3 (Benefit for the coalition) *The higher the benefit for the coalition, the more likely the logroll is.*

Hypothesis 4 (Benefit for the group) *The higher the benefit for the group, the more likely the logroll is.*

A logrolling agreement is always beneficial for the coalition, but it may be detrimental at the group level, because of the negative externalities that are induced by this agreement. Every predicted agreement under majority rule leads to negative externalities for the minority, but in some games, the cost imposed to the minority outweighs the benefits of the coalition and sometimes not. We predict that the higher these negative externalities are, the less likely these agreements will emerge. Note that under unanimity rule, these two hypotheses coincide as it requires every voter to agree.

5.3.2 Hypotheses on the outcome

Depending on the logrolling agreements, groups reach a certain outcome (a certain vector of payoffs). Our next two hypotheses suggest that some outcomes are more likely than others.

Hypothesis 5 (Core outcomes) *Predicted outcomes that are part of the core are more likely to emerge.*

Core outcomes are those where the payoff vector Pareto dominates the status-quo (where nothing passes) and is not dominated by any other payoff vectors. We hypothesize that these outcomes are more likely, as they offer a better result for every voter compared to the sincere outcome.

Hypothesis 6 (Utilitarian outcomes) *Predicted outcomes that correspond to the utilitarian outcome are more likely to emerge.*

The utilitarian outcome maximizes the aggregate payoff. We assume that participants will be inclined to trade to achieve this outcome. Under unanimity, this is possible only if everyone agrees, which may require some voters to sacrifice their preferences. In contrast, under majority rule, a minority may suffer from such outcomes without any recourse.

6 Experimental Results

We present and analyze the results using the untransformed payoffs, as in the simulations. As noted, this does not affect the predictions, results, or their interpretation. Each participant voted on 3 projects across 18 different matrices, with 4 sessions for each treatment, resulting in 3,888 votes per treatment. Each subgroup of 9 participants, within which the groups of 3 are reallocated, represents an independent observation. Thus, we have 2 independent observations per session, or 8 per treatment. Non-parametric tests are based on averaged measures per subgroup, and Mann-Whitney tests (MW) are two-tailed.

6.1 Results on logrolling agreements

6.1.1 Insincere votes

To form logrolling agreements, participants need to vote insincerely. Participants may vote yes (resp. no) while they prefer the project to fail (resp. pass): they are respectively called insincere-yes votes and insincere-no votes. The (in)sincere votes are summarized in Table 5, where insincere votes are in bold. On average, 23.15% of the total votes are insincere under majority and 30.53% are insincere under unanimity rule.[14] All the participants voted insincerely at some point.[15] There is no clear trend over time about the frequency of insincere votes.

Table 5: Sincere and insincere yes and no votes

Majority	Voted yes	Voted no
In favor of the project	1758 (87.20%)	**258 (12.80%)**
Opposed to the project	**642 (34.29%)**	1230 (65.71%)
Unanimity		
In favor of the project	1767 (87.65%)	**249 (12.35%)**
Opposed to the project	**938 (50.11%)**	934 (49.89%)

[14] The fact that there are more insincere votes under unanimity rule (MW test, p=0.006) is not surprising as no project was unanimously supported under sincere voting, so more vote trades need to occur for projects to move from status-quo.

[15] The most sincere participant under majority (unanimity) made 3 (8) insincere votes (over 54 votes). The most insincere participant under majority (unanimity) made 23 (27) insincere votes.

6.1.2 Logrolling agreements

Voting insincerely may not necessarily means vote trading. To consider that a vote is part of a logrolling agreement, it needs to fulfill three criteria: being insincere, useful (pivotal) and beneficial for the voters involved in the coalition. We start our results by testing the first two hypotheses on the complexity of logrolling agreements: the occurrence of bundles vs. mixed logrolls (majority treatment) and the occurrence of logrolls with more than 2 voters and/or 2 projects (unanimity treatment).

Result 1 (Complexity under majority) *Mixed logrolling agreements are slightly less likely to occur than agreements involving the bundling of projects.*

Our results show that 27.5% of the predicted mixed logrolls occurred while 36.11% of the bundles did.

Result 2 (Complexity under unanimity) *Logrolling agreements involving more than two voters and/or more than two projects are less likely to emerge.*

While under unanimity, 73.96% of the logrolling involving two voters emerge, only 55.42% of those involving three voters emerge. Concerning the number of projects, the predicted bundles of two projects emerge in 67.01% of the cases when there are 2 projects and only in 22.92% when there are 3 projects. Given these first two results, we can say that complexity does play a role in the occurrence of logrolling agreement.

We continue the tests of our hypotheses, by analyzing the occurrence of logrolls depending on the benefit for the coalition and for the whole group.

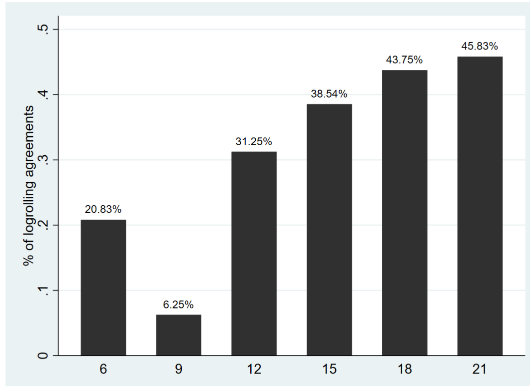
Result 3 (Benefit for the coalition) *Under the majority rule, more logrolls occurred when the benefits for the coalition are higher.*

This result is supported by Figure 7a that shows that under majority, the higher the gains for the coalition (the range of gains are from 6 points to 21 points compared to the sincere payoffs), the more likely the logrolling agreement.

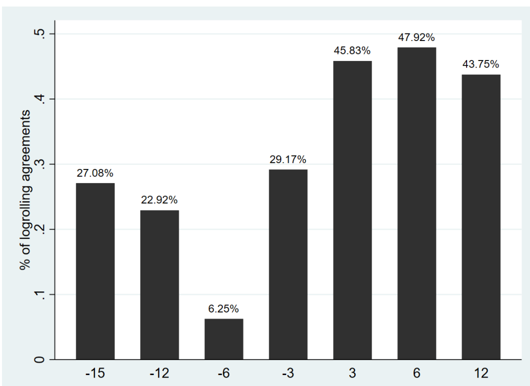
Result 4 (Benefit for the group) *Under majority and under unanimity rule, more logrolls occurred when the benefits for the group are higher.*

Under majority, logrolling agreements either improve the aggregate outcome (gains are equal to 3, 6 or 12 compared to the sincere case) or decrease it (losses are equal to -15, -12, -6 or -3). As can be seen in Figure 7b, logrolling agreements are more likely to occur when they increase the aggregate payoff. Thus, participants made less logrolling agreements than predicted, especially when the group suffered from this logrolling agreement (when the cost for the minority exceeds the gains for the coalition). If we divide logrolling agreement into two categories − logrolling agreements that yields to a gain for the group and logrolling agreements that yields to a loss for the group − around 45% of the predicted logrolling agreements occur in the first category, while only 22% occur in the second category. It mitigates the potential negative impact of logrolling under majority rule.

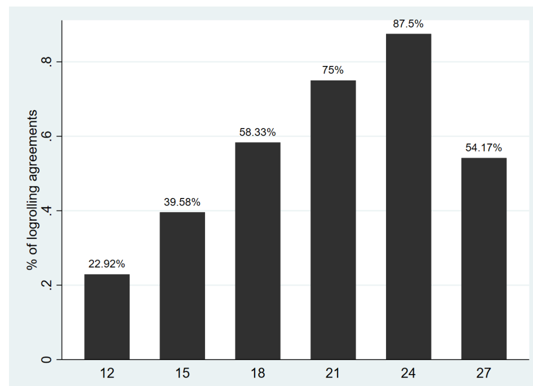
Under unanimity rule, Figure 7c shows that logrolling agreements occur more often than under majority. This is not surprising as the gains for the group are higher compared to majority, because



(a) Effect of the gains for the coalition under majority (Result 3)



(b) Effect of the gains for the group under majority (Result 4)



(c) Effect of the gains for the group under unanimity (Result 3-4)

Figure 7: Effect of the gains for the coalition or group (Result 3 and 4)

in the absence of logrolls, no projects pass.

