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# **Voting for Compromises: Alternative Voting Methods in Polarized Societies**

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# Voting for Compromises: Alternative Voting Methods in Polarized Societies\*

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## Abstract

Democratic societies have been increasingly confronted with extreme, knife-edge election outcomes that affect everybody's lives and contribute to social instability. Even if political compromises based on social conventions as equity or economic arguments as efficiency are available, polarized societies might fail to select them. We demonstrate that part of the problem might be purely technical and, hence, potentially solvable. We study different voting methods in three experiments (total  $N = 5,820$ ), including small, medium-sized, and large electorates, and find that currently-used methods (Plurality Voting and Rank-Order systems) can lead voters to overwhelmingly support egoistic options. In contrast, alternative, more nuanced methods (Approval Voting and Borda Count) reduce the support for egoistic options and favor equity and efficiency, avoiding extreme outcomes. Those methods differ in whether they favor equity or efficiency when the latter benefits a majority. Our evidence suggests that targeted changes in the electoral system could favor socially-desirable compromises and increase social stability.

**JEL Classification:** C91 · C92 · D63 · D70 · D71

**Keywords:** Polarization · Social compromises · Equity · Efficiency · Voting methods

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# 1 Introduction

Extreme political outcomes are becoming commonplace. Recent elections around the globe have produced an increasing number of close, surprising outcomes with long-ranging consequences, as in the case of the U.K. referendum to leave the European Union, or several of the most recent U.S. presidential elections. This is commonly seen as a consequence of the current rise of extremism and polarization in many democratic societies, be it in terms of the views of individual voters, the strength of partisanship, the distance between candidate platforms, or the extremism in pursued policies (Abramowitz and Saunders, 2008; Sunstein, 2009; Iyengar and Westwood, 2015; Mason, 2015; Boxell et al., 2017; Martini and Torcal, 2019). Many voters currently view the political process as confrontational (us vs. them) instead of conceiving of it as the search for political solutions with the potential to benefit a wide majority. This goes so far as to become a threat even to basic democratic principles (Graham and Svolik, 2020). Electorates might thus fail to identify alternatives which could serve as compromises and gain widespread social support, and electoral results might fail to provide clear majorities. This is problematic because the recognition of the legitimacy of the electoral system, especially among losers, is crucial for stable governments or resolutions (losers’ consent; Nadeau and Blais, 1993; Anderson and Mendes, 2006). The consequences can be dire, ranging from social and political instability and knife-edge, seemingly-random election outcomes to governments implementing heavily-partisan agendas.

One could hope that morally-rooted options appealing to well-established social conventions would serve to build a wide consensus, identify acceptable compromises, and construct stable governments. This, however, does not seem to be the case. Social conventions and appealing political and economic principles do not always succeed in providing “moral roots” (Haidt, 2008) and facilitating coordination on moderate alternatives. Yet, these principles still enjoy generalized support, even in polarized societies, and have been shown to be important determinants of actual voter behavior (e.g., Feddersen et al., 2009; Fisman et al., 2017; Morton and Ou, 2019). Key among them is *equity* (equal treatment of individuals), which underlies many prominent sociopolitical ideas, from distributive justice to equality of opportunities. For instance, the recent rise of nationalist parties centered on specific regions of European countries could be argued to reflect a concentration on self-interest as opposed to equity. Another powerful idea is *efficiency* (maximization of joint payoffs), which motivates many uncontroversial economic arguments from waste avoidance to cost-benefit analysis. For instance, the Brexit referendum could be conceived as a contest between the overall economic gains of remaining in a large trade union and the self-centered concerns arising from, e.g., local job insecurity due to international reallocation of production factors.

Why do widely-accepted, broadly-appealing conventions fail to provide effective coordination devices in the political arena? One aspect of the problem is the voting method. The requirement that a method should be democratic just means that every voter should

have the same influence on the political outcome as every other voter. The details of how ballots look like, and specifically how much information voters can provide, have traditionally been left to policymakers. Political scientists and social choice theorists have proposed and studied a number of alternative, theoretically-motivated voting methods (e.g., [Brams and Fishburn, 1978](#); [Saari, 1994](#)), and shown that the choice of one method or another is highly consequential in at least two ways: first, different methods can elicit different results from the same electorate (e.g. [Riker, 1982](#); [Saari, 1999](#)); second, the electoral system affects satisfaction with and acceptance of democratic outcomes ([Anderson and Guillory, 1997](#)). For example, using data from UK elections in various trade unions, professional associations and non-profit organizations [Felsenthal et al. \(1993\)](#) and [Felsenthal and Machover \(1995\)](#) found that the outcomes of Plurality Voting procedures, where each voter must select one candidate only, were inferior, in terms of several normative criteria, to the outcomes that would have obtained under alternative methods. A number of field experiments carried out during actual political elections have shown that alternative voting methods would have resulted in different outcomes, e.g. in presidential elections in France ([Laslier and Van der Straeten, 2008](#); [Baujard et al., 2014](#)) and in federal and state elections in Germany ([Alós-Ferrer and Granić, 2012, 2015](#)). However, little is known so far about the relation between specific methods and the distributional properties of the outcomes that they favor, and even less is known about the interaction between voting methods and morally-rooted social conventions. Consequently, it is important to ask whether and how the voting method itself affects the results in terms of distributional allocations and whether or not different methods might facilitate coordination on social conventions.

The question we raise is an empirical one. It is *a priori* unclear how actual voters will react to alternative voting methods. While outcome predictions could be derived theoretically by assuming specific behavior, e.g. sincere voting, it is well-known that voting methods differ with respect to the degree of strategic behavior that they elicit (e.g., [Van der Straeten et al., 2010](#)). Hence, any comparison across voting methods would depend on particular, additional behavioral assumptions, which are also hard to verify. Also, some of the methods considered in the literature ([Brams and Fishburn, 1978](#)) do not allow for point predictions even if sincere voting is assumed. Thus, we carried out three experiments to examine how voting methods differ when social conventions are confronted with selfish options.

If extreme political outcomes were exclusively the result of the social evolution of voter preferences in an increasingly-interconnected world, however, they would simply be the democratic expression of society’s desires and, independently of the consequences, remain in the province of political and moral arguments. Our results suggest that this is *not* necessarily the case, and in particular that extreme political results might reflect not only voter preferences, but also the voting method. We illustrate how giving voters *more* possibilities to express their preferences can reduce both self-centered voting decisions and extreme outcomes even when voter preferences are kept constant. The intuition

is that the outcome of commonly-used methods based on Plurality Voting (and also Rank-Order methods as used in several countries) mostly depends on the most-preferred alternatives of each voter, hence disregarding possible compromises. Alternative voting methods extract more nuanced information from the voters’ preferences and facilitate coordination on broadly-supported alternatives. Simply put, by relying on the highest-ranked alternatives only, methods as Plurality Voting lose sight of alternatives which would be acceptable for a large share of the electorate.

In our experiments, actual human participants made voting decisions (Forsythe et al., 1993, 1996; Hix et al., 2017) in up to four different, artificially-designed societies following three different voting methods. Our data further allows to analyze the outcomes under two additional methods. In our “small electorates” laboratory experiment, each voter participated in multiple elections in four different experimental societies with six voters each. We collected 5,400 voting decisions, systematically varying the voting method for each society. To ensure external validity, we also carried out two large-scale online experiments, one with “medium electorates” of 30 voters each (and a total of 19,440 additional voting decisions) and another with two “large electorates” of 1,200 voters each, which replicated the results obtained for small electorates.

In our societies, voters were endowed with (monetarily-induced) preferences and the alternatives pitted Self-Interest options, which favored specific groups, against social conventions based on Equity and Efficiency, either separately or jointly. By varying the consequences of Efficiency for different groups, we also varied the consequences of inequality and, in particular, whether Efficiency favored a majority or just a minority. Our societies were polarized in the sense that the opposed groups were equally-sized, and none of them was close to achieving a majority. To study the effect of the relative size of the competing interest groups within an electorate, the medium electorates experiment included an additional asymmetric treatment, which extends our results to interest groups of different sizes. The three voting methods we considered are Plurality Voting (PV), Approval Voting (AV),<sup>1</sup> and the Borda Count (BC), which are the three positional voting methods originally described in Riker (1982, Chapter 4E). PV simply specifies that each voter casts a single vote for a single alternative, mimicking the crucial building block of the most-frequently-used methods in large political elections. AV allows voters to approve of as many alternatives as they wish, effectively deciding how many (and which) votes to cast (Brams and Fishburn, 1978, 1988). BC asks voters to assign points to alternatives, with zero being allocated to their least-preferred option, one to the second-least preferred, and so on, until  $n - 1$  points are assigned to the most-preferred one, with  $n$  being the number of available alternatives (Saari, 1994, 2000). In each case, the winner is determined by simple majority (of votes, approvals, or points, respectively), with ties broken randomly. Additionally, the laboratory experiment in-

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<sup>1</sup>Approval voting is used for municipal elections in the US in Fargo, North Dakota since 2018, and St. Louis, Missouri since 2020. It is also used various associations (e.g. the Mathematical Association of America and the American Statistical Association) and by the United Nations to elect the Secretary-General.

cluded a preference elicitation task after the voting decisions. Further, we study two rank-order voting procedures (Single Transferable Vote and the Two-Round System) using extrapolation based on those elicited preferences (following, e.g., [Felsenthal et al., 1993](#); [Felsenthal and Machover, 1995](#)).

The results are striking. Our evidence shows that currently-favored voting methods, based on the “one man, one vote” principle (Plurality Voting), exacerbate self-centered voter behavior and result in outcomes favoring a particular group. Under rank-order voting methods (as those used in several countries for political elections), results are even more extreme. In contrast, methods which allow voters to support several options (Approval Voting) or to provide entire rankings (Borda Count) favor social compromise in the form of either equity or efficiency. Thus, we demonstrate that part of the problem underlying extreme political outcomes might be purely technical and, hence, potentially solvable.

In detail, our empirical findings are that Plurality Voting and Rank-Order methods create situations where options that favor just a minority win the upper hand in elections very frequently, while Approval Voting and Borda Count successfully gather support around socially desirable compromises. Borda Count systematically favors Equity-based alternatives, while Approval Voting favors Efficiency when inequality is not a concern (meaning that Efficiency favors a majority), but turns toward Equity when inequality is a problem (meaning that Efficiency favors only a minority). In the Online Appendix, we also discuss the consequences for winner’s legitimacy and sincerity (strategic voting), and provide additional analyses and details. The changes in electoral outcomes are large and occur in spite of the fact that the electorate’s preferences are kept constant. That is, the changes occur simply by virtue of the voting method. This is important because the social roots and causes of polarization are complex and difficult to address (voters’ preferences, affective issues, etc.), but changing the voting method, within the parameters given by a democratic society, amounts to a legislative decision, and is hence a feasible first step.

Our work contributes to the literature which examines the consequences of social conventions for electoral outcomes. The basic model of rational voting ([Downs, 1957](#)) assumes self-centered motivations, where voters maximize their own payoffs and act strategically. Strategic voting has indeed been shown to be empirically relevant (e.g., [Black, 1978](#); [Fisher, 2004](#)) and to vary with voter characteristics ([Eggers and Vivyan, 2020](#)). However, both equity and efficiency have been empirically demonstrated to be key determinants of actual human behavior for distributive decisions ([Fehr and Schmidt, 1999](#); [Bolton and Ockenfels, 2000](#); [Charness and Rabin, 2002](#); [Bechtel et al., 2018](#)) and actual voting behavior ([Feddersen et al., 2009](#); [Shayo and Harel, 2012](#); [Morton and Ou, 2019](#)). Linking individual equity-efficiency trade-offs to political decisions during the 2012 US elections, [Fisman et al. \(2017\)](#) found that the majority of equality-focused subjects did vote for Barack Obama (and were democrats), indicating that distributional preferences are a strong motive underlying voting behavior. In a different context,

distributional concerns related to social conventions (as opposed to self-interest) have been shown to be important for political participation (voter turnout; see, e.g., [Feddersen and Sandroni, 2006](#); [Fowler, 2006](#); [Fowler and Kam, 2007](#); [Gerber et al., 2008](#); [Gerber and Rogers, 2009](#)). Given their empirical relevance for individual behavior, social conventions should have been expected to play a crucial role to hinder extreme outcomes and identify socially-desirable compromises. Yet, under current electoral systems, there appears to be little evidence of such a moderating effect at this point.

Some previous works have studied equity-efficiency trade-offs, but have typically concentrated on a single voting method only. For instance, in a majority-rule voting game, [Bolton and Ockenfels \(2006\)](#) found twice as many deviations from self-interest in favor of equity than in favor of efficiency. In contrast, we focus on the interaction between voting methods and social conventions.

A plethora of voting methods are in use around the world, differing across dimensions such as how voters express their wishes and how votes are converted into representation. Accordingly, a strand of the literature has studied and compared different voting mechanisms, but not with respect to outcome selection and the equity-efficiency trade-off. Instead, such studies have focused, e.g., on informational efficiency and unequal cost of voting (strategic abstention) under simultaneous and sequential voting procedures ([Battaglini et al., 2007](#)), or on the comparison of sincerity and strategic behavior across methods ([Bassi, 2015](#)). The contribution of our work is to analyze the relative importance of different social conventions on voting behavior across voting methods and, in particular, whether (and if so, for which methods) they can serve as coordination devices to promote socially-desirable compromises.

## 2 Experimental Design

In all experiments, subjects were matched into electorates which remained fixed for the duration of the experiment. Each subject participated in a series of elections, each in a different voting round. Voting rounds were independent, that is, subjects received no feedback on the election outcomes or on the decisions of other voters. At the end of each experiment for each electorate one of the voting rounds was selected at random and subjects were paid according to the outcome of this round. All payoffs were presented in terms of Experimental Currency Units (ECU) that were converted to the appropriate currency at the end of the experiment at a fixed rate.

For each election, preferences over outcomes were induced by conditioning subjects' payoff on the election outcomes. There were three types of voters, each with a different monetary reward associated to each of the alternatives. The complete payoff profile of the electorate was presented on screen in the form of a table. That is, the induced preferences of all voters within an electorate were publicly known to all voters. We used four qualitatively different payoff profiles, corresponding to four experimental societies,



with either four or five alternatives.<sup>2</sup> Elections used three different voting methods: Plurality Voting (PV), Approval Voting (AV), and the Borda Count (BC). Under PV, voters had to vote for exactly one of the alternatives. Under AV, voters could approve of as many alternatives as they preferred, but had to approve of at least one alternative (abstention in the sense of casting the full ballot was allowed). Under BC, voters had to rank all alternatives by assigning 0 points to their least-preferred alternative, 1 point to their second-least-preferred alternative and so on with the highest number of points being assigned to the most-preferred alternative. The winner is the alternative that received most votes, approvals, or points in total within an electorate, respectively. For all voting methods ties were broken randomly.<sup>3</sup>

## 2.1 Small Electorates

The Small Electorates (SE) experiment consisted of six experimental sessions in the laboratory with a total of 180 subjects (111 female) who made a total of 5,400 voting decisions.<sup>4</sup> Subjects were randomly assigned to 30 different small electorates consisting of six subjects each, two for each type. Each subject took part in 40 elections split into four blocks of 10 independent elections each. Each block used a different voting method, which was fixed for all elections in the block. The three main (within-subject) treatments are PV, AV, and BC, which were used in the first three blocks.<sup>5</sup> In the final block all electorates voted via a random dictator mechanism used for preference elicitation (see Online Appendix for details).