Regressions in Table 6 summarize the findings for Results 1 to 4. The dependent variable is the occurrence of a logrolling agreement (binary variable) and standard errors are clustered at the subgroup level.[16] Under majority (regressions (1) to (3), the independent variables are *Mixed logrolls* (binary variable that equals 1 if this is a mixed logroll vs. a bundle), *Gains for coalition* (that represents the number of points gained by the coalition thanks to the logrolling agreement compared to sincere payoffs) and *Gains for group* (that represents the number of points gained/lost by the whole group thanks to the logrolling agreement compared to sincere payoffs). This last variable is also present under unanimity (regressions 4) to (6) and we have two additional binary variables to control for the number of voters and projects involved in the agreement with *Three*

[16]The observation of Game 8 in the Majority treatment and of Games 4 and 7 in the Unanimity treatment are not taken into account in these regressions as no logrolling agreements were predicted in these cases.

voters (vs. two voters) and *Three projects* (vs. two projects). Under majority rule, mixed logrolls occur less often than bundles, though the difference is not significant. The framing of our tables, with consistently positive transformed payoffs, may have facilitated mixed logrolls. However, our design cannot confirm this interpretation. Higher gains (for both the coalition and the group) increase the likelihood of predicted logrolling agreements, but Regression (3) shows that coalition gains primarily drive this effect. Under unanimity, agreements involving more voters or projects are significantly less likely, as they are more cognitively demanding and require better coordination. Finally, higher group gains increase the likelihood of logrolling agreements.

Table 6: Likelihood of logrolling agreements under both rules, probit, panel data (Result 1-4)

	(1)	(2)	(3)	(4)	(5)	(6)
	Maj	Maj	Maj	Unan	Unan	Unan
Mixed logrolls	-0.143	-0.168	-0.140			
	(0.190)	(0.178)	(0.185)			
Gains for coalition	0.064***		0.058**			
	(0.009)		(0.023)			
Gains for group		0.030***	0.004		0.090***	0.084***
		(0.007)	(0.016)		(0.0162)	(0.0261)
Three voters				-0.296**		0.236
				(0.146)		(0.187)
Three projects				-1.089***		-0.477
				(0.334)		(0.456)
Constant	-1.308***	-0.364*	-1.225***	0.643***	-1.532***	-1.511**
	(0.235)	(0.191)	(0.332)	(0.105)	(0.353)	(0.666)
N	384	384	384	336	336	336
Clusters	8	8	8	8	8	8

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

Project level: passage of positive/negative net benefit projects We now look at the results at the project level: some have a positive net benefit while others have a negative one. Our algorithm predicts that 80.95% and 61.90% of positive-benefit projects pass under majority and unanimity, respectively, while 66.67% and 33.33% of negative-benefit projects pass.[17] For positive-benefit projects, actual results align closely with predictions: 76.78% and 59.32% pass under majority and unanimity. However, only 36.46% and 22.22% of negative-benefit projects pass. The passage of negative-benefit projects under unanimity strongly suggests participants engaged in logrolling.

Individual level: realized and predicted gains/losses from logrolling We now look at payoffs at the individual level for each matrix (the original matrix and the variant as predictions are the same). In Figure 8, the colored bars represent *realized gains*; the difference between the

[17]Note that no negative benefit projects can pass under unanimity rule if voters vote sincerely. But they can pass if the losses of some voters are compensated by high gains in another project that would fail under sincere voting.

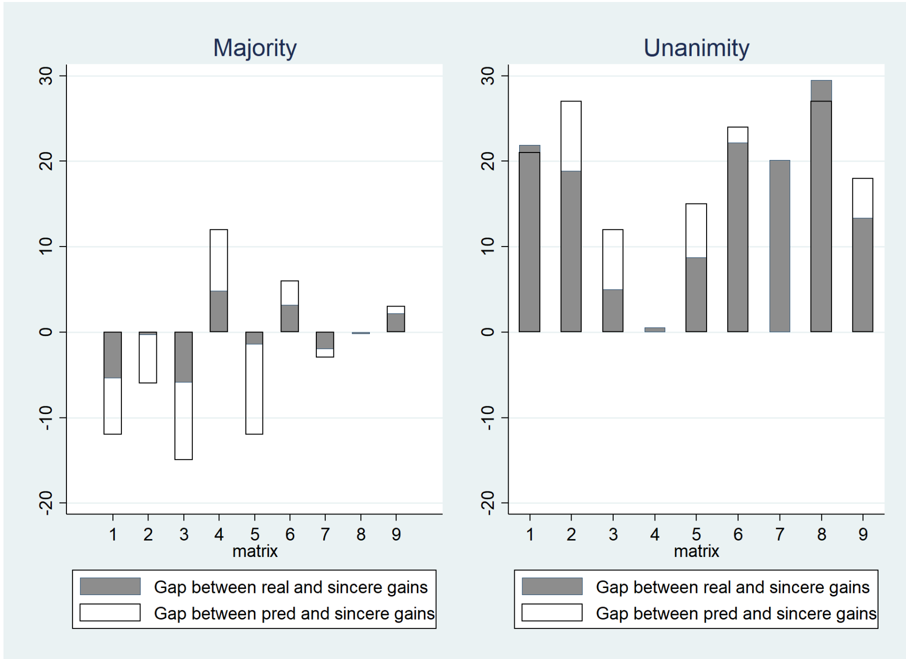


Figure 8: Realized vs. predicted gains from logrolling

realized payoffs and the payoffs if voters voted sincerely. The white bars with a black outline represent *predicted gains*; the difference between the predicted payoffs and the payoffs if voters voted sincerely.[18] Under majority rule, logrolling may have a negative − realized and predicted − impact, but the gains (losses) occurred with a lower intensity. On the contrary, under the unanimity rule, logrolling cannot be detrimental.[19] Thus, the negative impact of logrolling under majority rule is mitigated.

6.2 Results on outcomes

As explained in our experimental design, we classify outcomes into five categories: sincere, utilitarian, predicted, core, and other outcome. Figure 9 shows the percentage of each category of outcomes under each rule.[20] We can see that groups did not reach the same types of outcomes under both rules. First, there are more sincere outcomes under majority than unanimity (MW,

[18] Please note that it does not matter if we use the transformed or the untransformed payoffs. We would have the same graph. Let's illustrate that with an example: Matrix 5a (see Appendix). The aggregate sincere payoffs under majority with the transformed payoffs equal 57 (only C passes) and if the voters pass the predicted outcome (all projects pass), the aggregate realized payoffs are 63. The difference equals 6. If we take the untransformed payoffs, the sincere payoffs equal 9 and the realized payoffs equal 15, which also make a difference of 6. By substracting the sincere payoffs we "normalize" the payoffs to the same basis.

[19] Groups made even better than predicted in 4 matrices. Game 4 and game 9 are two situations where under unanimity rule, the sincere outcome corresponds to the status-quo. So the predicted payoffs are null. Despite that, voters managed to increase aggregate payoffs.

[20] One outcome may fall into different categories; in Game 8 under majority rule, passing all the projects is the sincere, predicted, utilitarian and core outcome. It occurs 95.93% of the time.

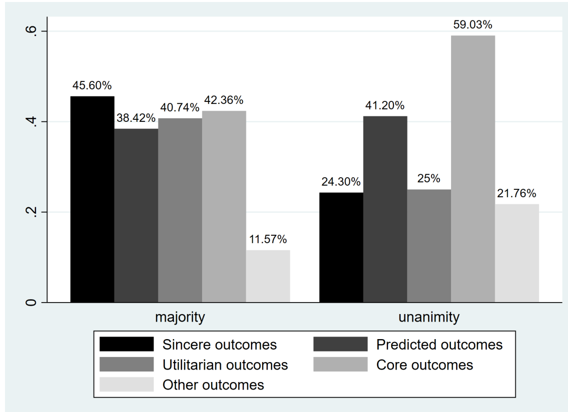


Figure 9: Type of outcomes under both rules

p=0.002). Given that the sincere outcome under the unanimity rule is the empty outcome, it means that in 24% of the cases, voters did not find any agreement and no project was undertaken. Second, predicted outcomes (based on our algorithm) occurred in about 40% of the cases and the percentage is similar across rules (MW, p = 0.792). Finally, we can see that there are much more utilitarian outcomes (3rd column) under majority than unanimity rule (MW, p=0.005), meaning that aggregate payoffs were maximized more often under majority rule. However, we see that more outcomes are part of the core under unanimity rule than under majority rule (MW, p = 0.001), meaning that groups managed to improve the payoff of every voter without penalizing anyone. It corroborates results 3 and 4 (benefit of logrolling for the coalition and/or the whole group), as the utilitarian outcome is the one that maximizes the payoffs of the group and the core outcome Pareto dominates the other payoff outcomes. We cannot conclude that one rule is "better" than another as one rule seems to foster the emergence of outcomes that benefits the whole group (at the expense of the minority), while the other rule fosters the emergence of outcomes that improve the situation of everyone but does not manage to maximize aggregate payoffs.