In Society 1 there were four alternatives available and the payoff profile was symmetric across types, that is, the monetary rewards for each type were identical up to a relabeling of the alternatives. Subjects were randomly assigned a type and cast one vote for Society 1 in that role. In contrast, Societies 2 to 4 were not symmetric, that is, the induced preferences over alternatives were qualitatively different across types. There were three rounds of elections for each of those profiles so that each subject cast exactly one vote in each role.<sup>6</sup> In each block the so-obtained 10 payoff profiles were presented in a pseudo-randomized order that was the same for each block, which allows for a clean comparison of voter behavior for a given profile (and type) across voting methods.

<sup>2</sup>Standard voting experiments typically use a fixed number of alternatives between three and five (see e.g. Forsythe et al., 1993, 1996; Blais et al., 2016; Hix et al., 2017).

<sup>3</sup>Figures A.13 and A.15 in the Online Appendix list the normative predictions of the voting methods for the different societies, assuming sincere voting.

<sup>4</sup>Participants were recruited using ORSEE (Greiner, 2015) from a large subject pool consisting mostly of students. The experiment was programmed with z-Tree (Fischbacher, 2007).

<sup>5</sup>Their order was randomized across electorates within a session to eliminate any potential order effects. At the beginning of each block subjects received a detailed description of the voting method on screen.

<sup>6</sup>Subjects did not face the exact same profile three times, but rather three slightly different profiles that were obtained from the profiles presented in Figures 1.A to 4.A via small random perturbations (jittering) keeping all its qualitative features unchanged.

The exchange rate for payoffs was 0.20 EUR for 1 ECU (equivalent to \$0.235 at the time of the experiment). Sessions took on average 70 minutes and subjects received an average payoff of 13.46 EUR plus an additional show-up fee of 4 EUR.

## 2.2 Large Electorates.

The laboratory experiment concentrated on small electorates. In actual political elections, electorates are large and individual decisions are almost negligible. Also, experimental evidence has shown that ethically-motivated alternatives receive larger support in large elections, since expressive preferences become more important as the likelihood of being pivotal decreases (Feddersen et al., 2009; Shayo and Harel, 2012). Thus, it is unclear whether the differences across voting methods that we observe will persist with large electorates. Hence, it is important to establish the external validity of the results. For this purpose, we carried out a large-scale experiment in the online-research platform Prolific (Palan and Schitter, 2018) with two treatments. Each treatment involved 1,200 voters, for a total of 2,400 unique voters (1,593 female).<sup>7</sup> We used the payoff profiles of Societies 3 and 4 in order to show that the results of the SE experiment extend to large electorates.

In each LE treatment, we assigned 400 voters to each of the three possible types, magnifying Societies 3 and 4 by a factor of 200. We refer to them as Large Electorate-3 (LE-3) and 4 (LE-4), respectively. Implementation was as in SE, with the exception that each experiment involved one society only and that each voter was assigned to a fixed type. That is, in contrast to SE, each LE treatment corresponds to a single, large election. Voters were aware of the size of the electorate and hence of the fact that, as in actual elections, their individual vote was practically negligible. In each treatment, voters cast votes according to all three methods (PV, AV, and BC). The objective was to show that the results described above transfer to large electorates, in spite of the noisier environment typical of online experiments.

The exchange rate for payoffs was 0.03 GBP for 1 ECU (equivalent to \$0.037 at the time of the experiment). The experiment took on average 8 minutes and subjects received an average payoff of 1.95 GBP (about 2.16 EUR at the time of the experiment).

## 2.3 Medium Electorates.

In SE and LE electorates were symmetric in the sense that they were split into three, equally-sized interest groups. Although we believe that this captures important features of polarized societies, it is clear that actual electorates typically are not perfectly symmetric. As previous work indicates that group size may affect willingness to compromise (Posner, 2004; Huber, 2012), it is important to study asymmetric electorates with interest

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<sup>7</sup>Participants were recruited using the online research platform Prolific (Palan and Schitter, 2018) from a large subject pool consisting of UK residents. The experiment was programmed and conducted with Qualtrics.

groups of different sizes. To that end, we conducted an additional Medium Electorates (ME) online experiment that varied the size of the three interest groups represented by the different voter types in two between-subject treatments. In each treatment 30 subjects formed a medium-sized electorate and took part in eight elections with five alternatives. Each election used a different voting method: PV, AV, BC, and the random dictator mechanism. Both treatments used the two payoff profiles corresponding to Societies 3 and 4. In contrast to the SE experiment, subjects were randomly assigned to a fixed type for each society. In treatment HOM the electorate was symmetric (as in SE and LE), whereas in treatment HET it was asymmetric (see details below). The treatments involved 1,620 voters each, for a total of 3,240 unique voters (1,985 female) and 19,440 voting decisions. We again focused on the payoff profiles of Societies 3 and 4.

The exchange rate for payoffs was as in the LE experiment. The experiment took on average 10 minutes and subjects received an average payoff of 1.99 GBP (about 2.31 EUR at the time of the experiment).

## 3 Results

### 3.1 Small Electorates

To compare voting behavior within and across methods, we measure a voter’s support for an alternative for a given voting method as follows. For PV, we use a binary variable indicating whether an alternative was chosen. For AV, we take the normalized approval score, that is, we normalize approvals by the number of approvals cast by a voter. For BC, we take a normalized score computed as the number of points assigned to an alternative divided by the total number of points allocated. For expositional simplicity, we refer to the resulting measures for all three voting methods as the “level of support” by a voter for an alternative under a particular voting method. All tests involving the level of support below are nonparametric Wilcoxon Signed-Rank tests (WSR) conducted at the individual level ( $N = 180$ ), with reported  $p$ -values corrected for multiple testing using the Holm-Bonferroni method (Holm, 1979) whenever necessary.

Society 1 pitted egoistical behavior against an equity-based compromise. Figure 1A details the payoffs and induced preferences. There were a total of four alternatives (labeled neutrally in the experiment). Three of them gave maximal payoff to a single voter type at the expense of others in society, and hence represented *Self-Interest* options, depicted in the table as  $SI_1$ ,  $SI_2$ , and  $SI_3$ . We will refer to  $SI_i$  as the self-interest (SI) alternative of voters of type  $i$ . The fourth option, Equity (Equ), equalized payoffs. Monetary payoffs (Fig. 1A, top) were such that the induced self-centered preferences for each type (Fig. 1A, bottom) put the own Self-Interest option on top and the equality-based alternative second; hence the latter was a morally-attractive compromise for all voters and a natural focal point for coordination. Self-Interest alternatives and Equity

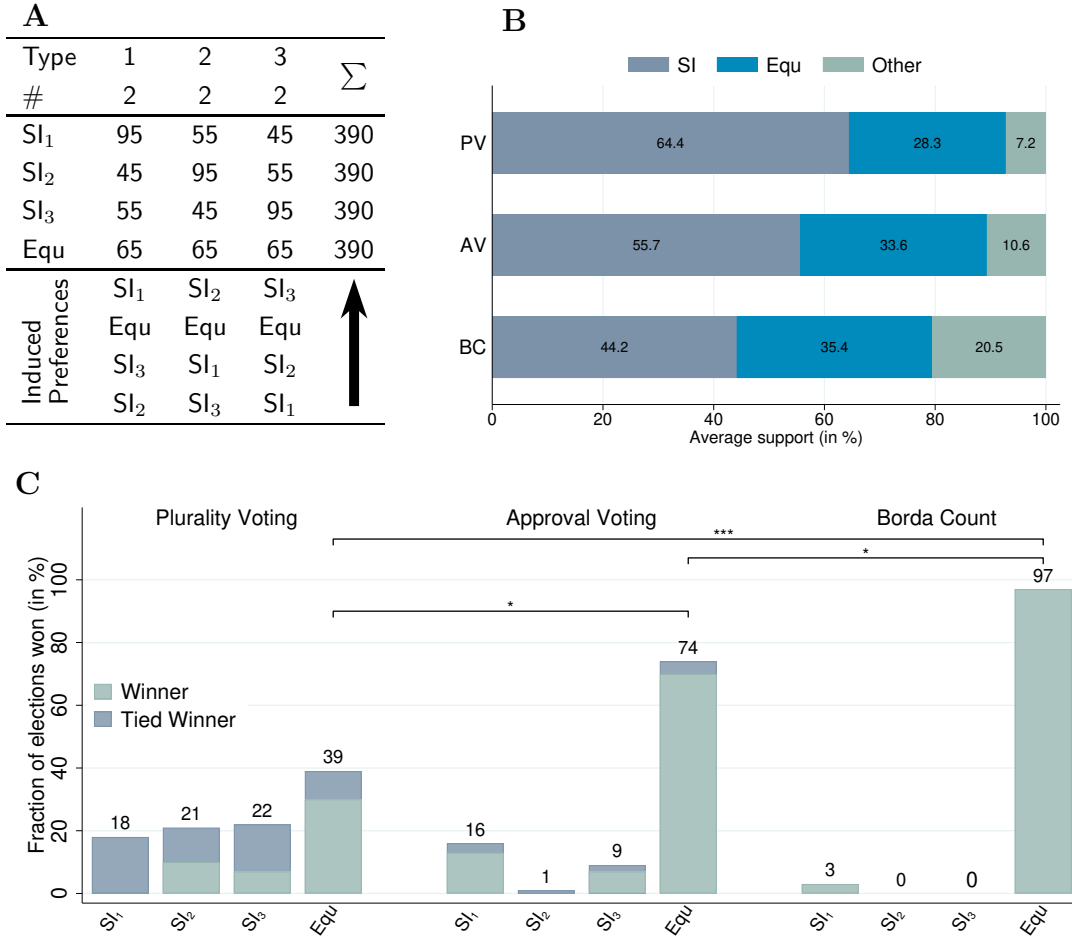


Figure 1: Preferences, voting behavior, and outcomes for Society 1.

Notes: **A**, Voter preferences in each electorate, induced monetarily. **B**, Aggregate voting behavior for the 180 voters. **C**, Voting outcomes for the 30 electorates, by voting method. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

paid the same total amount to the electorate; hence, there was no difference in terms of efficiency when comparing Self-Interest to Equity. Types were identical up to a relabeling of the alternatives and hence the analysis (in terms of whether voters voted for SI or Equ) does not need to distinguish among them. Each voter participated in Society 1 three times, once per voting method.

Figure 1B displays aggregate voting behavior in Society 1, where SI stands for support for the own Self Interest option. The support for Self Interest options is significantly larger than the support for Equity for all three voting methods (all  $p < 0.001$ ). This shows a failure of Equity to serve as a “moral root” facilitating coordination. However, average support for Equity is still substantial, confirming that it represents a socially-desirable compromise, and it increases from 28.3% under PV to 33.6% under AV and 35.4% under BC. The advantage in the level of support for Self-Interest over Equity (difference between the variables defined above) is larger under PV than under either AV or BC (PV vs. AV,  $p = 0.028$ ; PV vs. BC,  $p < 0.001$ ). That is, AV and BC mitigate

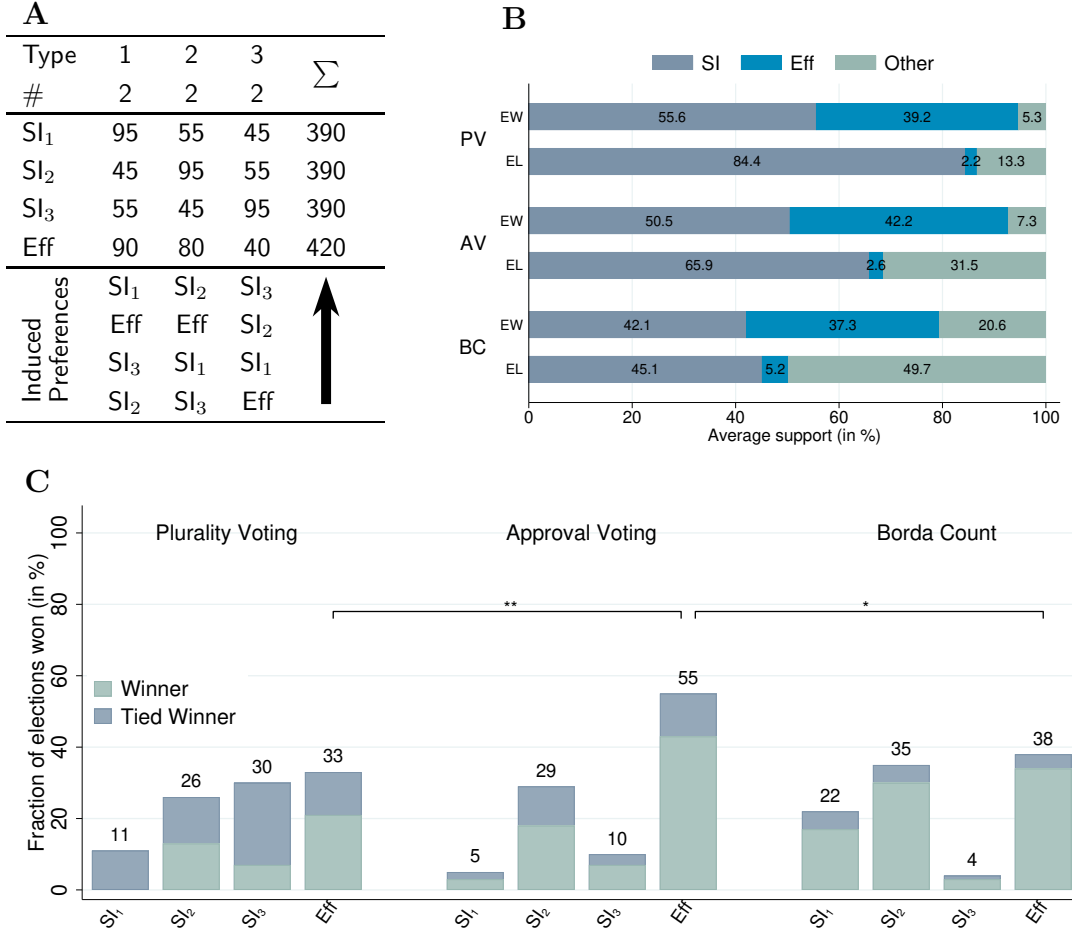


Figure 2: Preferences, voting behavior, and outcomes for Society 2.

Notes: **A**, Voter preferences in each electorate, induced monetarily. **B**, Aggregate voting behavior for the 180 voters. **C**, Voting outcomes for the 30 electorates, by voting method. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

the focus on Self-Interest, leading to a significant increase in the share of votes received by Equity.