Result 5 (Core outcomes) *Predicted outcomes that are part of the core emerge twice more than predicted outcomes that are not part of the core under both rules.*

Under majority, predicted outcomes occurred in 59.03% of the cases if they are part of the core, while they occurred in 28.13% of the case when they are not. Under unanimity, the results follow the same trend, even if our predicted outcomes are almost always part of the core: predicted outcomes occurred in 43.49% of the cases if they are part of the core, while they occurred in 22.92% of the case when they are not. We perform the same analysis for utilitarian outcomes.

Result 6 (Utilitarian outcomes) *Predicted outcomes that are part of the utilitarian outcomes emerge twice more than predicted outcomes that are not utilitarian under majority, while under unanimity they emerge 25% more.*

Under majority, predicted outcomes occurred in 63.89% of the cases if they are part of the utilitarian outcomes, while they occurred in 25.69% of the case when they are not. Under unanimity, the results are less strong: predicted outcomes occurred in 48.96% of the cases if they are part of the utilitarian outcomes, while they occurred in 38.99% of the case when they are not.

Table 7 summarizes Results 5 and 6. The dependent variable is a binary outcome that equals 1 if the outcome that occurs is the predicted outcome. We have two dependent variables to identify if being the *core outcome* and/or the *utilitarian outcome* makes it more likely to emerge. Under majority (regressions (1), (3), and (5)), a predicted outcome that is part of the core and that is the utilitarian outcome is more likely to occur. Under unanimity (regressions (2), (4), and (6)), this is true for core outcomes, where the coefficient is significant, but not for utilitarian outcomes.

Table 7: Likelihood of predicted outcomes

	(1) Maj.	(2) Unan.	(3) Maj.	(4) Unan.	(5) Maj.	(6) Unan.
Core outcome	0.820***	0.578**			0.442***	0.531**
	(0.171)	(0.275)			(0.132)	(0.270)
Util. outcome			1.028***	0.254	0.822***	0.184
			(0.211)	(0.203)	(0.185)	(0.199)
Constant	-0.588***	-0.742***	-0.666***	-0.280***	-0.746***	-0.742***
	(0.172)	(0.237)	(0.190)	(0.0541)	(0.210)	(0.237)
N	432	432	432	432	432	432
Clusters	8	8	8	8	8	8

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

6.3 The bargaining process

6.3.1 The chat

Although the color system could substitute for communication, the chat was essential for group coordination and forming logrolling agreements; only 7.63% of logrolling agreements occurred without any chat under majority rule, and 3.92% under unanimity rule.[21] Moreover, voters took significantly longer to confirm their votes under unanimity rule (87 seconds on average) compared to majority rule (61 seconds) (MW, $p = 0.021$). In the chat, we noticed two things. First, we saw that participants wrote down the trade they wanted to make, and often from the very first round of the experiment, under both rules.[22] Second, we also noticed that trust was a major topic. In both treatments, participants reproached other participants and mentioned that they had been betrayed by other participants.[23] Trust was complicated to restore as some people betrayed others by promising to vote insincerely and finally changed their vote at the last minute. This explains, at least partly, why not all logrolling agreements took place: participants betrayed each other, did not trust each other enough, and did not take the risk of trading.

[21] Participants chatted more under unanimity rule (1947 rows) than majority rule (1085 rows).

[22] Here is an example of discussion between two participants (session 4, majority treatment): participant 5qfrcfhj: "Participant 3, if you vote yes on Project B, I'll vote no on Project C. Deal?", participant pr6nm1ax : "Sure.".

[23] Here is an example (session 6, unanimity treatment): participant hqjlx2c9 "There are some sharks here. I'm willing to cooperate...", participant 0qc4z17l "Me too, but I'm also heavily traumatized...", participant v3gd6b5q "I'm also very traumatized. Bad people here.".

6.3.2 Treason

We can analyze the data more precisely to determine whether participants betrayed each other. Examining the percentage of insincere votes in each matrix (see Appendix, Section A.5), it appears that some participants did not honor their commitments. For instance, in Game 2a under the unanimity rule, voters 2 and 3 can modify their votes on projects C and B, respectively, to pass the bundle. On average, 66.67% of voter 2s voted yes on project C, and 58.33% of voter 3s voted yes on project B. However, these insincere votes occurred together only 50% of the time. This suggests that some voters promised to vote a certain way but changed their votes after their partner confirmed theirs. Due to the stranger matching setting, there is no concern about reputation. This could be seen as a limitation of our design, but there are two possible ways to address it. First, we could have used a partner-matching setting. However, if groups remained the same across rounds, we were concerned that strong other-regarding preferences might emerge, leading participants to pursue the utilitarian outcome every period, which would not capture the essence of logrolling. A second solution would involve binding agreements, but this approach has two limitations. First, we aimed to allow participants to trade as freely as possible to observe which agreements *naturally* emerged. Second, enforcing logrolling could make the behavior too obvious, raising concerns about demand effects.

During the experiment, we also recorded participants' clicks, i.e., intended votes, that represent clicks in the Yes or No boxes. In each session, 18 participants voted on 18 matrices for 3 projects, resulting in 972 intended votes if participants clicked only once per project. However, as shown in Table 9 in the Appendix, this number is consistently higher across all sessions (30% more than expected). While some of these changes in intended votes may reflect genuine strategy adjustments, their presence in the final seconds of each round ¯ combined with chat data ¯ suggests that some betrayal occurred.

7 Conclusion

We examined the performance of alternative voting rules in the presence of logrolling, with a focus on simple majority and unanimity rule. A committee of voters decides whether to undertake various projects, each with a specific value (positive or negative) for each voter. Using simulations on randomly generated value matrices, we find that majority rule yields higher aggregate payoffs on average when voters vote sincerely and payoffs are drawn independently from a symmetric distribution. However, when logrolling is possible and the number of projects is large enough, unanimity rule yields higher expected payoffs. This effect is due to the fact that logrolling can be associated with negative externalities under majority rule, while it is always Pareto improving under unanimity rule.

To examine whether human subjects engage in logrolling agreements, we conduct a laboratory experiment using a selection of payoff matrices. The environment is largely unstructured, with no binding agreements and open communication via chat. We find that subjects engage in some, but not all of the logrolling agreements that the experimental situations allow. Complex agreements, involving multiple projects or voters, are less likely to emerge than simple agreements involving two subjecst and two projects. We also find that agreements are less likely when they lead to a decrease in the aggregate payoff. Under majority rule, outcomes often maximize overall payoffs at the expense of a minority, whereas under unanimity rule, outcomes tend to favor everyone.

The experiment is not designed to assess whether majority or unanimity is better in the presence of logrolling. Still, the results suggest that the predicted detrimental effects of logrolling under majority rule may be mitigated by cognitive constraints and social or efficiency concerns.

Several points are subject to discussion with our paper. The first one is about the context. Comparing decisions in large institutions, such as the Council of Europe, to those in small committees is challenging due to differences in scale, structure, and incentives. In large institutions, decision-making involves more diverse interests, greater complexity, and higher coordination costs, making consensus or logrolling more intricate. In contrast, small committees operate with fewer participants, allowing for easier communication, simpler negotiations, and often more transparent agreements. Analyzing further how logrolling impacts decision processes in different contexts is a crucial topic. The second point addresses social preferences and reputation. We minimized their influence using a stranger matching design, but we cannot fully rule them out, as the most detrimental logrolls were rare and trust appeared to decline during the experiment, as seen in the chat. Finally, it can be argued that in reality, voter preferences are privately known. Therefore an interesting avenue for future research might be to consider the implications of private information in our context.

A Appendix

A.1 Logrolling algorithm

The logrolling algorithm was implemented using Mathematica. The corresponding code is provided in the supplementary material. In this section, we describe the logic of the program in plain language.

To identify potential deals, we begin with the vector of sincere voting outcomes $p^S(Z)$ and consider the payoffs that would result if a *subset* of those outcomes were “flipped”. For an individual project k, these payoffs are given by $-p^S_k \cdot z_k$ where z_k is the k^{th} row of Z. Thus, the $L \times N$ matrix $F(Z, m) = -p^S(Z, m)Z$ summarizes the payoffs associated with “flipping” the sincere outcomes on each of the L projects individually.