Figure 1C displays the percentage of the time that an option won the election in Society 1, with ties broken randomly, across different voting methods. All tests on voting outcomes below are WSR tests conducted at the electorate level ( $N = 30$ ), with  $p$ -values corrected using the Holm-Bonferroni method (Holm, 1979) whenever necessary. The apparently-modest increase in support for Equity has a very large impact on actual voting outcomes. Under PV, there is a large number of ties (paralleling knife-edge results in large elections) and the outcome typically favors the self-interest of just one voter subgroup, with Equity winning only 38.9% of the elections. In contrast, AV implements Equity in an astounding 74.2% of the elections, significantly more than under PV based on the number of elections won per electorate ( $p = 0.012$ ). The results under BC are even more extreme, with Equity winning almost universally (in 96.7% of the elections), significantly more often than under PV ( $p < 0.001$ ) and under AV ( $p = 0.013$ ).

Society 2 pitted egoistical behavior against an efficiency-based compromise. The Self-Interest alternatives were exactly as in Society 1, but the fourth alternative was an Efficiency (Eff) one which yielded a strictly higher total payoff to the overall electorate (Fig. 2A). The payoff distribution for Efficiency creates inequality, with two types (four voters) being efficiency winners (EWs) and the remaining type (two voters) being efficiency losers (ELs). That is, Efficiency benefits a majority of the electorate. EWs rank Efficiency second, after their own Self-Interest option, while ELs rank Efficiency last. This profile was also designed to minimize the effect of equity concerns, with no clear equity-based focal point according to standard theories (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000). Voters participated in Society 2 three times for each voting method, and each time they were assigned to a different voter type.

Figure 2B displays aggregate voting behavior in Society 2, distinguishing EWs and ELs, and focusing on the comparison of SI and Eff. ELs are very close to fully-selfish behavior, displaying almost no support for Efficiency in any method (PV: 2.2%, AV: 2.6%, BC: 5.2%), in particular below their support for Self-Interest (all  $p < 0.001$ ). However, the advantage in support for Self-Interest over Efficiency for ELs is significantly larger for PV than under either AV or BC (both  $p < 0.001$ ). For EWs, we pool decisions for types 1 and 2 (since induced preferences were identical up to relabeling of alternatives) and define their level of support for an alternative as the average across their two decisions made as EW. Their support is split between SI and Efficiency, with the average support for the former being slightly larger for all three methods (all  $p < 0.001$ ). That is, EWs appear to be torn between Efficiency and Self-Interest, while ELs essentially focus exclusively on Self-Interest although to a lesser extent under AV and BC.

Again, the apparently-small differences in voting behavior across methods are enough to induce substantial differences in actual voting outcomes (Fig. 2C). PV leads to frequent ties among the Self-Interest alternatives, with Efficiency winning only 33.1% of the elections. In contrast, under AV the efficient outcome wins 55.0% of the elections, significantly more than under PV ( $p = 0.003$ ). Under BC, Efficiency wins 38.3% of the elections, significantly less often than under AV ( $p = 0.037$ ), but not significantly different from PV ( $p = 0.248$ ). That is, when an Efficiency option favoring a majority is available (but no Equity option is), AV is more often able to elicit clear majorities for it, while BC is not.

While Societies 1 and 2 confronted Self-Interest with either Equity or Efficiency in isolation, in Societies 3 and 4 both social conventions were present (hence five alternatives were available). Efficiency creates inequality in both societies, but they differ in whether a majority or just a minority benefits. Society 3 is characterized by a majority of efficiency winners if Efficiency is selected. This society allows us to study both self-centered choices and the equity-efficiency trade-off in a situation where a majority of the electorate benefits from Efficiency, and hence the latter could be argued to be a democratic ideal.

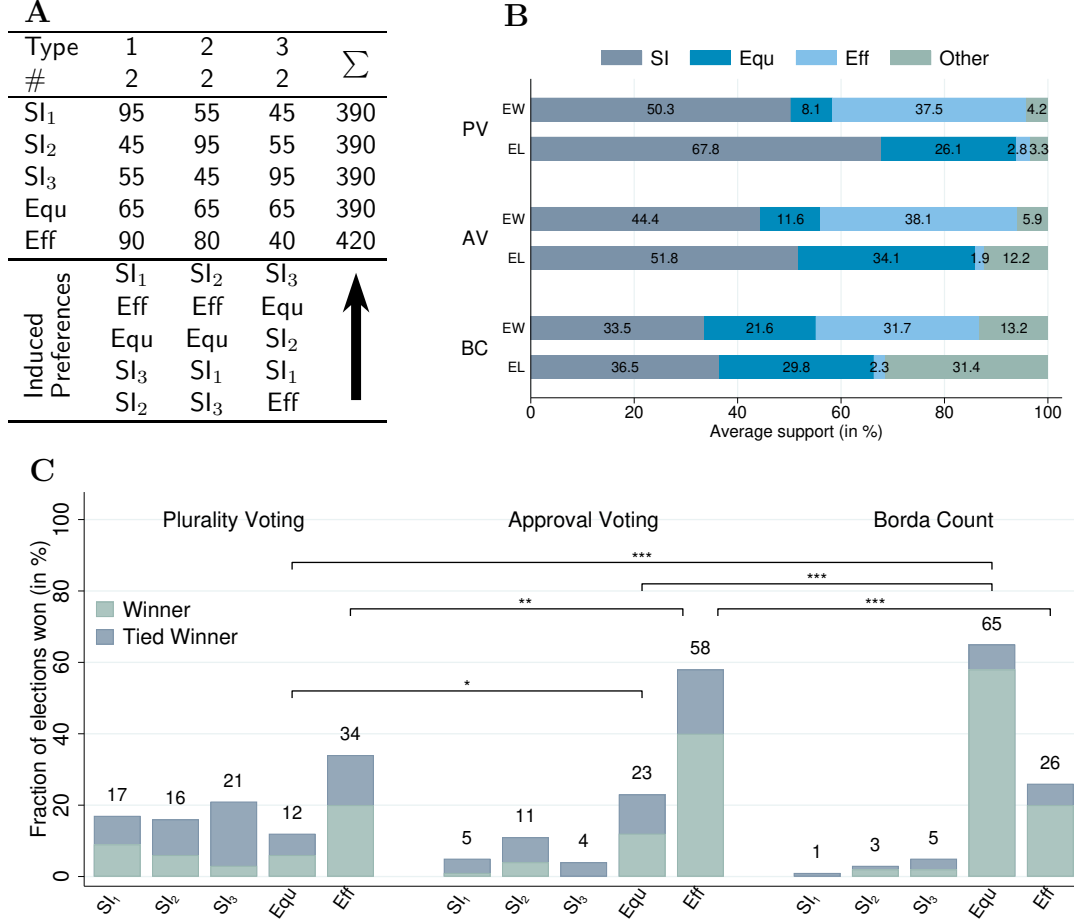


Figure 3: Preferences, voting behavior, and outcomes for Society 3.

Notes: **A**, Voter preferences in each electorate, induced monetarily. **B**, Aggregate voting behavior for the 180 voters. **C**, Voting outcomes for the 30 electorates, by voting method. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

Figure 3A details the payoffs and induced preferences in Society 3. Figure 3B summarizes actual aggregate voting behavior. EWs tend to support Efficiency (PV: 37.5%; AV: 38.1%; BC: 31.7%) over Equity (PV: 8.1%; AV: 11.6%; BC: 21.6%; all three methods  $p < 0.001$ ). For ELs, support for Efficiency is virtually nonexistent (PV: 2.8%; AV: 1.9%; BC: 2.3%), and far smaller than their support for Equity (PV: 26.1%; AV: 34.1%; BC: 29.8%; all three methods  $p < 0.001$ ). However, for all methods, Self-Interest options receive a larger support than Efficiency for EWs (PV,  $p = 0.038$ ; AV,  $p = 0.007$ ; BC,  $p = 0.048$ ), although the difference is small for AV and BC. Self-Interest options also receive a clearly larger support than Equity for ELs (all three methods  $p < 0.001$ ).

Again, differences in voting behavior result in considerable differences in voting outcomes (Fig. 3C). Under PV, SI options win most of the time (54.3%), while under AV and BC the most-frequent winners are Efficiency (58.2%) and Equity (64.8%), respectively. Efficiency wins most frequently under AV (AV vs. PV,  $p = 0.002$ ; AV vs. BC,  $p < 0.001$ ), and Equity wins most elections under BC, compared to both PV and

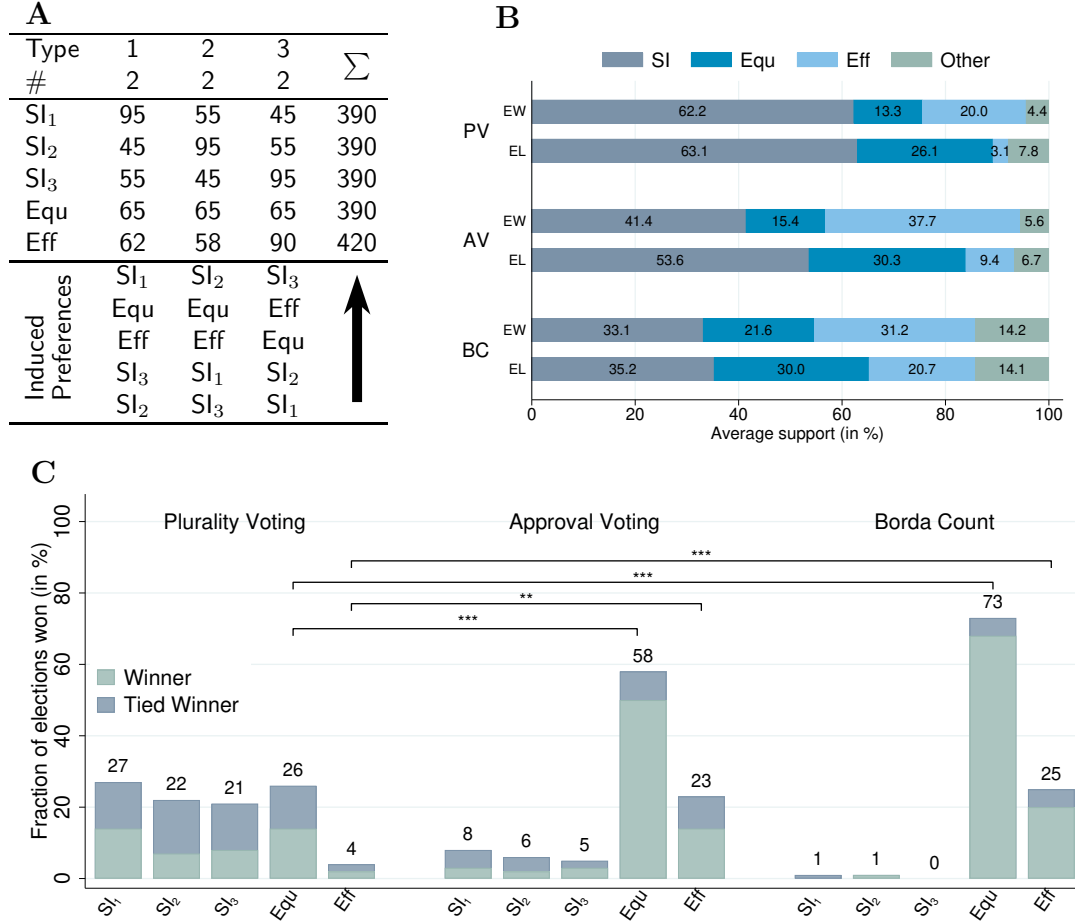


Figure 4: Preferences, voting behavior, and outcomes for Society 4.

Notes: **A**, Voter preferences in each electorate, induced monetarily. **B**, Aggregate voting behavior for the 180 voters. **C**, Voting outcomes for the 30 electorates, by voting method. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

AV (both  $p < 0.001$ ). Equity still fares significantly better under AV than under PV ( $p = 0.017$ ). Indeed, under AV SI options only win 18.9% of the elections, and only 9.3% under BC. That is, while Self-Interest often wins the upper hand under PV, each of the alternative voting methods manages to select a desirable social convention as an acceptable compromise, which goes on to win most elections. The methods clearly differ, with AV favoring Efficiency and BC selecting Equity.

Finally, in Society 4 both Equity and Efficiency are available alternatives, but if Efficiency were implemented a majority of the electorate would be worse off, i.e. there is a majority of ELs (Fig. 4A). Figure 4B summarizes actual aggregate voting behavior for Society 4, separately for EWs and ELs. As in Society 3, EWs tend to support Efficiency (PV: 20.0%; AV: 37.7%; BC: 31.2%) over Equity (PV: 13.3%; AV: 15.4%; BC: 21.6%; PV,  $p = 0.121$ ; AV and BC,  $p < 0.001$ ). For ELs, support for Efficiency (PV: 3.1%; AV: 9.4%; BC: 20.7%) is much smaller than support for Equity (PV: 26.1%; AV: 30.3%; BC: 30.0%; all three methods  $p < 0.001$ ). Self-Interest options receive a larger support than



Efficiency for EWs under PV ( $p < 0.001$ ), but, as in Society 3, the differences are small under both AV and BC (AV,  $p = 0.136$ ; BC,  $p = 0.065$ ). Self-Interest options receive a clearly larger support than Equity for ELs (all three methods  $p < 0.001$ ).

Under PV, the average support received by Efficiency from EWs is almost cut in half in Society 4 (where efficiency benefits only a few) compared to Society 3 (where efficiency benefits a majority;  $p < 0.001$ ). Thus, there is a clear “wasted vote” effect for EWs under PV when they are in the minority, as they realize that their favorite option has no chance of winning and hence strategically misrepresent their preferences. This effect is absent under AV ( $p = 0.557$ ) and BC ( $p = 0.804$ ). For ELs, support for Self-Interest and Equity are very similar in Societies 3 and 4. However, Efficiency also receives some support from ELs under AV (9.4%) and BC (20.7%) in Society 4. This is likely due to the fact that, compared to Society 3, a larger group of ELs shares the losses relative to Equity, and in terms of payoffs the comparison of Efficiency and Equity is less aversive.

Differences in voting outcomes are also large for Society 4 (Fig. 4C). Under PV, SI options win an overwhelming 70.4% of the time. In contrast, the most-frequent winner under both AV and BC is Equity (AV, 57.8%; BC, 72.8%), and both select it significantly more often than PV (both  $p = 0.001$ ). Since PV mostly selects Self-Interest, also Efficiency is selected more often under AV ( $p = 0.002$ ) and BC ( $p < 0.001$ ). There is no significant difference in outcomes between AV and BC. That is, on the one hand, Society 4 confirms the previous observation that Self-Interest wins often under PV but the other methods manage to shift the balance to desirable conventions. On the other hand, putting Societies 3 and 4 together we see that BC is non-responsive in the sense that it favors Equity independently of whether a majority or just a minority benefits from Efficiency, while AV is highly responsive to the latter distinction, favoring Efficiency only when the majority profits from it, and shifting support to Equity otherwise.

### 3.2 Large Electorates

We now look at voting behavior and voting outcomes for both large electorates across voting methods. Since each LE treatment captured a single election per method, outcomes correspond to the actual, overall winners. Both average voting behavior and election outcomes show exactly the same trends in LE as in SE.

For LE-3, under PV, each of the three SI options received more votes ( $\geq 263$ ) than either Equity (196) or Efficiency (188), consequently one of the self-interest options ( $SI_3$ ) won the election. In contrast, under AV both Equity (655) and Efficiency (692) received more approvals than any SI option ( $\leq 551$ ), with Efficiency winning the election. Under BC, again both Equity (2786) and Efficiency (2592) received more points than any SI option ( $\leq 2281$ ), and Equity emerged as the winner. That is, while Self-Interest won the upper hand in LE-3 under PV, each of the alternative voting methods managed to select a desirable social convention as an acceptable compromise. This reproduces the results

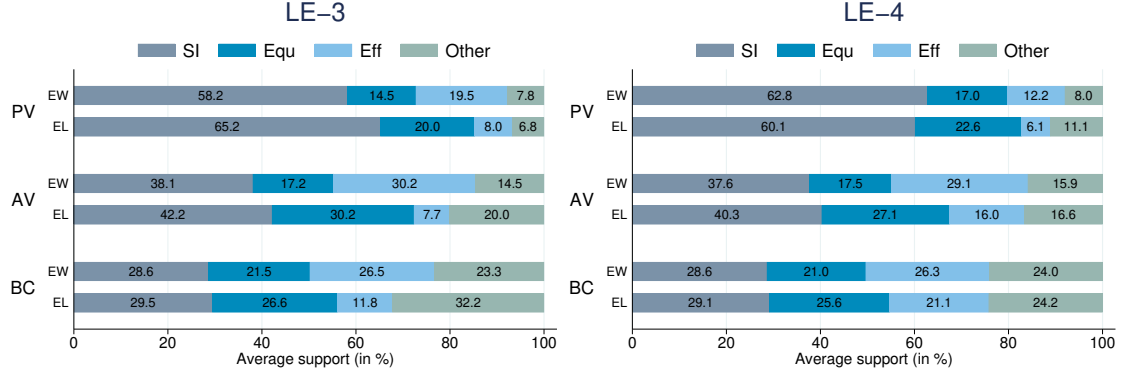


Figure 5: Aggregate voting behavior for large electorates.

from the laboratory experiment (Society 3) and confirms that the methods clearly differ, with AV favoring Efficiency and BC selecting Equity.

Figure 5 (left panel) summarizes aggregate voting behavior across voting methods for LE-3, separately for EWs and ELs. All comparisons are as in the small electorates. EWs tend to support Efficiency (PV: 19.5%; AV: 30.2%; BC: 26.5%) over Equity (PV: 14.5%; AV: 17.2%; BC: 21.5%; WSR test,  $N = 800$ ; PV,  $p = 0.018$ ; AV and BC,  $p < 0.001$ ). For ELs, support for Efficiency is very low (PV: 8.0%; AV: 7.7%; BC: 11.8%), and in particular lower than their support for Equity (PV: 20.0%; AV: 30.2%; BC: 26.6%; WSR test,  $N = 400$ ; all three methods  $p < 0.001$ ). Self-Interest options receive a larger support than Efficiency for EWs (all three methods  $p < 0.001$ ), although the difference is small for AV and BC. Self-Interest options also receive a clearly larger support than Equity for ELs (all three methods  $p < 0.001$ ). In summary, all previous conclusions for Society 3 hold in a large electorate.

The second treatment (LE-4) reproduced Society 4 for a large electorate. Again, voting behavior and outcomes paralleled the results from the small electorates, with large differences in voting margins. Under PV, each of the three SI options received more votes ( $\geq 275$ ) than either Equity (249) or Efficiency (98), and consequently one of the self-interest options ( $SI_3$ ) won the election. In contrast, under AV both Equity (725) and Efficiency (677) received more approvals than any SI option ( $\leq 556$ ), and Equity won the election by a large margin. Under BC, both Equity (2888) and Efficiency (2740) also received more points than any SI option ( $\leq 2175$ ), and Equity emerged again as the winner with a large advantage over SI options. That is, as in the small electorates, Self-Interest won the upper hand in our large electorate under PV, and both alternative voting methods selected Equity as an acceptable compromise. On the one hand, LE-4 confirms the previous observation that Self-Interest wins often under PV but the other methods manage to shift the balance to desirable conventions. On the other hand, comparing LE-3 and LE-4 confirms the previous comparison between Societies 3 and 4. BC favors Equity independently of whether a majority or just a minority benefits from Efficiency, while AV responds to the latter distinction, favoring Efficiency only when the majority profits from it, and shifting support to Equity otherwise.

Figure 5 (right panel) summarizes aggregate voting behavior across voting methods for LE-4, separately for EWs and ELs. Again, EWs tended to support Efficiency (PV: 12.2%; AV: 29.1%; BC: 26.3%) over Equity (PV: 17.0%; AV: 17.5%; BC: 21.0%) under AV and BC (both  $p < 0.001$ ), whereas the opposite holds under PV ( $p = 0.096$ ). For ELs, support for Efficiency (PV: 6.1%; AV: 16.0%; BC: 21.1%) is much smaller than support for Equity (PV: 22.6%; AV: 27.1%; BC: 25.6%; all three methods  $p < 0.001$ ). Self-Interest options receive a larger support than Efficiency for EWs under PV ( $p < 0.001$ ); as in LE-3, differences are small under both AV and BC, but remain statistically significant (AV,  $p < 0.001$ ; BC,  $p = 0.001$ ). Self-Interest options receive a clearly larger support than Equity for ELs (all three methods  $p < 0.001$ ). All conclusions are as in Society 4 in the small electorates.

All previous conclusions comparing Societies 3 and 4 are supported for large electorates (the comparison is now between subjects). Under PV, support for Efficiency from EWs is almost halved in LE-4 compared to LE-3 (Wilcoxon Rank-Sum test, WRS,  $N = 1200$ ; PV,  $p = 0.002$ ), confirming the “wasted vote” effect for EWs under PV when they are in the minority. This effect is absent under AV and BC, with the EWs’ support for Efficiency being of comparable magnitude in both societies (AV,  $p = 0.432$ ; BC,  $p = 0.474$ ). For ELs, support for Self-Interest and Equity are very similar in both societies. However, Efficiency also receives larger support from ELs under AV (16.0%) and BC (21.1%) in LE-4 than in LE-3 (both  $p < 0.001$ ).

We conclude that the results obtained in our laboratory experiments are not limited to small electorates. The conclusion that alternative voting methods allow electorates to successfully coordinate on socially desirable compromises extends to large electorates, as does the observation that BC favors Equity, while AV supports Efficiency provided a majority benefits from it.

### 3.3 Medium (and Asymmetric) Electorates

In the ME experiment, in treatment HOM we assigned 10 voters to each of the three possible types in Society 3 (HOM-3) and Society 4 (HOM-4). In HET, the distribution of types was asymmetric. In Society 3 of HET (HET-3), 8 voters were assigned to type 1, 9 to type 2, and 13 voters to type 3, increasing the size of the minority group of efficiency losers relative to HOM-3. This asymmetry between voter types in HET-3 affects the efficiency of alternatives in two ways: First, the three Self-Interest alternatives differ in terms of efficiency with  $SI_1$  being the least and  $SI_3$  the most efficient of those alternatives. Second, while Eff remains the efficient compromise in the sense of being more efficient than Equity, it is now less efficient overall compared to  $SI_3$ . In Society 4 of HET (HET-4), 9 voters were assigned to type 1, 8 to type 2, and 13 to type 3, increasing the size of the minority group of efficiency winners relative to HOM-4. As in HET-3, the three Self-Interest options differ in terms of efficiency, but now  $SI_1$  and  $SI_2$

are the most and least efficient of those alternatives, respectively. In contrast to HET-3, however, Eff remains the alternative with the highest efficiency overall.

The results of HOM closely replicate all results obtained for Societies 3 and 4 in SE (see Online Appendix for details), hence we turn to compare HOM and HET. In HET-3, the electorate was not only asymmetric, but as a consequence of this asymmetry the advantage in terms of efficiency of the efficient compromise Eff over equity was also much smaller compared to HOM-3. Although voting behavior is rather similar in both treatments, the difference in the size of the three interest groups have a clear effect on voting outcomes in HET-3. Under PV, SI options win almost all elections (92.6%), while under AV and BC the most-frequent winner is Equity (AV: 60.2%; BC: 76.9%). Under AV and BC, SI options win only 24.1% and 17.6% of the elections, respectively. That is, while Self-Interest almost always wins the upper hand under PV, each of the alternative voting methods manages to select a desirable social convention. In contrast to HOM-3, AV selects Equity in HET-3, which yields two interesting insights: First, it shows that AV is also sensitive to whether the efficiency gain is small or large, selecting Efficiency in HOM-3, where it is large and Equity in HET-3, where it is small. Second, although in HET-3 alternative SI<sub>3</sub> is overall the most efficient option (since voters of type 3 form the largest interest group), it is not selected by AV.

Next, we consider Society 4. In HET-4, EWs are still a minority but now form the largest of the three interest groups. Consequently, the efficient compromise Eff is even more efficient in HET-4 than in HOM-4. Again, there are no large differences in voting behavior across treatments, however, the same cannot be said about voting outcomes. Under PV, SI options win an overwhelming 88.6% of the time in HET-4. In contrast, under both AV and BC Equ emerges as the winner most of the time (AV, 56.5%; BC, 57.4%). As in HOM-4, equity is selected by both AV and BC, however, both methods react to the overall greater efficiency of Eff by selecting it more frequently in HET-4 than in HOM-4.

In summary, HOM shows that our previous results for small and large electorates also obtain for medium-sized electorates. A comparison of HOM and HET reveals that all voting methods react to differences in the size of the interest groups. Under PV, an asymmetric electorate leads to even more extreme outcomes with selfish options winning almost all elections. In contrast, AV and BC also allow the asymmetric electorate to successfully coordinate on socially desirable compromises. For those methods, the asymmetry merely affects the frequency with which one or the other compromise is selected.

## 4 Rank-Order Methods

Our experiments focused on the three positional voting methods originally described in [Riker \(1982, Chapter 4E\)](#): PV, AV, and BC. Naturally, there are many other interesting voting methods that could have been used as well. Two prominent examples are the rank-order voting methods Single Transferable Vote (STV), used e.g. for the election

of the Australian Parliament, and the two-round system (TRS) used in the French presidential elections. Although those methods were not included in our experiments, we can use the preference rankings elicited via the random dictator mechanism to infer the outcomes that would be obtained under those voting procedures by extrapolation based on those elicited preferences (see [Felsenthal et al., 1993](#); [Felsenthal and Machover, 1995](#), for a similar approach employed in a field setting). In this section we report the results of this exercise for small and medium electorates, which featured the random dictator mechanism (the Online Appendix provides further details of these analyses).<sup>8</sup>

We first consider the induced election outcomes under STV for small electorates. Voting outcomes exhibit a large number of ties, with self-interest options winning an overwhelming amount of elections. Across the four societies, equity and efficiency win only between 5% and 8% of the elections, which suggests that outcomes under STV (assuming that voters vote according to their elicited preferences) would be even more extreme than under PV. For small electorates, the outcomes under TRS are exactly identical.

Turning to the outcomes under STV for medium electorates, we find that ties are less frequent, probably due to the larger size of the electorates. Nevertheless, self-interest options still win an overwhelming amount of elections. In HOM-3 and HOM-4, equity only wins 11% and 20% of the elections, respectively, whereas efficiency never emerges as the winner. In HET-3 and HET-4, where the type distribution in the electorate is asymmetric, compromises tend to be selected more often than in HOM. However, they are still chosen less frequently than under PV.

Given that rank-order methods are often used in actual political elections as an alternative to Plurality Voting, these results are striking. However, the intuition is simple. Rank-Order methods as STV and TRS employ multiple rounds of ballot counting, with alternatives which fare poorly in one round being eliminated from the set available in the next round. Faring poorly, though, is defined as being ranked highest by a small share of the electorate. Under these methods, self-interest alternatives are almost universally ranked first in the first round, resulting in a small support for compromises. Hence, the latter are often eliminated and are simply not available in later rounds. By basing the elimination criterion on the highest-ranked alternatives, rank-order methods run into the same problem as PV: the information on which alternatives would be acceptable for a large share of the electorate is lost.

## 5 Discussion

We have shown that moving away from current voting systems and toward methods that give voters more flexible and detailed ways to express their preferences could greatly

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<sup>8</sup>For LE, we conducted a similar exercise based on the preference ranking induced by subjects' BC vote. These results are presented in the Online Appendix. Under STV applied to these BC preferences, all three SI options received more votes than equity and efficiency in the first round and consequently SI<sub>1</sub> and SI<sub>3</sub> emerged as the winner in LE-3 and LE-4, respectively. TRS yields very similar results.

reduce the prevalence of extreme outcomes in actual elections. With these, more flexible voting methods in place (but not with the ones which are mostly used nowadays), two key, prominent social conventions, social justice (equity) and efficiency, can help polarized societies coordinate on desirable compromises.

In our experiments, which include both small electorates in the laboratory as well as medium and large electorates online, Plurality Voting (and also rank-order methods as Single Transferable Vote) generally exacerbates egoistic voting, whereas both Approval Voting and Borda Count partially mitigate it, with large-magnitude effects on election outcomes. Inequality (as a result of implementing efficiency at the societal level) plays a large role. Efficiency losers, who get the short end of the stick when the efficient alternative is implemented, exhibit a higher degree of self-interest and are less sensible to the voting method. When both Efficiency and Equity are present, efficiency winners tend to favor Efficiency, whereas efficiency losers tend to favor Equity.

The choice of the method is also consequential. Borda Count tends to favor Equity over Efficiency independently of whether a majority or just a minority would benefit from Efficiency. Approval Voting is more reactive: It tends to implement Efficiency only if a majority of the society benefits from it, shifting to Equity otherwise. This suggests that Approval Voting might be more sensitive to and better reflect the aggregate preferences of the electorate in contrast to the Borda Count, which might also affect other dimensions of voter satisfaction such as losers' consent.

In our experiments, we have concentrated on societies where several similarly-sized groups have opposed interests. We believe that this captures important features of polarized societies (Posner, 2004; Huber, 2012), for which our results might be especially relevant. If a dominant group were to constitute a majority with diametrically-opposed interests to the rest of the society, there is little hope that a compromise will be reached regardless of the voting method. However, as our asymmetric treatment with medium electorates shows, equal distributions are not a prerequisite for the results to be relevant. Indeed, we find that under PV an asymmetric electorate leads to even more extreme outcomes, whereas AV and BC allow the asymmetric electorate to successfully coordinate on socially desirable outcomes. For the latter two methods, the asymmetry only determines which but not whether a compromise is selected.

On the other hand, the problem in some societies might not be that the voting method prevents coordination on a desirable compromise, but rather that a compromise is not available among the alternatives to begin with. In this latter case, there is little hope that changing the voting method will change the result. However, it is conceivable that the nonexistence of compromises might sometimes be a consequence of the expectation that, under existing voting methods, putting such options forward is fruitless, for instance because such attempts have been seen to fail in the past. Thus, changing the voting method might result in appropriate compromises arising.