To assess voters' myopic preferences over logrolling *deals*, we construct a matrix $D(Z, m)$, each row of which is equal to the sum over a subset of the rows of $F(Z, m)$. Specifically, all subsets consisting of between 2 and K rows (projects) are considered. Each row of $D(Z, m)$ summarizes the payoff changes that would result if a deal was reached that caused the sincere outcomes on all projects contained in the corresponding subset to be “flipped”. The parameter K places an upper bound on the number of projects that can be “flipped” by a single deal. We then identify, for each subset of projects, the coalition of voters who would benefit from “flipping” it. This is given by the set of columns for which the corresponding row in $D(Z, m)$ contains a positive element. Next, we test whether this coalition can flip the sincere outcome on every project in the set by voting appropriately, assuming that all voters not in the coalition continue to vote sincerely. If so, we add that subset of projects to a list of *"potential deals"*. After completing this list, we remove from it all elements that fully contain others.[24]

The construction of a list of "potential deals" is done once for a given matrix of payoffs Z and voting rule (margin) m, and for $K = 6$. Then, we simulate the myopic proposal and voting program described in the main text once for every possible sequence of turns and for every value of K between 2 and 6. As an example, if $N = 3$ and $K = 4$, one of the possible turn sequences is $\{2, 1, 3\}$. The corresponding simulation begins by removing all deals involving more than 4 projects from the list of potential deals. Among those that remain, we identify the one which yields the greatest payoff for voter 2. (If no deal yields a positive payoff for voter 2, we move to voter 1.) For all projects that are part of this deal, the corresponding outcomes are recorded, and all other deals involving any of these projects are removed from the list of potential deals. This process is repeated for voter 1, then 3, and again 2, etc., until the list of potential deals is empty. For all projects whose outcomes are not determined at the end of this process, the sincere outcome is recorded.

After repeating this process for all possible sequence of turns, we record the vector of average utilities for all voters from all sequences. That is, for a given matrix Z and all values K between 2 and 6, we obtain a vector of "expected" utilities if all turn sequences are equally likely. This expected payoff vector is the main output from our simulations, and all of the results we report are based on it.

Table 8: Summary statistics: Socio-demographic individual characteristics

Treatments	Majority-stranger	Unanimity-stranger	p-value
Age	23.46 (2.99)	22.92 (3.19)	0.295
Male (%)	47.22%	50%	0.741
Economic student (%)	23.61%	19.44%	0.546
# sessions	4	4	
# participants	72	72	

Notes: Standard deviations are in parentheses. P-values from t-tests.

Table 9: Numbers of changes and confirmations (info not recorded due to technical issue during session 1)

Session number	Changes	Confirmations	Total
2	1241	909	2150
3	1134	967	2101
4	1155	971	2126
5	1226	917	2143
6	1168	932	2100
7	1181	921	2102
8	1340	955	2295
Total if truthful	972	972	1944

A.2 Laboratory experiment

A.3 Screenshots of the experiment

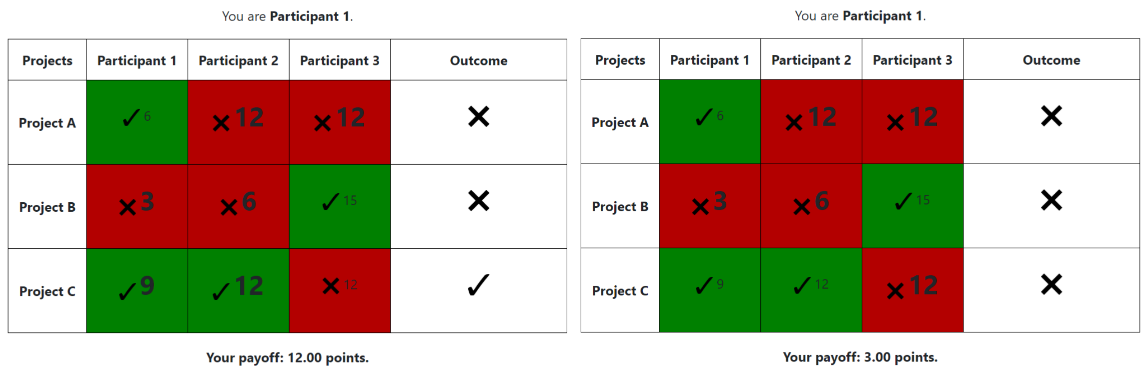
A.4 Instructions

Thank you for participating in this experiment. Please read the following instructions carefully.

General rules

- This experiment will take about 90 minutes. During this time, you cannot leave your seat.
- Please turn off your phone. From this point; there should be nothing left on your desk. (A drink is allowed of course.)
- Please remain quiet during the experiment and do not speak with other participants.
- If you have a question, please raise your hand or say "I have a question".
- Remain seated at the end of the experiment until your seat number is called. You will then receive your payment and sign your receipt.

[24] For example, if the list contains the elements j, k, l and j, k, then the former is removed, as it contains the latter. This step limits proposer power, as it prevents proposers from "flipping" a project (l in the example) by adding it into a deal that others would support even without that project being included.



Notes: The gains of each participant is written bigger to highlight their earnings for the period.

Figure 10: Screenshot of voting outcomes under majority (left) and unanimity (right).

Rounds, points, payment

For your participation, you will receive a participation fee of 5 EUR. During the experiment, there is also the possibility to get a higher payoff. Your payoff will depend on your decisions and the decisions of the others participants. The experiment consists in 18 rounds. In each round you have the opportunity to earn points. At the end of the experiment, 5 rounds are randomly chosen for payment. Your payment will depend on your average score in the random rounds. The conversion rate is the following: 1 point = 1 EUR.

Groups and ID numbers

At the beginning of the experiment, groups of 3 participants are randomly formed. Each participant in a group is randomly assigned an ID number (1,2 or 3). The composition of the groups and the ID numbers of participants will be redefined each round, i.e. you will interact with different participants in each round and your ID number as well as the ID numbers of other participants will change. (It may happen that you randomly meet the same participant in several rounds, but it is impossible that the exact same composition of a group repeats itself.

Projects and points

In each round, your group will make three decisions. Each decision corresponds to one of the three projects (A, B and C) that your group will either "pass" or "not pass". Each participant, depending on the decision on projects either receives points when the project passes or when it does not pass. This information is shown in a table. In this table, each row corresponds to a project and each column to a participant. Here is an example:

Each cell shows the outcome for which the corresponding participant would receive points (✗ and ✓), and the number of points she receives if the group decides accordingly.

As an example, consider the first cell (Participant 1, Project A):

- The ✗ means that Participant 1 receives points if Project A does not pass.

Project	Participant 1	Participant 2	Participant 3
Project A	✗ 6	✓ 3	✓ 12
Project B	✓ 6	✓ 9	✓ 15
Project C	✗ 12	✓ 15	✗ 3

- The number "6" means that she receives 6 points if the group decides not to pass the project.
- If Project A passes, Participant 1 will get 0 point.

As another example, consider Project B and Participant 2. The ✓ and the number "9" mean that Participant 2 receives 9 points if Project B passes. Otherwise, she will not receive any points.

The total gain of a participant in a round is given by the sum of points earned from the three projects. The actual content of the table is different in the experiment than in the examples, and changes from round to round.

How the group makes decisions

The members of the group vote separately on each of the three projects. Each participant can vote either with "Yes" or "No". *Majority treatment: A project passes if at least 2 participants in the group vote Yes. Unanimity treatment: A project passes if all 3 participants in the group vote Yes.* Otherwise it does not pass.

To submit a vote for a project, first click on "yes" or "no" in the corresponding row:

- If a participant clicks on "yes", the associated cell to the project and ID number will be colored in light green. If a participant clicks on "no", the corresponding cell is colored in light red.
- Participants may change their decision as often as they like until they clock the "confirm" button.

If a participant clicks on the "confirm" button, the corresponding cell becomes dark green or dark red depending on her vote. At that point, the participant cannot change her vote anymore on this project. All the group members can see how the colors of the cells change. Thus, all the participants can see the votes of the other participants and whether their votes are confirmed or not. Each round lasts 3 minutes at maximum. If at the end of the 3 minutes, a or several participants did not vote and confirm her vote(s) for a or several projects, the unconfirmed votes are automatically considered as "no" votes.

Example:

In this example, Participant 1 voted "no" and confirmed her vote on Project C. For Project B, she voted "yes" but did not confirm yet. Participant 1 can also see that:

You are **Participant 1.**

Projects	Participant 1	Participant 2	Participant 3	Your vote
Project A	✗ 6	✓ 3	✓ 12	Yes No
Project B	✓ 6	✓ 9	✓ 15	Yes No confirm
Project C	✗ 12	✓ 15	✗ 3	confirmed

- Participant 2 has voted "yes" on Project C but has not yet confirmed it.
- Participant 3 has voted "yes" on Project B and confirmed her vote.
- Participant 3 has voted "no" on Project C and confirmed her vote.

End of each round

A round ends after 3 minutes, or once all participants have voted on all projects and have confirmed their decisions. After that, you will be informed about the outcomes of the votes, as well as about the points achieved in the round.

The confirmed votes are displayed in the table, with the cells colored in dark green or dark green depending on the votes.(If a participant has not voted on a project or has not confirmed her vote on time, the corresponding cell appears dark red, because in this case it is considered as a "no" vote.)

It also indicates which projects pass and which projects do not pass. If the project passes, a ✓ in displayed in the last column on the right.If the project does not pass, a ✗ is displayed. The points earned in this round are highlighted.

Projects	Participant 1	Participant 2	Participant 3	Outcome
Project A	✗ 6	✓ 3	✓ 12	✓
Project B	✓ 6	✓ 9	✓ 15	✓
Projekt C	✗ 12	✓ 15	✗ 3	✗

Projects	Participant 1	Participant 2	Participant 3	Outcome
Project A	✗ 6	✓ 3	✓ 12	✗
Project B	✓ 6	✓ 9	✓ 15	✓
Projekt C	✗ 12	✓ 15	✗ 3	✗

Figure 11: Majority treatment (left) and Unanimity treatment (right)

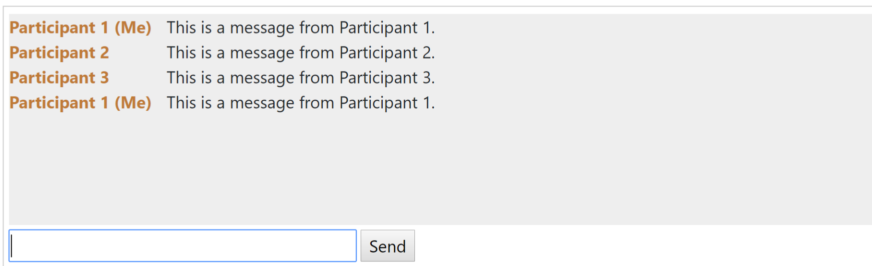
The total score you achieved in the round will be displayed below the table. This information remains visible for 20 seconds or until you click "Next". After all the groups have finished the round and have seen the outcome, a new round begins with a new table. Before the start of the next round (as described above) new groups are formed.

Note: Since the next round begins only when all participants are ready, there may be a certain waiting time between two rounds.

Communication in the group

Within each round of the experiment, you have the opportunity to exchange messages with your group members. To do this, use the chat window at the bottom of the screen. To send a message, enter your message in the template, then either click "send" or press the entry button of your keyboard.

Please, use communication only to discuss about the experiment and the decisions of your group. It is not allowed to reveal your identity to other participants. For example, your should not mention your name, your seat number or any other identifying features under no circumstances. Participants who do not follow this rule will be excluded from the experiment and will not receive any payment.



Summary: procedure of a round

1. At the beginning of each round random groups of 3 participants are formed. The composition of your group will never be repeated.

2. In each round, the participants see a table representing the points they may earn depending on the group decisions. A ✓ means that a participant receives points, when the corresponding project passes. A ✗ means that a participant receives points if the corresponding project does not pass.

3. *Majority treatment* You have three minutes to vote on each project and to confirm your votes. If at least 2 participants vote "yes", the project passes, otherwise it does not pass. Depending on the voting outcomes, participants receive points.

4. *Unanimity treatment* You have three minutes to vote on each project and to confirm your votes. If all 3 participants vote "yes", the project passes, otherwise it does not pass. Depending on the voting outcomes, participants receive points.

5. You can communicate with other participants using a chat window.

6. At the end of a round; you will learn the voting outcome and the total number of points you earned in this round.

7. At the end of the experiment, 5 rounds are randomly chosen for payment. Your payment in EUR equals the average of the total score you have reached in these rounds.

Before the start of the experiment, we ask you to answer some comprehension questions. If you have a question, please raise your hand or say "I have a question".

A.5 Games used in the experiment.

In this section, we display the different games used in the experiment. We provide a very short explanation about why we selected each game. We give a lot of information on each game:

- We describe the values of each project for each voter. We first display the original game and its variant where fey numbers change compared to the original one but the sum of the columns and the rows are the sum in the original game and in its variant.
- Under the values of each project for each voter, we display the average percentage of insincere votes in the experiment.
- We display in bold the predicted vote trading.
- The column *Sinc.* shows which project(s) pass if voters vote sincerely. The column *Util.* shows which projects should pass to maximize the aggregate payoffs under both rules. Note that the Utilitarian outcomes are the same under both rules. Finally, *Pred.* shows which project(s) are predicted to pass with our algorithm. The columns of the original game and its variant are exactly the same. There is only a cardinal difference (so there will be differences in terms of payoffs), but the sincere, utilitarian and predicted outcomes are the same in the original version and in the variant.
- We describe the two sequences of games by providing the round of each game for the first and the second subgroup of 9 participants. The two subgroups face the same game but in a different order to see if there is an order effect.

After the four games (the original game and its variant for each decision rule), we draw a table including different pieces of information:

- We describe for each rule the payoff vectors and the aggregate payoffs depending on each type of outcome (sincere, utilitarian and predicted) for both the original game and the variant.
- The final row of the table shows which logrolling agreement is predicted by our algorithm. Let's take the example of game 1 under majority to explain our notation: {2, 3} means that voter 2 and voter 3 are part of the logrolling agreement and {A, B} means that in this logrolling agreement, they decide to flip the outcome on project A and B compared to the sincere outcome. So here, they decide to pass Project A and to block Project B. For that, voter 2 has to vote yes on Project A and voter 3 has to vote no on Project B. The resulting outcome is that projects A and C pass.

A.5.1 Game 1

Under majority, we predict a mixed logroll that generates negative externalities on Voter 1 and decreases the aggregate payoff. Under unanimity, we predict a bundle of two projects where three voters vote insincerely.

Game 1: majority.

Game 1a: Round 5 / Round 15.

	Voter					
Project	1	2	3	Sinc.	Util.	Pred.
A	-9	**-3**	9			X
	20.83	**62.5**	20.83			
B	15	-9	**3**	X	X	
	4.17	29.17	**45.83**			
C	15	12	-3	X	X	X
	0	0	41.67			
Pred. combi.		37.50%				

Game 1b: Round 13 / Round 5.

	Voter					
Project	1	2	3	Sinc.	Util.	Pred.
A	-9	**-6**	12			X
	33.33	**37.5**	20.83			
B	15	-9	**3**	X	X	
	4.17	33.33	**37.5**			
C	15	15	-6	X	X	X
	0	0	54.17			
Pred. combi.		25%				

Game 1: unanimity.

Game 1a: Round 5 / Round 15.

	Voter					
Project	1	2	3	Sinc.	Util.	Pred.
A	**-9**	**-3**	9			X
	87.5	**91.67**	0			
B	15	-9	3		X	
	4.17	41.67	8.33			
C	15	12	**-3**		X	X
	0	0	**87.5**			
Pred. combi.		79.17%				

Game 1b: Round 13 / Round 5.

	Voter					
Project	1	2	3	Sinc.	Util.	Pred.
A	**-9**	**-6**	12			X
	91.67	**87.5**	8.33			
B	15	-9	3		X	
	4.17	54.17	8.33			
C	15	15	**-6**		X	X
	0	0	**79.17**			
Pred. combi.		70.83%				

Game 1	Majority	Unanimity
Sincere	(30, 3, 0) = 33 and (30, 6, -3) = 33	(0, 0, 0) = 0
Utilitarian	(30, 3, 0) = 33 and (30, 6, -3) = 33	(30, 3, 0) = 33 and (30, 6, -3) = 33
Predicted	(6, 9, 6) = 21 and (6, 9, 6) = 21	(6, 9, 6) = 21 and (6, 9, 6) = 21
Logrolling agreement	Mixed: {2,3} {A, B}	Bundle: {1,2,3} {A, C}

A.5.2 Game 2

Under majority, we predict a mixed logroll that generates negative externalities on Voter 3 and decreases aggregate payoffs. Under unanimity, we predict a bundle of two projects where two voters vote insincerely.

Game 2: majority.