Overall, our results suggest that some extreme outcomes in elections might partly be a consequence of the limitations of the voting methods currently in place, and not

only of underlying social tendencies. While social science has little to say about the latter (in the sense that voters are entitled to their true preferences), it has a lot to contribute to the former. If a faithful, descriptive representation of voters' preferences is among the main objectives of a voting method, then those based on Plurality Voting are doing a poor job of it. In doing so, they are also failing to provide clear majorities, identify stable social compromises, and ensure the legitimacy of the winners. Democratic societies might benefit from moving beyond currently-employed methods toward other, more nuanced ones capable of better eliciting preferences from voters and, especially, identifying acceptable social compromises. We have concentrated on two prominent methods, and found both to be an improvement over Plurality Voting and rank-order methods in this sense. A discussion can be started on the virtues of one or the other (or a third one), and our work already contributes to that. In terms of which social convention is favored, our data suggests that Approval Voting might be more responsive to the well-being of the majority, and seems to better elicit sincere voting behavior (see Online Appendix). However, choosing among methods should be viewed as a second-order consideration compared to the social urgency surrounding the potential negative consequences of rising extremism, and the fact that a purely methodological (legislative) change could greatly (and immediately) curtail them.

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## Appendix A Medium (and Asymmetric) Electorates

We conducted an online experiment with medium electorates that varied the size of the three groups with different types of voters. In treatment HOM the electorate was symmetric (as in SE and ME), whereas in treatment HET the electorate was asymmetric. The treatments involved 1,620 voters each, for a total of 3,240 unique voters. We again focused on the payoff profiles of Societies 3 and 4.

In each treatment, voters were randomly assigned to electorates of 30 voters each. In HOM, we assigned 10 voters to each of the three possible types in each Society. In HET, the distribution of types was asymmetric. In Society 3 (HET-3), 8 voters were assigned to type 1, 9 to type 2, and 13 voters to type 3, increasing the size of the minority group of efficiency losers relative to HOM-3. This asymmetry between voter types in HET-3 affects the efficiency of alternatives in two ways: First, the three Self-Interest alternatives differ in terms of efficiency with  $SI_1$  being the least and  $SI_3$  the most efficient of those alternatives. Second, while Eff remains the efficient compromise in the sense of being more efficient than Equity, it is now less efficient overall compared to  $SI_3$ . In Society 4 (HET-4), 9 voters were assigned to type 1, 8 to type 2, and 13 to type 3, increasing the size of the minority group of efficiency winners relative to HOM-4. As in HET-3, the three Self-Interest options now differ in terms of efficiency, but now  $SI_1$  is the most and  $SI_2$  is the least efficient of those alternatives. In contrast to Society 3, however, Eff remains the alternative with the highest efficiency overall. Implementation was as in the laboratory, with the exception that each voter was assigned to a fixed type.

We first consider HOM, where electorates were symmetric. Figure A.1A details the payoffs and induced preferences in Society 3 for HOM. Figure A.1B summarizes actual aggregate voting behavior. EWs tend to support Efficiency (PV: 21.9%; AV: 31.1%; BC: 27.3%) over Equity (PV: 5.7%; AV: 11.8%; BC: 21.2%; PV,  $p = 0.005$ ; AV and BC,  $p < 0.001$ ). For ELs, support for Efficiency is virtually nonexistent (PV: 4.8%; AV: 6.5%; BC: 9.9%), and far smaller than their support for Equity (PV: 25.0%; AV: 30.9%; BC: 26.6%; all three methods  $p < 0.001$ ). However, for all methods, Self-Interest options receive a larger support than Efficiency for EWs (all three methods  $p < 0.001$ ), although the difference is small for AV and BC. Self-Interest options also receive a clearly larger support than Equity for ELs (all three methods  $p < 0.001$ ).

Those differences in voting behavior result in considerable differences in voting outcomes (Fig. A.1C). Under PV, SI options win most of the time (66.0%), while under AV the most-frequent winner is Efficiency (51.9%) and under BC the most frequent winner is Equity (76.9%). Efficiency wins most frequently under AV, compared to both PV and BC (WSR tests,  $N = 54$ ; both  $p < 0.001$ ), and Equity wins most elections under BC (BC vs. PV,  $p < 0.001$ ; BC vs. AV,  $p = 0.002$ ). Equity still fares significantly better under AV than under PV ( $p = 0.008$ ). Indeed, under AV SI options only win 1.9% of the elections, and only 2.8% under BC. That is, while Self-Interest often wins the upper hand under PV, each of the alternative voting methods manages to select a desirable

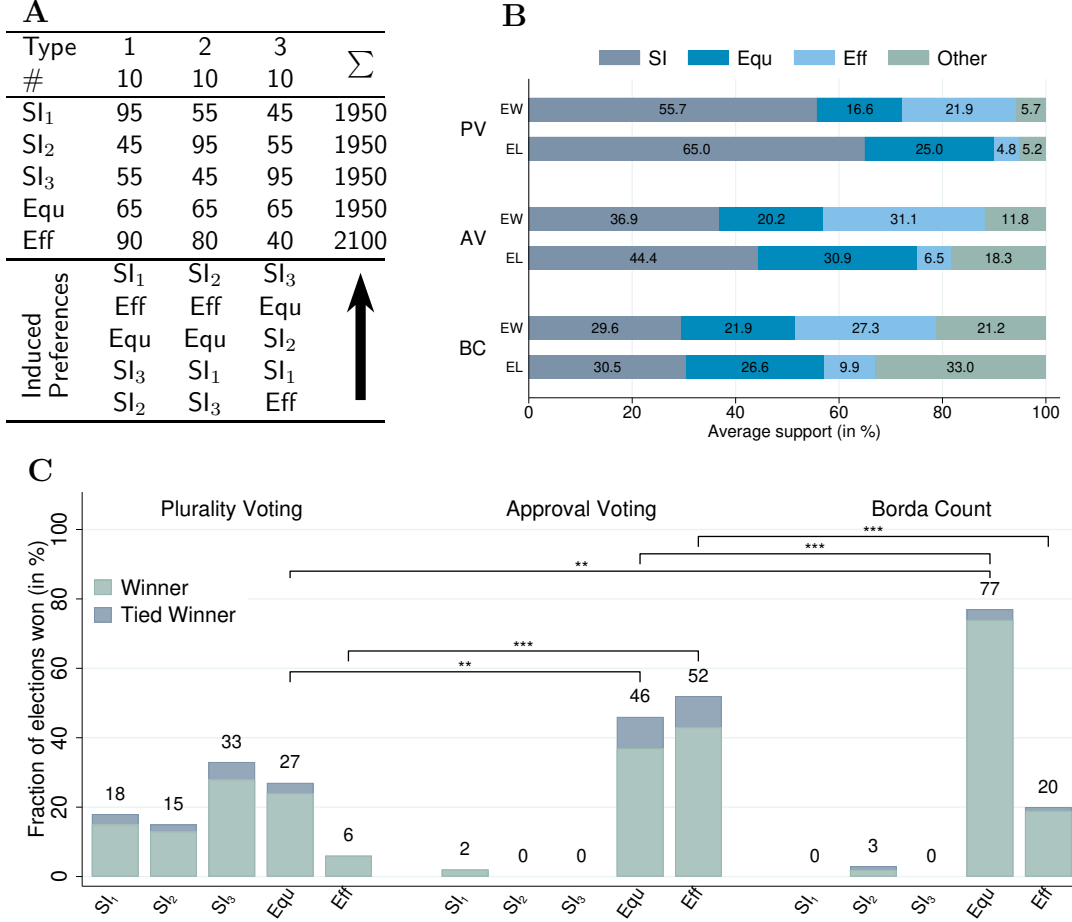


Figure A.1: Preferences, voting behavior, and outcomes for HOM-3.

Notes: **A**, Voter preferences per electorate, induced monetarily. **B**, Aggregate voting behavior for the 1,620 voters. **C**, Voting outcomes for the 54 electorates, by voting method. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

social convention as an acceptable compromise, which goes on to win most elections. The methods clearly differ, with AV favoring Efficiency and BC selecting Equity.

We now turn to Society 4 in HOM. Payoffs and induced preferences are shown in Fig. A.2A). Figure A.2B summarizes actual aggregate voting behavior for Society 4. EWs tend to support Equity over Efficiency under PV (Equ 21.7%, Eff 14.1%,  $p = 0.003$ ), whereas they tend to support Efficiency over Equity under AV (Equ 20.8%, Eff 30.0%,  $p < 0.001$ ) and BC (Equ 22.6%, Eff 26.4%,  $p < 0.001$ ). For ELs, support for Efficiency (PV: 4.0%; AV: 13.3%; BC: 20.4%) is much smaller than support for Equity (PV: 25.0%; AV: 30.7%; BC: 27.0%; all three methods  $p < 0.001$ ). For EWs, Self-Interest options receive a larger support than Equity under PV ( $p < 0.001$ ) and also a larger support than Efficiency under AV and BC (both methods  $p < 0.001$ ), although the difference is small for AV and BC. Self-Interest options receive a clearly larger support than Equity for ELs (all three methods  $p < 0.001$ ).

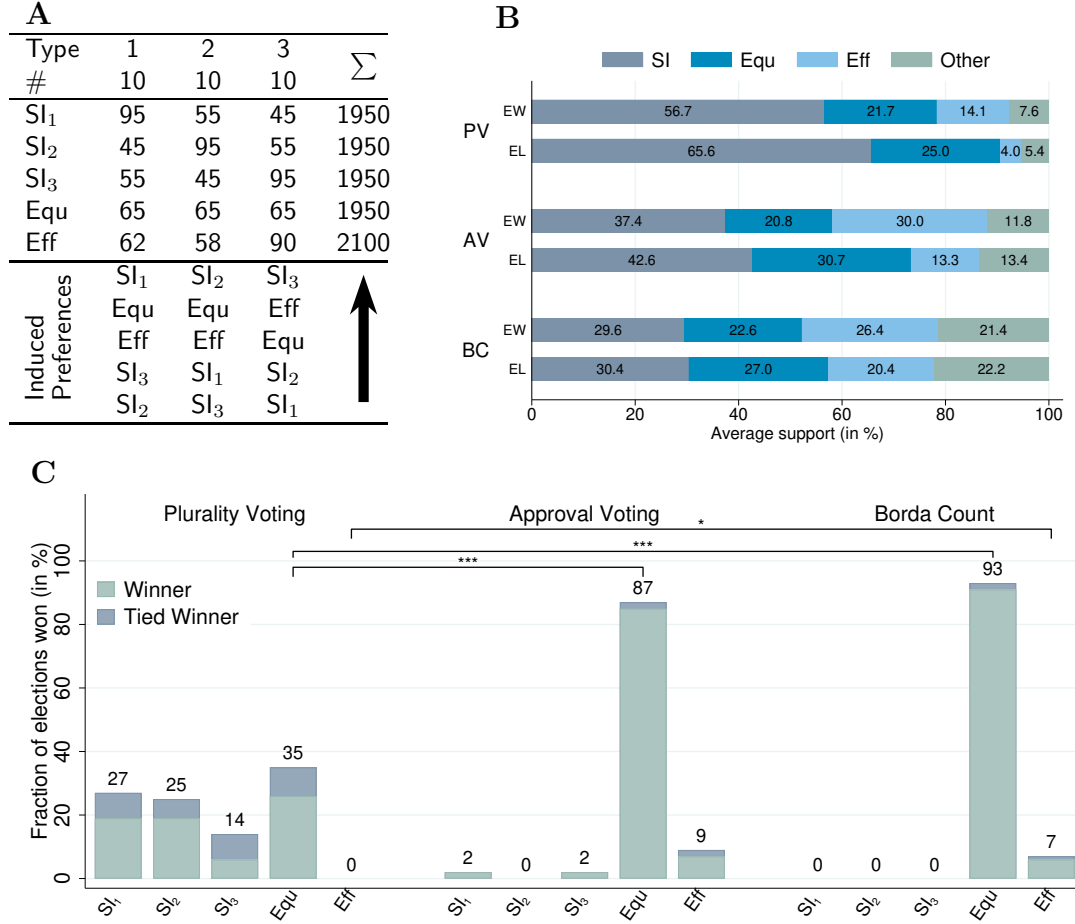


Figure A.2: Preferences, voting behavior, and outcomes for HOM-4.

Notes: **A**, Voter preferences per electorate, induced monetarily. **B**, Aggregate voting behavior for the 1,620 voters. **C**, Voting outcomes for the 54 electorates, by voting method. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

Under PV, the average support received by Efficiency from EWs is almost cut in half in Society 4 (where efficiency benefits only a few) compared to Society 3 (where efficiency benefits a majority). That is, we again observe a clear “wasted vote” effect for EWs under PV when they are in the minority. This effect is absent under AV (Soc. 3: 31.1%, Soc. 4: 30.0%) and BC (Soc. 3: 27.3%, Soc. 4: 26.4%). For ELs, support for Self-Interest and Equity are very similar in Societies 3 and 4. However, Efficiency also receives some support from ELs under AV (13.3%) and BC (20.4%) in Society 4, as observed previously for small electorates.

Differences in voting outcomes are also large for Society 4 (Fig. A.2C). Under PV, SI options win an overwhelming 65.1% of the time. In contrast, under both AV and BC Equity emerges as the winner in almost all elections (AV, 87.0%; BC, 92.6%), and both select it significantly more often than PV ( $N = 54$ ; both  $p < 0.001$ ). Since PV never selects Efficiency, it also is selected (marginally) more often under AV ( $p = 0.051$ ) and BC ( $p = 0.043$ ). There is no significant difference in outcomes between AV and BC. In

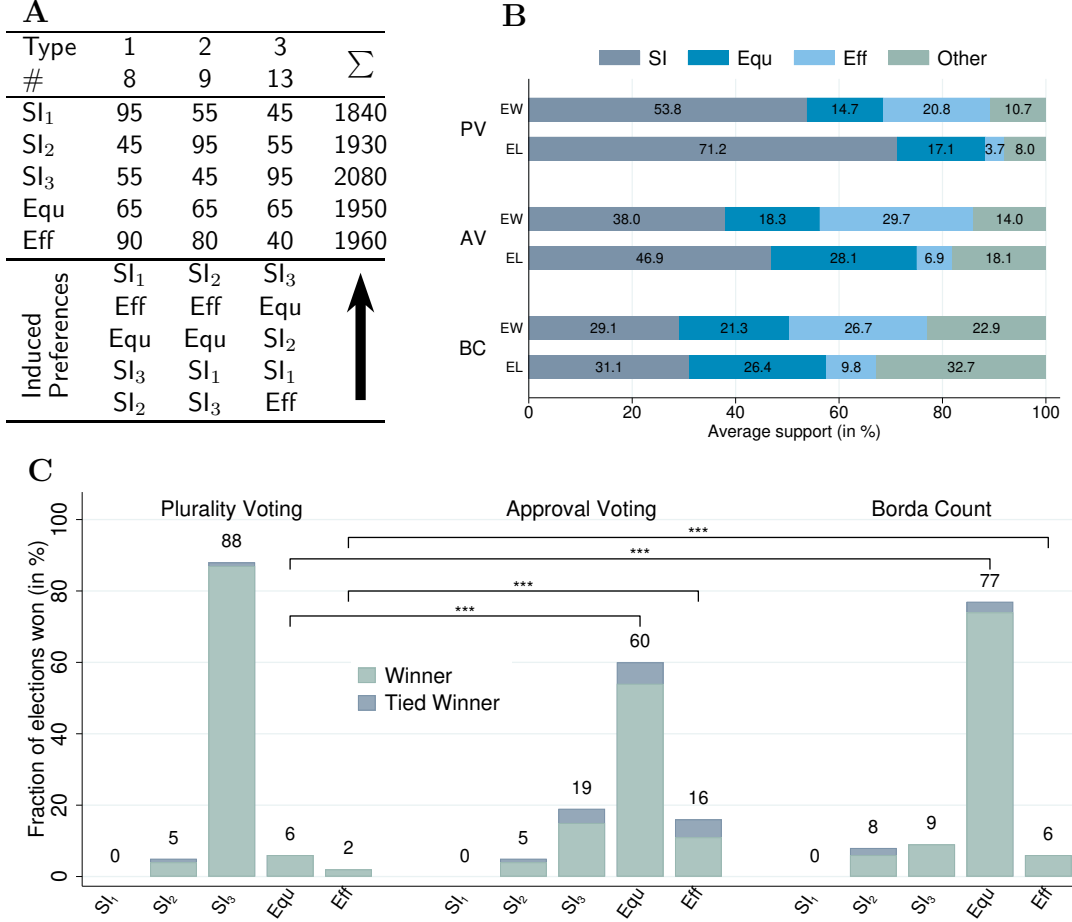


Figure A.3: Preferences, voting behavior, and voting outcomes for HET-3.

Notes: **A**, Voter preferences per electorate, induced monetarily. **B**, Aggregate voting behavior for the 1,620 voters. **C**, Voting outcomes for the 54 electorates, by voting method. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

summary, HOM confirms the results on voting outcomes obtained previously for small electorates.

Next, we turn to HET where electorates were asymmetric. Figure A.3A details the payoffs and induced preferences in Society 3 for HET. Figure A.3B summarizes actual aggregate voting behavior. EWs tend to support Efficiency (PV: 20.8%; AV: 29.7%; BC: 26.4%) over Equity (PV: 14.7%; AV: 18.3%; BC: 21.3%;  $N = 918$ , PV,  $p = 0.002$ ; AV and BC,  $p < 0.001$ ). For ELs, support for Efficiency is virtually nonexistent (PV: 3.7%; AV: 6.9%; BC: 9.8%), and far smaller than their support for Equity (PV: 17.1%; AV: 28.1%; BC: 26.4%;  $N = 702$ , all three methods  $p < 0.001$ ). However, for all methods, Self-Interest options receive a larger support than Efficiency for EWs (all three methods  $p < 0.001$ ), although the difference is small for AV and BC. Self-Interest options also receive a clearly larger support than Equity for ELs (all three methods  $p < 0.001$ ).

Those differences in voting behavior result in considerable differences in voting outcomes (Fig. A.3C). Under PV, SI options win almost all elections (92.6%), while under

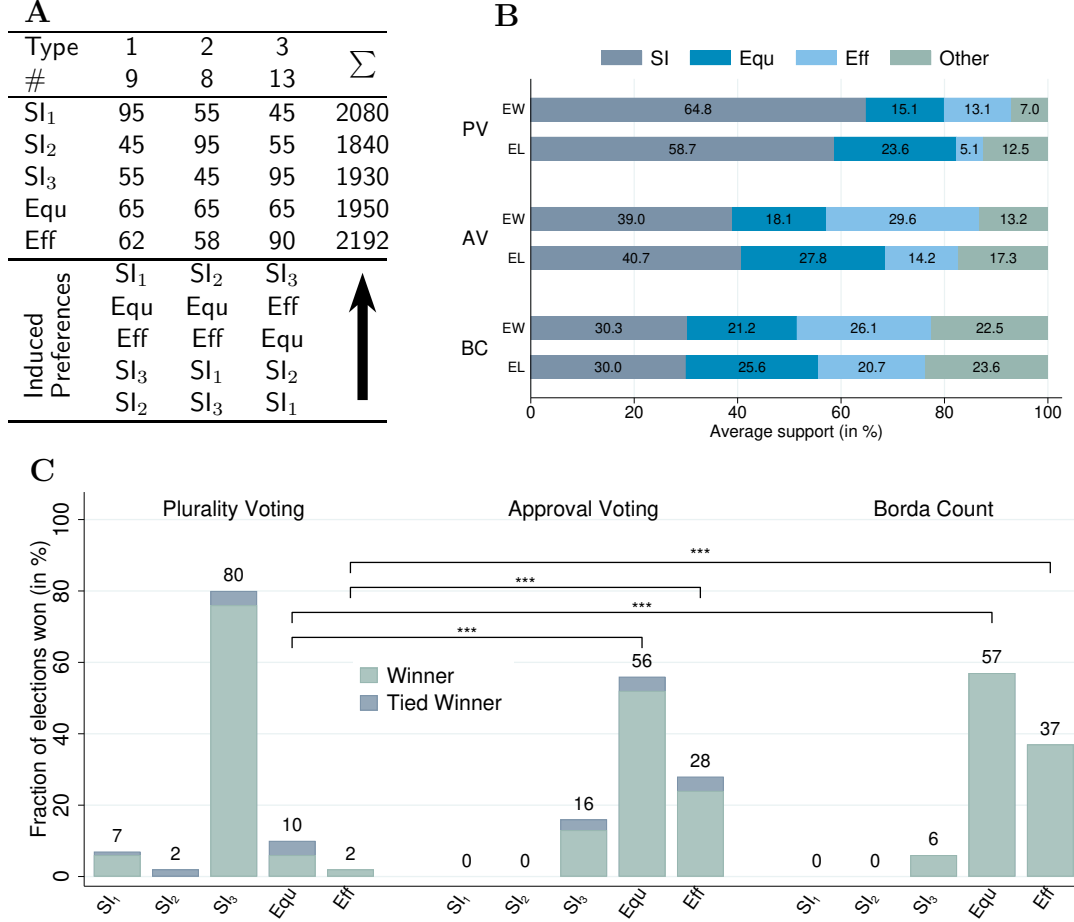


Figure A.4: Preferences, voting behavior, and voting outcomes for HET-4.

*Notes:* **A**, Voter preferences per electorate, induced monetarily. **B**, Aggregate voting behavior for the 1,620 voters. **C**, Voting outcomes for the 54 electorates, by voting method. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

AV and BC the most-frequent winner is Equity (AV: 60.2%; BC: 76.9%). Efficiency wins more frequently under AV compared to both PV and BC (WSR tests,  $N = 54$ : AV vs. PV  $p = 0.013$ ; AV vs. BC  $p = 0.049$ ), and Equity wins most elections under AV and BC (BC vs. PV,  $p < 0.001$ ; AV vs. PV,  $p < 0.001$ ) with no significant difference between AV and BC ( $p = 0.066$ ). Under AV SI options win 24.1% of the elections, and 17.6% under BC. That is, while Self-Interest almost always wins the upper hand under PV, each of the alternative voting methods manages to select a desirable social convention as an acceptable compromise, which goes on to win most elections. In contrast to HOM, here both AV and BC select Equity.

Finally, we consider Society 4 in HET. Payoffs and induced preferences are shown in Fig. A.4A). Figure A.4B summarizes actual aggregate voting behavior for Society 4. For EWs, there is no difference in support between Equity and Efficiency under PV (Equ 15.1%, Eff 13.1%,  $p = 0.320$ ), whereas EWs tend to support Efficiency over Equity under AV (Equ 18.1%, Eff 29.6%,  $p < 0.001$ ) and BC (Equ 21.2%, Eff 26.1%,  $p < 0.001$ ). For



ELs, support for Efficiency (PV: 5.1%; AV: 14.2%; BC: 20.7%) is much smaller than support for Equity (PV: 23.6%; AV: 27.8%; BC: 25.6%; all three methods  $p < 0.001$ ). For EWs, Self-Interest options receive a larger support than Equity under PV ( $p < 0.001$ ) and also a larger support than Efficiency under AV and BC (both methods  $p < 0.001$ ), although the difference is small for AV and BC. Self-Interest options receive a clearly larger support than Equity for ELs (all three methods  $p < 0.001$ ).

Under PV, the average support received by Efficiency from EWs is almost cut in half in Society 4 (where efficiency benefits only a few) compared to Society 3 (where efficiency benefits a majority). That is, we again observe a clear “wasted vote” effect for EWs under PV when they are in the minority. This effect is absent under AV (Soc. 3: 29.7%, Soc. 4: 29.6%) and BC (Soc. 3: 26.7%, Soc. 4: 26.1%). For ELs, support for Self-Interest and Equity are very similar in Societies 3 and 4. However, again Efficiency receives some support from ELs under AV (14.2%) and BC (20.7%) in Society 4.

Differences in voting outcomes are also large for Society 4 in HET (Fig. A.4C). Under PV, SI options win an overwhelming 88.6% of the time. In contrast, under both AV and BC Equity emerges as the winner most of the time (AV, 56.5%; BC, 57.4%), and both select it significantly more often than PV ( $N = 54$ ; both  $p < 0.001$ ). Since PV almost never selects Efficiency, it is also selected more often under AV and BC (both  $p < 0.001$ ). There is no significant difference in outcomes between AV and BC. In summary, also HET confirms the results on voting outcomes obtained previously for small electorates.

## Appendix B Legitimacy of the Winner

The recognition of the legitimacy of the winner in an electoral system is crucial for stable governments or resolutions (Nadeau and Blais, 1993; Anderson and Mendes, 2006). Thus, besides the question of which alternative is selected by a voting method in a given environment, it is also important to study the legitimacy of the winner. For a given voting method, we define legitimacy of an alternative as the average proportion of votes/approvals/points of the alternative, conditional on being the winner, relative to the maximum number of votes/approvals/points an alternative can obtain. That is, legitimacy of an alternative is 0% if no voter voted for/approved of that alternative or if all voters ranked it last. Conversely, legitimacy is 100% if all voters voted for/approved of that alternative or if all voters ranked it first.

To compare legitimacy, we focus on the most-frequent winner for each society and experiment/treatment summarized in Table A.1. There are two important insights: First, legitimacy is smaller the larger the electorate for all voting methods. Average legitimacy across treatments in SE is highest, with 40.1% for PV, 68.0% for AV, and 66.8% for BC. In comparison, for the medium electorates legitimacy drops to 32.7% for PV, 63.0% for AV, and 61.5% for BC. Legitimacy is lowest for large electorates amounting to 24.4% for PV, 59.1% for AV, and 59.1% for BC. Second, legitimacy is low for PV, whereas it is high for both AV and BC. For PV, legitimacy ranges from 24.8%

Table A.1: Legitimacy of the winner (in percent).

		Most frequent winner (Legitimacy)		
		PV	AV	BC
SE	Soc. 1	Equ (44.4)	Equ (75.0)	Equ (71.8)
	Soc. 2	Eff (40.5)	Eff (65.8)	Eff (61.1)
	Soc. 3	Eff (38.7)	Eff (61.6)	Equ (63.8)
	Soc. 4	SI <sub>1</sub> (36.8)	Equ (69.6)	Equ (70.5)
ME HOM	Soc. 3	SI <sub>3</sub> (29.4)	Eff (59.9)	Equ (59.9)
	Soc. 4	Equ (30.8)	Equ (67.6)	Equ (64.3)
	HET	Soc. 3	SI <sub>3</sub> (36.2)	Equ (59.9)
		Soc. 4	SI <sub>3</sub> (34.3)	Equ (61.8)
LE	Soc. 3	SI <sub>3</sub> (24.0)	Eff (57.7)	Equ (58.0)
	Soc. 4	SI <sub>3</sub> (24.8)	Equ (60.4)	Equ (60.2)

to 44.4% across treatments and experiments, in particular, the legitimacy of the most-frequent winner is always well below 50%. In contrast, for AV and BC legitimacy ranges from 57.7% to 75.0% and from 58.0% to 71.8%, respectively. That is, in all treatments legitimacy of the most-frequent winner is well above 50% for both AV and BC.<sup>9</sup>

## Appendix C Sincerity

One of the main objectives of a voting method is to represent the electorate’s preferences as faithfully as possible (e.g., [Riker, 1982](#)). Theoretical results have shown that any voting method within a wide family creates incentives to misrepresent preferences for strategic reasons ([Gibbard, 1973](#); [Satterthwaite, 1975](#)), and empirical evidence suggests that strategic voting is frequent in political elections (e.g., [Black, 1978](#); [Alvarez and Nagler, 2000](#); [Fisher, 2004](#); [Eggers and Vivyan, 2020](#)). For instance, strategic considerations lead to the wasted-vote effect where favorite candidates thought to be unlikely to win are abandoned in favor of popular ones, which might ultimately lead to a reduction in the number of parties ([Duverger, 1954](#)). Although one can argue whether or not manipulation attempts at the individual level should be a concern ([Dowding and van Hees, 2008](#)), it is still important to know which methods elicit a higher degree of strategic behavior in actual voting decisions. In this section we take a closer look at strategic voting and the sincerity of voters’ behavior in our data.

Differences in strategic voting across methods are especially interesting in our experimental setting, because Approval Voting does not belong to the class covered by the formal results of [Gibbard \(1973\)](#) and [Satterthwaite \(1975\)](#) and at least partially

<sup>9</sup>In the first municipal election under AV in Fargo, North Dakota, in June 2020, both of the elected candidates received more than 50% approvals by voters. In the last municipal elections before the introduction of AV in St. Louis, Missouri, the winner received only 32% of the vote; in contrast, in March 2021, under AV, the winner received 57% of approvals (and became the city’s first Black woman mayor) ([Alley Peña, 2021](#)).

escapes them (Brams and Fishburn, 1978; Alós-Ferrer and Buckenmaier, 2019). The intuition is that, even if there are strategic reasons to approve of a non-favorite option, this can be accomplished by merely moving the approval threshold without misrepresenting preferences (see, however, Niemi, 1984).

In our experimental societies, we induced preferences via monetary payoffs. The behavioral literature mostly considers sincerity with respect to the preferences induced in this way. However, a large literature in economics and political science shows that preferences take into account both inequality and efficiency (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000; Charness and Rabin, 2002; Feddersen et al., 2009; Bechtel et al., 2018; Morton and Ou, 2019). Hence, our voters' true preferences may differ from monetarily-induced ones. Since our experimental setup focuses on social conventions, it is likely that non-egoistic motives play a role. For that reason, our laboratory experiment implemented a novel preference-elicitation method (presented as a fourth voting method) based on a random dictator mechanism. To that end, subjects were first asked to choose an alternative that, in case the subject was randomly selected to be the dictator, would be implemented independently of the decisions of the other voters in the group. In order to elicit the full preference over alternatives and not just the most-preferred alternative, subjects were informed that for each alternative there was a small probability of 5% that this alternative could not be implemented. Hence, subjects were asked to name a second alternative to be implemented in case their first choice was not feasible. Continuing in that fashion subjects had to sequentially provide a complete ranking of the alternatives. Payment for this method was implemented truthfully, that is, a voter was randomly selected and the most-preferred alternative of this voter was implemented with a probability of 95%, and eliminated from the ranking otherwise; in the latter case, the procedure was repeated with the reduced ranking. This method elicits preferences in an incentive-compatible way, with incentives being fully independent from the decisions of the other voters. We refer to the ranking so obtained as a subject's *elicited preferences*.