Game 2a: Round 15 / Round 18.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	15 16.67	**-3** **37.5**	-6 12.5		X	X
B	6 8.33	15 0	-6 29.17	X	X	X
C	**12** **16.67**	-9 37.5	9 4.17	X	X	
Pred. combi.		12.50%				

Game 2b: Round 8 / Round 2.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	15 33.33	**-3** **25**	-6 8.33		X	X
B	6 4.17	12 4.17	-3 58.33	X	X	X
C	**12** **4.17**	-6 37.5	6 4.17	X	X	
Pred. combi.		0%				

Game 2: unanimity.

Game 2a: Round 15 / Round 18.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	15 25	-3 29.17	-6 4.17		X	
B	6 4.17	15 0	**-6** **58.33**		X	X
C	12 4.17	**-9** **66.67**	9 8.33		X	X
Pred. combi.		50%				

Game 2b: Round 8 / Round 2.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	15 54.17	-3 0	-6 0		X	
B	6 8.33	12 4.17	**-3** **75**		X	X
C	12 4.17	**-6** **79.17**	6 8.33		X	X
Pred. combi.		58.33%				

Game 2	Majority	Unanimity
Sincere	(18, 6, 3) = 27 and (18, 6, 3) = 27	(0, 0, 0) = 0
Utilitarian	(33, 3, -3) = 33 and (33, 3, -3) = 33	(33, 3, -3) = 33 and (33, 3, -3) = 33
Predicted	(21, 12, -12) = 21 and (21, 9, -9) = 21	(18, 6, 3) = 27 and (18, 6, 3) = 27
Logrolling agreement	Mixed: {1, 2} {A, C}	Bundle: {2,3} {B, C}

A.5.3 Game 3

Under majority, we predict a mixed logroll that generates negative externalities on Voter 1 and decreases aggregate payoffs. Under unanimity, we predict a bundle of three projects where three voters vote insincerely.

Game 3: majority.

Game 3a: Round 18 / Round 7.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	-12 0	9 33.33	**-3** **37.5**			X
B	9 8.33	-12 45.83	12 4.17	X	X	X
C	9 0	**6** **29.17**	-6 33.33	X	X	
Pred. combi.		29.17%				

Game 3b: Round 1 / Round 10.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	-12 12.5	9 29.17	**-3** **33.33**			X
B	6 8.33	-12 25	15 4.17	X	X	X
C	12 12.5	**6** **37.5**	-9 33.33	X	X	
Pred. combi.		25%				

Game 3: unanimity.

Game 3a: Round 18 / Round 7.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	**-12** **33.33**	9 33.33	**-3** **45.83**			X
B	9 20.83	**-12** **37.5**	12 29.17		X	X
C	9 12.5	6 8.33	**-6** **37.5**		X	X
Pred. combi.		20.83%				

Game 3b: Round 1 / Round 10.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	**-12** **29.17**	9 33.33	**-3** **29.17**			X
B	6 16.67	**-12** **33.33**	15 20.83		X	X
C	12 16.67	6 20.83	**-9** **41.67**		X	X
Pred. combi.		25%				

Game 3	Majority	Unanimity
Sincere	(18, -6, 6) = 18 and (18, -6, 6) = 18	(0, 0, 0) = 0
Utilitarian	(18, -6, 6) = 18 and (18, -6, 6) = 18	(18, -6, 6) = 18 and (18, -6, 6) = 18
Predicted	(-3, -3, 9) = 3 and (-6, -3, 12) = 3	(6, 3, 3) = 12 and (6, 3, 3) = 12
Logrolling agreement	Mixed: {2,3} {A, C}	Bundle: {1,2,3} {A,B, C}

A.5.4 Game 4

Under majority, we predict a mixed logroll that generates negative externalities on Voter 2 but increases aggregate payoffs. Under unanimity, we predict no logrolling agreements as one voter dislikes all the projects.[25]

Game 4: majority.

Game 4a: Round 17 / Round 4.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	**-3**	-3	15		X	X
	58.33	33.33	12.5			
B	-15	3	-9			
	4.17	45.83	16.67			
C	-9	3	**3**	X		
	12.5	16.67	**37.5**			
Pred. combi.		37.50%				

Game 4b: Round 6 / Round 17.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	**-3**	-3	15		X	X
	62.5	20.83	16.67			
B	-12	3	-12			
	4.17	45.83	8.33			
C	-12	3	**6**	X		
	8.33	25	**58.33**			
Pred. combi.		58.33%				

Game 4: unanimity.

Game 4a: Round 17 / Round 4.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	-3	-3	15		X	
	41.67	25	16.67			
B	-15	3	-9			
	0	58.33	4.17			
C	-9	3	3			
	25	12.5	16.67			
Pred. combi.	No logrolling predicted					

Game 4b: Round 6 / Round 17.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	-3	-3	15		X	
	16.67	8.33	16.67			
B	-12	3	-12			
	0	45.83	12.5			
C	-12	3	6			
	12.5	33.33	12.5			
Pred. combi.	No logrolling predicted					

Game 4	Majority	Unanimity
Sincere	(-9, 3, 3) = -3 and (-12, 3, 6) = -3	(0, 0, 0) = 0
Utilitarian	(-3, -3, 15) = 9 and (-3, -3, 15) = 9	(-3, -3, 15) = 9 and (-3, -3, 15) = 9
Predicted	(-3, -3, 15) = 9 and (-3, -3, 15) = 9	(0, 0, 0) = 0
Logrolling agreement	Mixed: {1,3} {A, C}	No logroll

[25] This is the "generous legislator" case studied by Hortala-Vallve et al. (2011). Thanks to lab experiments, the author shows that the voter who dislikes all projects "generously" offers her support to a voter to form a coalition to reduce her cost. This is what we predict under majority rule.

A.5.5 Game 5

Under majority, we predict a bundle that generates negative externalities on Voter 2 and decreases aggregate payoffs. Under unanimity, we predict a bundle of two projects where three voters vote insincerely.

Game 5: majority.

Game 5a: Round 9 / Round 1.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	**-12**	-12	6			X
	16.67	4.17	54.17			
B	15	-6	**-3**		X	X
	8.33	20.83	**29.17**			
C	-12	12	9	X	X	X
	37.5	4.17	4.17			
Pred. combi.		16.67%				

Game 5b: Round 16 / Round 11.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	**-12**	-15	9			X
	16.67	8.33	41.67			
B	15	-3	**-6**		X	X
	8.33	33.33	**33.33**			
C	-12	12	9	X	X	X
	54.17	4.17	4.17			
Pred. combi.		16.67%				

Game 5: unanimity.

Game 5a: Round 9 / Round 1.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	-12	-12	6			
	4.17	4.17	62.5			
B	15	**-6**	**-3**		X	X
	12.5	**62.5**	**58.33**			
C	**-12**	12	9		X	X
	70.83	12.5	4.17			
Pred. combi.		45.83%				

Game 5b: Round 16 / Round 11.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	-12	-15	9			
	8.33	4.17	45.83			
B	15	**-3**	**-6**		X	X
	8.33	**75**	**45.83**			
C	**-12**	12	9		X	X
	79.17	0	0			
Pred. combi.		41.67%				

Game 5	Majority	Unanimity
Sincere	(-12, 12, 9) = 9 and (-12, 12, 9) = 9	(0, 0, 0) = 0
Utilitarian	(3, 6, 6) = 15 and (3, 9, 3) = 15	(3, 6, 6) = 15 and (3, 9, 3) = 15
Predicted	(-9, -6, 12)=-3 and (-9, -6, 12) = -3	(3, 6, 6) = 15 and (3, 9, 3) = 15
Logrolling agreement	Bundle: {1,3} {A, B}	Bundle: {1,2,3} {B, C}

A.5.6 Game 6

Under majority, we predict a bundle that generates negative externalities on Voter 1 but increases aggregate payoffs. Under unanimity, we predict a bundle of two projects where three voters vote insincerely.

Game 6: majority.

Game 6a: Round 11 / Round 6.

		Voter				
Project	1	2	3	Sinc.	Util.	Pred.
A	-6 29.17	**-6** **45.83**	15 4.17		X	X
B	-3 37.5	12 20.83	**-6** **37.5**		X	X
C	12 4.17	15 4.17	-6 54.17	X	X	X
Pred. combi.		37.50%				

Game 6b: Round 7 / Round 14.

		Voter				
Project	1	2	3	Sinc.	Util.	Pred.
A	-6 20.83	**-3** **79.17**	12 8.33		X	X
B	-3 25	9 16.67	**-3** **70.83**		X	X
C	12 0	15 0	-6 45.83	X	X	X
Pred. combi.		62.50%				

Game 6: unanimity.

Game 6a: Round 11 / Round 6.