By construction Self-Interest is always the most preferred alternative according to voters' induced preferences. A small but still sizable fraction of voters prefers one of the social conventions, Equity (11-13%) or Efficiency (10-17%), to implementing their payoff-maximizing alternative at least once according to their elicited preferences (Fig. A.5). For those voters, the induced preference profile does not always coincide with their preferences as revealed by the elicitation mechanism. Thus we obtain a novel measure of sincerity. We refer to the classic notion of sincerity relative to the induced preferences as *induced sincerity*, and to our alternative measure of sincerity relative to the elicited preferences as *elicited sincerity*. Specifically, we define sincerity (induced or elicited) over a set of alternatives as follows. For PV, the only sincere vote is to vote for the most-preferred alternative. For AV, a ballot is sincere if it approves of any alternative that is (strictly) preferred to some approved alternative. For BC, the only sincere vote is to rank the alternatives from most-preferred to least-preferred.

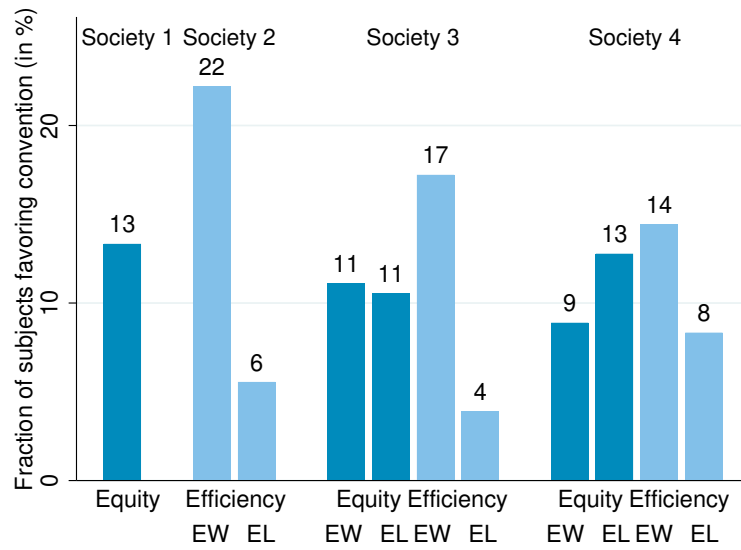


Figure A.5: Elicited preferences for small electorates.

*Notes:* Fraction of subjects who favor Equity or Efficiency over Self-Interest at least once, according to their elicited preferences.

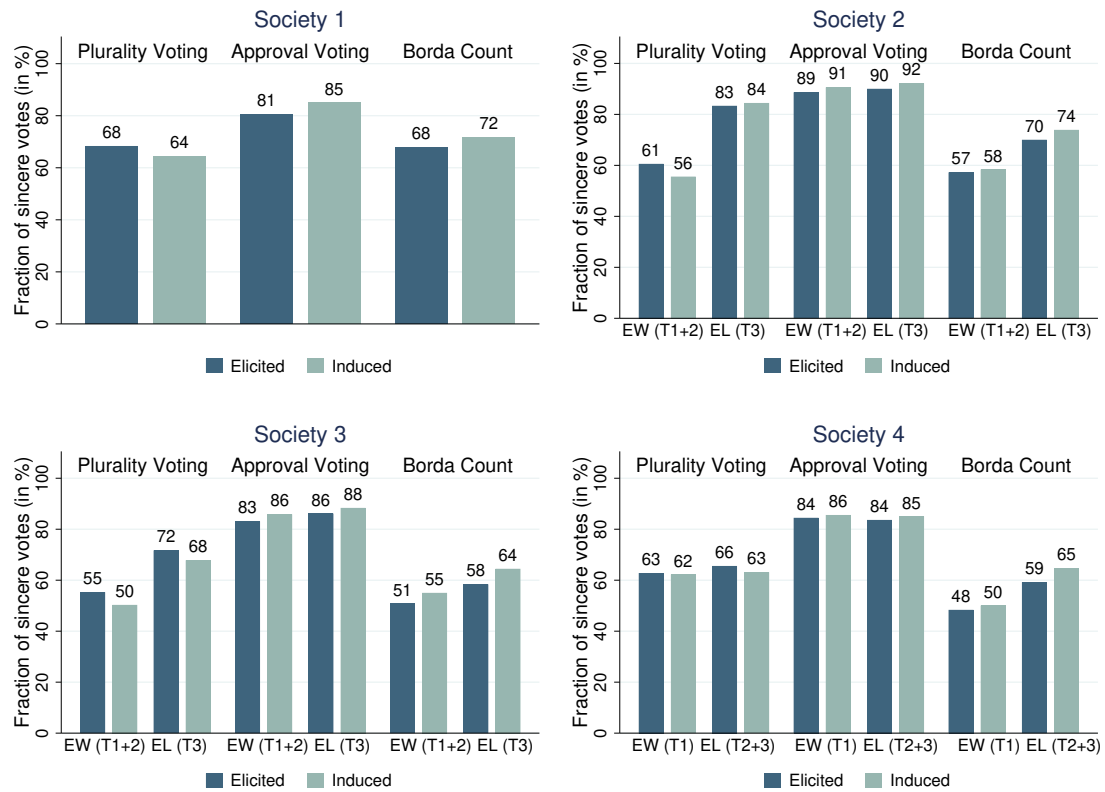


Figure A.6: Induced and elicited sincere votes for small electorates.

*Notes:* Fraction of induced/elicited sincere votes for each voting method in the four experimental societies.

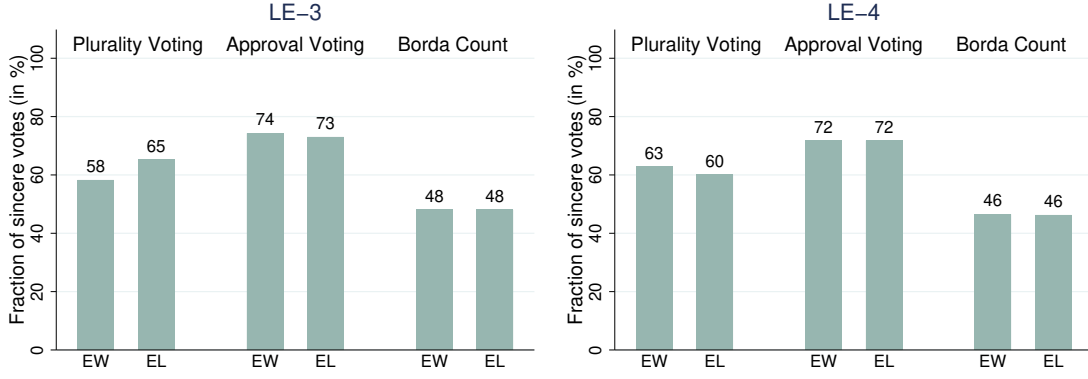


Figure A.7: Induced sincere votes for large electorates.

*Notes:* Fraction of induced sincere votes for each voting method for large electorates.

Focusing on elicited sincerity, we find a large fraction of insincere votes under PV, except for efficiency losers in Society 2 (Fig. A.6). In contrast, we find high levels of sincerity under AV and no systematic difference in sincerity between EWs and ELs (WSR tests,  $N = 180$ ; Soc. 2,  $p = 0.046$ ; Soc. 3,  $p = 0.056$ ; Soc. 4,  $p = 0.360$ ). Under BC there is also a large fraction of insincere votes, with a stronger tendency toward strategic voting for EWs compared to ELs (Soc. 2,  $p < 0.001$ ; Soc. 3,  $p = 0.078$ ; Soc. 4,  $p = 0.003$ ). However, for BC sincerity is a very demanding concept, as it requires subjects to truly state their complete preference ranking and not just the top-ranked one as it is the case for PV. Given this, the fact that sincerity in BC is of a similar magnitude than in PV means that BC did not exacerbate insincerity in our data. Interestingly, voters in the minority show more strategic voting under BC compared to PV (Soc. 2, ELs,  $p < 0.001$ ; Soc. 3, ELs,  $p = 0.003$ ; Soc. 4, EWs,  $p = 0.001$ ), while the majority shows no such effect (Soc. 2, EWs,  $p = 0.471$ ; Soc. 3, EWs,  $p = 0.138$ ; Soc. 4, ELs,  $p = 0.073$ ). We also find that the overall level of sincerity is qualitatively the same with respect to both the induced and the elicited preferences (17 out of 21 tests are insignificant).

For large electorates, we can also examine induced sincerity. Overall sincerity seems to be lower than in the laboratory. However, the relative magnitudes of sincerity across voting methods and EW/EL are again very similar. We find a large fraction of insincere votes under PV (Fig. A.7) with a stronger tendency toward strategic voting for EWs compared to ELs in LE-3 (WSR test,  $N = 1200$ ,  $p = 0.020$ ). In contrast, we find high levels of sincerity under AV and no systematic difference in sincerity between EWs and ELs (WSR tests,  $N = 1200$ ; LE-3,  $p = 0.643$ ; LE-4,  $p = 1.000$ ). Under BC there is also a large fraction of insincere votes and no difference between EWs and ELs (WSR tests,  $N = 1200$ ; LE-3,  $p = 1.000$ ; LE-4,  $p = 0.935$ ).

The ME experiment also featured our preference-elicitation method, hence, we can consider both induced and elicited sincerity. A small but still sizable fraction of voters prefers one of the social conventions, Equity (20-22%) or Efficiency (16-19%), to im-

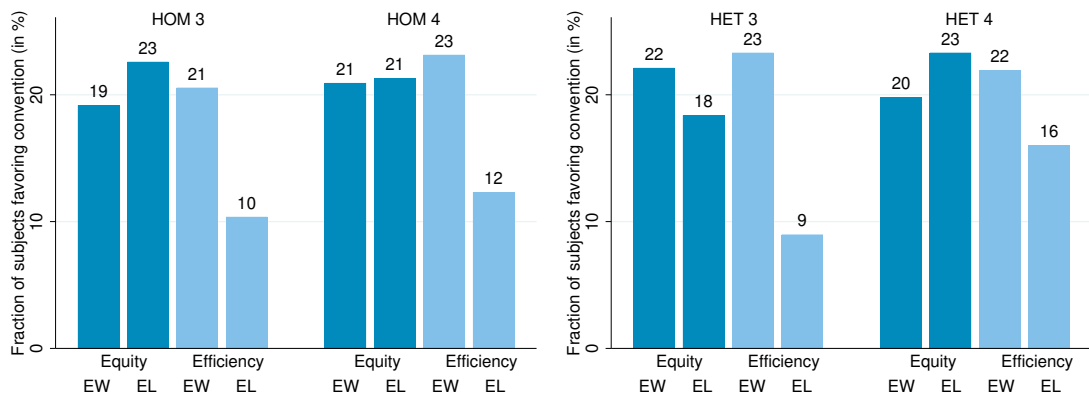


Figure A.8: Elicited preferences in medium electorates.

*Notes:* Fraction of subjects who favor Equity or Efficiency over Self-Interest at least once, according to their elicited preferences.

plementing their payoff-maximizing alternative at least once according to their elicited preferences (Fig. A.8).

Focusing on elicited sincerity, we find a large fraction of insincere votes under PV, except for efficiency losers in HET-3 (Fig. A.9). In contrast, we find high levels of sincerity under AV and no systematic difference in sincerity between EWs and ELs except for HET-3 (MWU tests,  $N = 1620$ ; HOM-3,  $p = 0.369$ ; HOM-4,  $p = 0.232$ ; HET-3,  $p = 0.016$ ; HET-4,  $p = 0.117$ ). Under BC there is also a large fraction of insincere votes, with no difference in strategic voting between EWs and ELs for HOM (HOM-3,  $p = 0.273$ ; HOM-4,  $p = 0.359$ ). However, in HET there is a stronger tendency toward strategic voting for EWs compared to ELs in Society 3 (HET-3,  $p = 0.003$ ), whereas we find the opposite for Society 4 (HET-4,  $p < 0.001$ ).

Comparing elicited sincerity to induced sincerity, we find that sincerity tends to be higher with respect to the elicited preferences compared to the induced preferences for PV (5 out of 8 tests significant). For AV, we find that the overall level of sincerity is qualitatively the same with respect to both the induced and the elicited preferences (7 out of 8 tests are insignificant). For BC, induced sincerity tends to be higher than elicited sincerity (6 out of 8 tests significant).

## Appendix D Rank-Order Methods

### Extrapolation based on elicited preference ranking

In this section, we use the preference rankings elicited via the random dictator mechanism to infer the outcomes that would be obtained under other voting procedures by extrapolation based on their elicited preference (an analogue analysis based on the ranking elicited under BC delivers similar results). Specifically, we will consider the

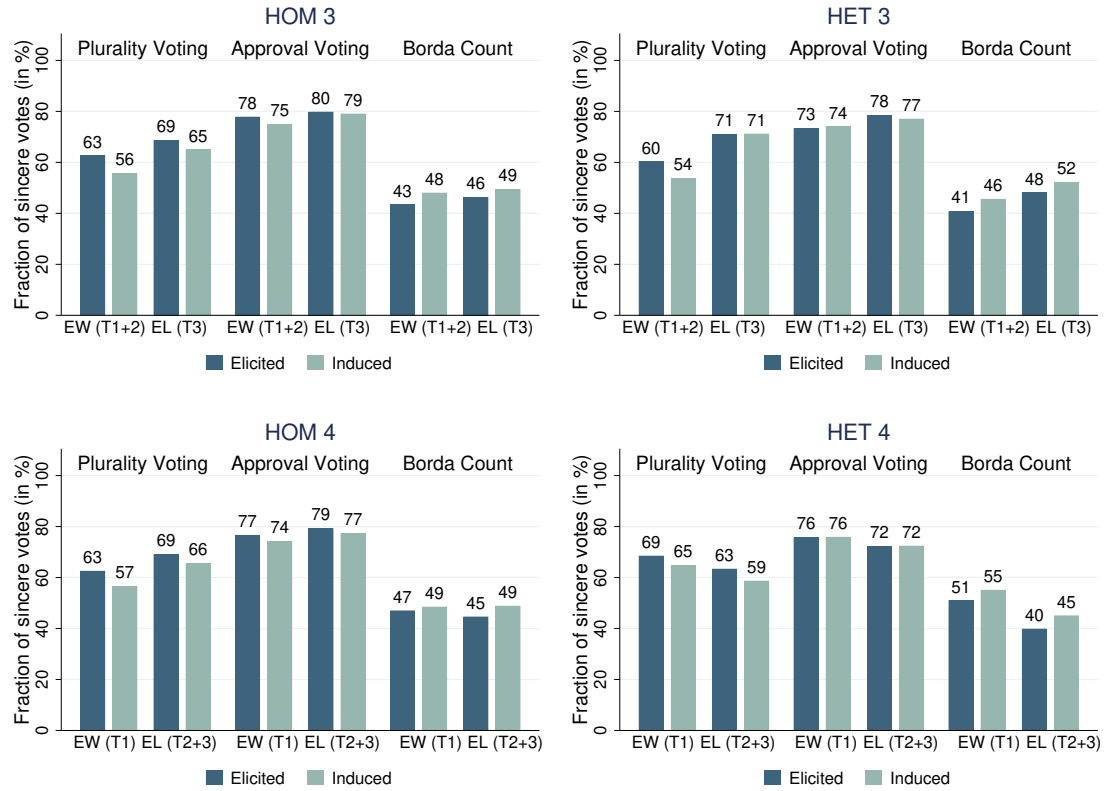


Figure A.9: Induced and elicited sincere votes.