		Voter				
Project	1	2	3	Sinc.	Util.	Pred.
A	**-6** **87.5**	**-6** **91.67**	15 8.33		X	X
B	-3 41.67	12 16.67	-6 45.83		X	
C	12 0	15 0	**-6** **95.83**		X	X
Pred. combi.		87.50%				

Game 6b: Round 7 / Round 14.

		Voter				
Project	1	2	3	Sinc.	Util.	Pred.
A	**-6** **87.5**	**-3** **95.83**	12 0		X	X
B	-3 20.83	9 29.17	-3 25		X	
C	12 0	15 0	**-6** **83.33**		X	X
Pred. combi.		70.83%				

Game 6	Majority	Unanimity
Sincere	(12, 15, -6) = 21 and (12, 15, -6) = 21	(0, 0, 0) = 0
Utilitarian	(3, 21, 3) = 27 and (3, 21, 3) = 27	(3, 21, 3) = 27 and (3, 21, 3) = 27
Predicted	(3, 21, 3) = 27 and (3, 21, 3) = 27	(6, 9, 9) = 24 and (6, 12, 6) = 24
Logrolling agreement	Bundle: {2,3} {A, B}	Bundle: {1,2,3} {A, C}

A.5.7 Game 7

Under majority, we predict two mixed logrolls, a and b, depending on which voter "starts". Both generate a negative externality on one voter and decrease the aggregate payoff. Under unanimity, we predict no logrolls (no bundles are unanimously supported).

Game 7: majority.

Game 7a: Round 12 / Round 13.

	Voter					
Project	1	2	3	Sinc.	Util.	Pred.
A	15	**6^{b}**	-9	X	X	X^a
	4.17	**41.67**	33.33			
B	**-3^{a}**	15	**-3^{b}**		X	X^{a+b}
	37.5	16.67	**54.17**			
C	-6	**12^{a}**	9	X	X	X^b
	29.17	**8.33**	0			
Pred. combi. (a or b)		41.67%				

Game 7b: Round 2 / Round 8.

	Voter					
Project	1	2	3	Sinc.	Util.	Pred.
A	15	**9^{b}**	-12	X	X	X^a
	8.33	**29.17**	29.17			
B	**-3^{a}**	15	**-3^{b}**		X	X^{a+b}
	29.17	20.83	**25**			
C	-6	**9^{a}**	12		X	X^b
	29.17	**16.67**	8.33			
Pred. combi. (a or b)		25%				

Game 7: unanimity.

Game 7a: Round 12 / Round 13.

	Voter					
Project	1	2	3	Sinc.	Util.	Pred.
A	15	6	-9		X	
	4.17	8.33	62.5			
B	-3	15	-3		X	
	41.67	33.33	41.67			
C	-6	12	9		X	
	83.33	4.17	0			
Pred. combi.	No logrolling predicted					

Game 7b: Round 2 / Round 8.

	Voter					
Project	1	2	3	Sinc.	Util.	Pred.
A	15	9	-12		X	
	4.17	8.33	41.67			
B	-3	15	-3		X	
	37.5	16.67	29.17			
C	-6	9	12		X	
	66.67	4.17	4.17			
Pred. combi.	No logrolling predicted					

Game 7	Majority	Unanimity
Sincere	(9, 18, 0) = 27 and (9, 18, 0) = 27	(0, 0, 0) = 0
Utilitarian	(6, 33, -3) = 36 and (6, 33, -3) = 36	(6, 33, -3) = 36 and (6, 33, -3) = 36
Predicted	(12, 21, -12) = 21 and (12, 24, -15) = 21 or (-9, 27, 6) = 24 and (-9, 24, 9) = 24	(0, 0, 0) = 0
Logrolling agreement	Mixed: {1,2} {B, C} or {2, 3} {A, B}	No logroll

A.5.8 Game 8

Under majority, we predict no logrolling agreements. Under unanimity, we have two predictions depending on which voter "starts": both are bundles of two voters and two projects.

Game 8: majority.

Game 8a: Round 10 / Round 3.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	6 0	-3 58.33	6 0	X	X	X
B	9 8.33	3 4.17	-6 62.5	X	X	X
C	-3 54.17	9 0	12 0	X	X	X
Pred. combi.	No logrolling predicted					

Game 8b: Round 4 / Round 12.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	6 0	-6 33.33	9 0	X	X	X
B	9 0	6 0	-9 37.5	X	X	X
C	-3 41.67	9 0	12 0	X	X	X
Pred. combi.	No logrolling predicted					

Game 8: unanimity.

Game 8a: Round 10 / Round 3.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	6 4.17	$\mathbf{-3^{a}}$ **91.67**	6 4.17		X	X^a
B	9 4.17	3 8.33	$\mathbf{-6^{b}}$ **75**		X	X^b
C	$\mathbf{-3^{a+b}}$ **91.67**	9 0	12 4.17		X	X^{a+b}
Pred. combi. (a or b)		91.67%				

Game 8b: Round 4 / Round 12.

Project	Voter 1	Voter 2	Voter 3	Sinc.	Util.	Pred.
A	6 0	$\mathbf{-6^{a}}$ **79.17**	9 4.17		X	X^a
B	9 0	6 0	$\mathbf{-9^{b}}$ **95.83**		X	X^b
C	$\mathbf{-3^{a+b}}$ **100**	9 0	12 4.17		X	X^{a+b}
Pred. combi. (a or b)		100%				

Game 8	Majority	Unanimity
Sincere	(12, 9, 12) = 33 and (12, 9, 12) = 33	(0, 0, 0) = 0
Utilitarian	(12, 9, 12) = 33 and (12, 9, 12) = 33	(12, 9, 12) = 33 and (12, 9, 12) = 33
Predicted	(12, 9, 12) = 33 and (12, 9, 12) = 33	(3, 6, 18) = 27 and (3, 3, 21) = 27 or (6, 12, 6) = 24 and (6, 15, 3) = 24
Logrolling agreement	No logroll	Bundle: {1, 2} {A, C} or {1, 3} {B, C}

A.5.9 Game 9

Under majority, we predict a bundle that generates negative externalities on Voter 2 but increases aggregate payoffs. Under unanimity, we predict a bundle of two projects where three voters vote insincerely.

Game 9: majority.

Game 9a: Round 3 / Round 16.

	Voter					
Project	1	2	3	Sinc.	Util.	Pred.
A	**-6** **58.33**	-3 25	15 0		X	X
B	12 4.17	6 4.17	-6 37.5	X	X	X
C	15 12.5	-15 8.33	**-3** **45.83**			X
Pred. combi.		41.67%				

Game 9b: Round 14 / Round 9.

	Voter					
Project	1	2	3	Sinc.	Util.	Pred.
A	**-3** **62.5**	-6 41.67	15 8.33		X	X
B	9 4.17	9 4.17	-6 58.33	X	X	X
C	15 29.17	-15 16.67	**-3** **58.33**			X
Pred. combi.		50%				

Game 9: unanimity.

Game 9a: Round 3 / Round 16.

	Voter					
Project	1	2	3	Sinc.	Util.	Pred.
A	**-6** **70.83**	**-3** 91.67	15 4.17		X	X
B	12 8.33	6 0	**-6** **87.5**		X	X
C	15 54.17	-15 0	-3 4.17			
Pred. combi.		66.67%				

Game 9b: Round 14 / Round 9.

	Voter					
Project	1	2	3	Sinc.	Util.	Pred.
A	**-3** **75**	**-6** **83.33**	15 4.17		X	X
B	9 8.33	9 8.33	**-6** **79.17**		X	X
C	15 50	-15 0	-3 25			
Pred. combi.		54.17%				

Game 9	Majority	Unanimity
Sincere	(12, 6, -6) = 12 and (9, 9, -6) = 12	(0, 0, 0) = 0
Utilitarian	(6, 3, 9) = 18 and (6, 3, 9) = 18	(6, 3, 9) = 18 and (6, 3, 9) = 18
Predicted	(21, -12, 6) = 15 and (21, -12, 6) = 15	(6, 3, 9) = 18 and (6, 3, 9) = 18
Logrolling agreement	Bundle: {1, 3} {A, C}	Bundle: {1, 2, 3} {A, B}

Table 28: Vector of payoffs for each outcome and core outcomes (untransformed payoffs).

Game	A passes	B passes	C passes	A and B pass	A and C pass	B and C pass	A, B and C pass	Empty outcome
Game 1a	*(-9,-3,9)*	(15, -9, 3)	(15, 12, -3)	(6, -12, 12)	**(6, 9, 6)**	**(30, 3, 0)**	**(21, 0, 9)**	*(0, 0, 0)*
Game 1b	(-9, -6, 12)	(15, -9, 3)	(15, 15, -6)	(6, -15, 15)	**(6, 9, 6)**	(30, 6, -3)	**(21, 0, 9)**	*(0, 0, 0)*
Game 2a	*(15, -3, -6)*	(6, 15, -6)	(12, -9, 9)	(21, 12, -12)	(27, -12, 3)	**(18, 6, 3)**	(33, 3, -3)	*(0, 0, 0)*
Game 2b	*(15, -3, -6)*	(6, 12, -3)	(12, -6, 6)	(21, 9, -9)	(27, -9, 0)	**(18, 6, 3)**	(33, 3, -3)	*(0, 0, 0)*
Game 3a	(-12, 9, -3)	(9, -12, 12)	(9, 6, -6)	(-3, -3, 9)	(-3, 15, -9)	(18, -6, 6)	**(6, 3, 3)**	*(0, 0, 0)*
Game 3b	(-12, 9, -3)	(6, -12, 15)	(12, 6, -9)	(-6, -3, 12)	(0, 15, -12)	(18,-6, 6)	**(6, 3, 3)**	*(0, 0, 0)*
Game 4a	(-3, -3, 15)	*(-15, 3, -9)*	(-9, 3, 3)	*(-18, 0, 6)*	(-12, 0, 12)	(-24, 6, -6)	(-27, 3, 9)	**(0, 0, 0)**
Game 4b	(-3, -3, 15)	*(-12, 3, -12)*	(-12, 3, 6)	*(-15, 0, 3)*	(-15, 0, 21)	(-24, 6, -6)	(-27, 3, 9)	**(0, 0, 0)**
Game 5a	*(-12, -12, 6)*	(15, -6, -3)	(-12, 12, 9)	*(3, -18, 3)*	(-24, 0, 15)	**(3, 6, 6)**	(-9, -6, 12)	*(0, 0, 0)*
Game 5b	*(-12, -15, 9)*	(15, -3, -6)	(-12, 12, 9)	*(3, -18, 3)*	(-24, -3, 18)	**(3, 9, 3)**	(-9, -6, 12)	*(0, 0, 0)*
Game 6a	(-6,-6, 15)	*(-3, 12, -6)*	(12, 15, -6)	(-9, 6, 9)	**(6, 9, 9)**	(9, 27, -12)	**(3, 21, 3)**	*(0, 0, 0)*
Game 6b	(-6, -3, 12)	*(-3, 9, -3)*	(12, 15, -6)	(-9, 6, 9)	**(6, 12, 6)**	(9, 24, -9)	**(3, 21, 3)**	*(0, 0, 0)*
Game 7a	(15, 6, -9)	*(-3, 15, -3)*	(-6, 12, 9)	(12, 21, -12)	**(9, 18, 0)**	(-9, 27, 6)	(6, 33, -3)	*(0, 0, 0)*
Game 7b	(15, 9, -12)	*(-3, 15, -3)*	(-6, 9, 12)	(12, 24, -15)	**(9, 18, 0)**	(-9, 24, 9)	(6, 33, -3)	*(0, 0, 0)*
Game 8a	*(6, -3, 6)*	*(9, 3, -6)*	*(-3, 9, 12)*	**(15, 0, 0)**	**(3, 6, 18)**	**(6, 12, 6)**	**(12, 9, 12)**	*(0,0,0)*
Game 8b	*(6, -6, 9)*	*(9, 6, -9)*	*(-3, 9, 12)*	**(15, 0, 0)**	**(3, 3, 21)**	**(6, 15, 3)**	**(12, 9, 12)**	*(0, 0, 0)*
Game 9a	(-6, -3, 15)	(12, 6, -6)	*(15, -15, -3)*	**(6, 3, 9)**	(9, -18, 12)	(27, -9, -9)	(21, -12, 6)	*(0, 0, 0)*
Game 9b	(-3, -6, 15)	(9, 9, -6)	*(15, -15, -3)*	**(6, 3, 9)**	(12, 21, 12)	(24, -6, -9)	(21, -12, 6)	*(0, 0, 0)*

Note: This table present the payoff vector and aggregate payoff for all outcomes in each game. The payoff vectors in bold weakly Pareto-dominate the empty outcome and are not Pareto-dominated by any other outcome. We refer to these as "core outcomes". The payoff vectors in italic are Pareto-dominated.

Table 29: Percentage of sincere, predicted, utilitarian and core outcomes under both rules.

	Majority								Unanimity							
Game 1	Ad(1)	Bd	C	AB	AC	BC	ABC	∅	Ad(1)	Bd	C	AB	AC	BC	ABC	∅d
Original			8.33		37.5	29.17	25		4.17		8.33		37.5		41.67	8.33
Variant			12.5		25	41.67	20.83				4.17	8.33	29.17	4.17	41.67	12.5
Sincere						X										X
Predicted					X								X			
Utilitarian						X								X		
Core					X	X(1)	X						X	X(1)	X	
Game 2	Ad	B	C	AB	AC	BC	ABC	∅d	Ad	B	C	AB	AC	BC	ABC	∅d
Original		4.17	4.17	12.5	4.17	50	25			4.17	16.67	4.17		50		25
Variant		4.17	4.17			70.83	20.83			16.67	20.83			58.33		4.17
Sincere						X										X
Predicted				X										X		
Utilitarian							X								X	
Core						X								X		
Game 3	A	B	C	AB	AC	BC	ABC	∅d	A	B	C	AB	AC	BC	ABC	∅d
Original			8.33	29.17		54.17	8.33			4.17	12.5	8.33		4.17	20.83	50
Variant		12.5	4.17	25	4.17	50	4.17		4.17	4.17	12.5			4.17	25	50
Sincere						X										X
Predicted				X											X	
Utilitarian						X								X		
Core							X								X	
Game 4	A	Bd	C	ABd	AC	BC	ABC	∅	A	Bd	C	ABd	AC	BC	ABC	∅
Original	33.33		33.33	8.33	16.67	4.17	4.17		12.5		16.67		8.33			62.5
Variant	58.33		20.83		4.17	4.17	4.17	8.33			8.33		4.17			87.5
Sincere			X													X
Predicted	X															X
Utilitarian	X								X							
Core								X								X
Game 5	Ad	B	C	ABd	AC	BC	ABC	∅d	Ad	B	C	ABd	AC	BC	ABC	∅d
Original			58.33			20.83	12.5	8.33		4.17	25			41.67	4.17	25
Variant		4.17	45.83		4.17	25	20.83				37.5			37.5	4.17	20.83
Sincere			X													X
Predicted							X							X		
Utilitarian						X								X		
Core						X								X		
Game 6	A	Bd	C	ABd(1)	AC	BC	ABC	∅d	A	Bd	C	ABd(1)	AC	BC	ABC	∅d
Original			50	4.17	4.17	4.17	37.5				8.33		54.17		33.33	4.17
Variant			12.5		16.67	8.33	62.5		12.5		12.5	4.17	58.33		12.5	
Sincere			X													X
Predicted							X						X			
Utilitarian							X								X	
Core					X		X						X		X	
Game 7	A	Bd	C	AB	AC	BC	ABC	∅d	A	Bd	C	AB	AC	BC	ABC	∅d
Original			4.17	4.17	29.17	33.33	25	4.17			12.5	4.17	33.33	12.5	25	12.5
Variant	8.33	4.17	4.17	4.17	41.67	20.83	12.5	4.17			16.67		33.33	8.33	8.33	33.33
Sincere					X											X
Predicted				X		X										X
Utilitarian							X								X	
Core					X								X			
Game 8	Ad	Bd	Cd	AB	AC	BC	ABC	∅d	Ad	Bd	Cd	AB	AC	BC	ABC	∅d
Original					8.33		91.67						16.67		75	8.33
Variant							100							20.83	75	4.17
Sincere							X									X
Predicted							X						X	X		
Utilitarian							X								X	
Core				X	X	X	X					X	X	X	X	
Game 9	A	B	Cd	AB	AC	BC	ABC	∅d	A	B	Cd	AB	AC	BC	ABC	∅d
Original	4.17	20.83		29.17		4.17	41.67		4.17	20.83		62.5				12.5
Variant		20.83		16.67		8.33	50	4.17	8.33	20.83		54.17				16.67
Sincere		X														X
Predicted							X					X				
Utilitarian				X								X				
Core				X								X				

Note: d denotes a Pareto-dominated outcome and (1) indicates that the outcome is part of the core in the original variant 1 only.

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