Notes: Fraction of induced/elicited sincere votes for each voting method for medium electorates.

rank-order method Single Transferable Vote (STV) and the two-round system (TRS) used in the French presidential elections.

Under STV, there are multiple rounds of ballot counts. In the first round, only the alternatives that are ranked first are counted. If an alternative receives an absolute majority, it is declared the winner. Otherwise, the alternatives that are ranked first by the fewest voters are eliminated from all the ballots. In the second round, only the alternatives that are now (after elimination) ranked first are counted. If an alternative receives an absolute majority, it is declared the winner. This procedure is repeated until there is an alternative that receives an absolute majority or several alternatives are tied with the highest proportion of votes. Ties are broken randomly.

Figure A.10 shows the induced election outcomes for small electorates under STV. Voting outcomes exhibit a large number of ties, with self-interest options winning an overwhelming amount of elections. In Society 1, equity wins only 12% of the elections with the remaining elections going to self-interest alternatives. In Society 2, efficiency performs even worse, winning only 8% of the elections. In Society 3, the outcomes almost always go in favor of self-interested options with each of equity and efficiency winning only 3% of the elections. In Society 4, efficiency never emerges as the winner, whereas equity wins a meager 5% of the elections. Summarizing, our analysis suggests that

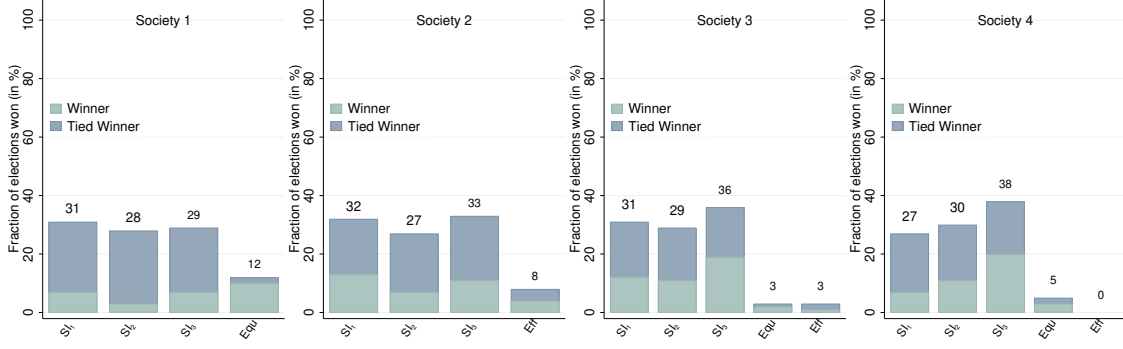


Figure A.10: Voting outcomes under single transferable vote for small electorates.

*Notes:* Actual voting outcomes for the 30 small electorates under single transferable vote based on subjects elicited preferences with ties split randomly.

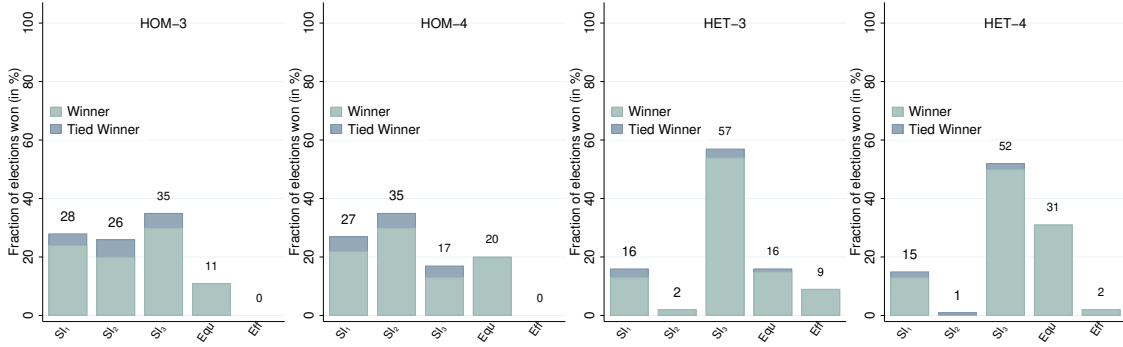


Figure A.11: Voting outcomes under single transferable vote for HOM and HET.

*Notes:* Actual voting outcomes for the 30 small electorates under single transferable vote based on subjects elicited preferences with ties split randomly.

outcomes under STV (assuming that voters vote according to their elicited preferences) would be even more extreme than under PV.

Figure A.11 shows the induced election outcomes for medium electorates (HOM and HET) under STV. Electorates are larger than in SE and, hence, ties are much less frequent. Nevertheless, self-interest options still win an overwhelming amount of elections. In HOM-3, the outcomes almost always go in favor of self-interested options with equity winning only 11% of the elections and efficiency not winning a single one. In HOM-4 the picture is not much different: again efficiency never emerges as the winner, whereas equity wins 20% of the elections. In HET-3, the self-interest options favoring the largest group of voters wins most elections with equity and efficiency winning only 16% and 9% of the elections, respectively. A similar picture emerges for HET-4, here, however, equity wins 31% of the elections, whereas efficiency wins almost no elections (2%). Thus, in HET, where the type distribution in the electorate is asymmetric, compromises tend to be selected more often than in HOM.

Summarizing, our results suggest that the outcomes under STV (assuming that voters vote according to their elicited preferences) would be even more extreme than under PV.



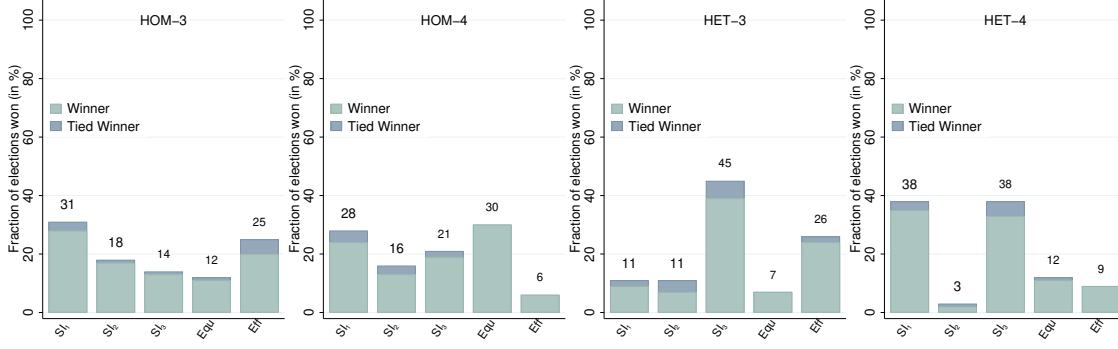


Figure A.12: Voting outcomes under single transferable vote for medium electorates (HOM and HET).

*Notes:* Actual voting outcomes for the 54 electorates in HOM and the 54 electorates in HET under Single Transferable Vote based on subjects BC rankings with ties split randomly.

Under the two-round system (TRS), voters participate in two rounds of plurality voting. The two candidates that receive the most votes in the first round participate in a second runoff plurality vote. The candidate that receives the majority of votes in the second round is declared the winner. For small electorates, the voting outcomes under TRS turn out to be exactly the same as the ones obtained under STV, presented in Figure A.10. For medium electorates (HOM and HET), equity and efficiency win even slightly less often but otherwise the results are also very similar to those under STV presented in Figure A.11.

### Extrapolation based on Borda Count ranking

In this section, we apply the procedure outlined in the previous section to the ranking elicited under BC to infer the outcomes under STV and TRS. This allows us to apply the same procedure also to the large electorate experiment where the preference elicitation via the random dictator mechanism was not included.

For LE-3, in the first round of STV the three self-interest options were ranked first by 280, 284, and 295 voters respectively, whereas equity received 141 votes and efficiency received 200 votes. Consequently, equity is eliminated in the first round. In the second round, the three self-interest options receive 297, 309, and 338 votes, respectively, whereas efficiency is ranked first by 256 voters. Hence, efficiency is eliminated in the second round, and completing the procedure SI<sub>1</sub> emerges as the winner. For LE-4, in the first round of STV the three self-interest options were ranked first by 289, 306, and 317 voters respectively, whereas equity received 152 votes and efficiency received 136 votes. Consequently, efficiency is eliminated first. In the second round, the three self-interest options receive 318, 324, and 347 votes, respectively, whereas equity is ranked first by 211 voters. Hence, equity is eliminated in the second round, and completing the procedure SI<sub>3</sub> emerges as the winner.

Next, we consider the two-round system (TRS). For LE-3, in the first round of TRS the three self-interest options were ranked first by 280, 284, and 295 voters, respectively, whereas equity received 141 votes and efficiency received 200 votes. Consequently,  $SI_2$  and  $SI_3$  participate in the runoff. In the second round,  $SI_3$  wins with 702 to 498 votes. For LE-4, a very similar picture emerges. Again  $SI_2$  and  $SI_3$  participate in the second round runoff, and again  $SI_3$  emerges as the winner with 710 to 490 votes.

## Appendix E Predicted Outcomes

In this section, we provide the predicted outcomes assuming voters vote sincerely according to their induced preferences. Figures A.13 and A.14 summarize the results of sincere voting for Societies 1–4 in SE. The predictions for LE and treatment HOM of ME are identical. Figure A.15 summarizes the results of sincere voting for Societies 3 and 4 in treatment HET of ME.




Society 1						Society 2				
Type	1	2	3			Type	1	2	3	
#	2	2	2			#	2	2	2	
Induced Preferences	SI <sub>1</sub>	SI <sub>2</sub>	SI <sub>3</sub>			Induced Preferences	SI <sub>1</sub>	SI <sub>2</sub>	SI <sub>3</sub>	
	Equ	Equ	Equ				Eff	Eff	SI <sub>2</sub>	
	SI <sub>3</sub>	SI <sub>1</sub>	SI <sub>2</sub>				SI <sub>3</sub>	SI <sub>1</sub>	SI <sub>1</sub>	
	SI <sub>2</sub>	SI <sub>3</sub>	SI <sub>1</sub>				SI <sub>2</sub>	SI <sub>3</sub>	Eff	
PV				Votes		PV				Votes
SI <sub>1</sub>	2	0	0	2		SI <sub>1</sub>	2	0	0	2
SI <sub>2</sub>	0	2	0	2		SI <sub>2</sub>	0	2	0	2
SI <sub>3</sub>	0	0	2	2		SI <sub>3</sub>	0	0	2	2
Equ	0	0	0	0		Eff	0	0	0	0
AV <sub>2</sub>						AV <sub>2</sub>				
SI <sub>1</sub>	2	0	0	2		SI <sub>1</sub>	2	0	0	2
SI <sub>2</sub>	0	2	0	2		SI <sub>2</sub>	0	2	2	4
SI <sub>3</sub>	0	0	2	2		SI <sub>3</sub>	0	0	1	1
Equ	2	2	2	6		Eff	2	2	0	4
AV <sub>3</sub>						AV <sub>3</sub>				
SI <sub>1</sub>	2	2	0	4		SI <sub>1</sub>	2	2	2	6
SI <sub>2</sub>	0	2	2	4		SI <sub>2</sub>	0	2	2	4
SI <sub>3</sub>	2	0	2	4		SI <sub>3</sub>	2	0	2	4
Equ	2	2	2	6		Eff	2	2	0	4
BC						BC				
SI <sub>1</sub>	6	2	0	8		SI <sub>1</sub>	6	2	2	10
SI <sub>2</sub>	0	6	2	8		SI <sub>2</sub>	0	6	4	10
SI <sub>3</sub>	2	0	6	8		SI <sub>3</sub>	2	0	6	8
Equ	4	4	4	12		Eff	4	4	0	8

Figure A.13: Predicted outcomes under sincere voting for Societies 1 and 2 in small electorates.

*Note:* Outcomes are calculated under the assumption that subjects vote sincerely according to their induced preferences.  $AV_2$  assumes that all voters approve of exactly two alternatives.  $AV_3$  assumes that all voters approve of exactly three alternatives. Predicted winners are highlighted in boldface.

Society 3				
Type	1	2	3	
#	2	2	2	
Induced Preferences	SI <sub>1</sub>	SI <sub>2</sub>	SI <sub>3</sub>	
	Eff	Eff	Equ	
	Equ	Equ	SI <sub>2</sub>	
	SI <sub>3</sub>	SI <sub>1</sub>	SI <sub>1</sub>	
	SI <sub>2</sub>	SI <sub>3</sub>	Eff	
PV			Votes	
<b>SI<sub>1</sub></b>	2	0	0	2
<b>SI<sub>2</sub></b>	0	2	0	2
<b>SI<sub>3</sub></b>	0	0	2	2
Equ	0	0	0	0
Eff	0	0	0	0
AV <sub>2</sub>				
SI <sub>1</sub>	2	0	0	2
SI <sub>2</sub>	0	2	0	2
SI <sub>3</sub>	0	0	2	2
Equ	0	0	2	2
<b>Eff</b>	2	2	0	4
AV <sub>3</sub>				
SI <sub>1</sub>	2	0	0	2
SI <sub>2</sub>	0	2	2	4
SI <sub>3</sub>	0	0	2	2
<b>Equ</b>	2	2	2	6
Eff	2	2	0	4
BC				
SI <sub>1</sub>	8	2	2	12
SI <sub>2</sub>	0	8	4	12
SI <sub>3</sub>	2	0	8	10
<b>Equ</b>	4	4	6	14
Eff	6	6	0	12


Society 4				
Type	1	2	3	
#	2	2	2	
Induced Preferences	Sl <sub>1</sub>	Sl <sub>2</sub>	Sl <sub>3</sub>	
	Eff	Equ	Equ	
	Equ	Eff	Eff	
	Sl <sub>3</sub>	Sl <sub>1</sub>	Sl <sub>2</sub>	
	Sl <sub>2</sub>	Sl <sub>3</sub>	Sl <sub>1</sub>	
PV			Votes	
<b>SI<sub>1</sub></b>	2	0	0	2
<b>SI<sub>2</sub></b>	0	2	0	2
<b>SI<sub>3</sub></b>	0	0	2	2
Equ	0	0	0	0
Eff	0	0	0	0
AV <sub>2</sub>				
Sl <sub>1</sub>	2	0	0	2
Sl <sub>2</sub>	0	2	0	2
Sl <sub>3</sub>	0	0	2	2
<b>Equ</b>	0	2	2	4
Eff	2	0	0	2
AV <sub>3</sub>				
Sl <sub>1</sub>	2	0	0	2
Sl <sub>2</sub>	0	2	0	2
Sl <sub>3</sub>	0	0	2	2
<b>Equ</b>	2	2	2	6
<b>Eff</b>	2	2	2	6
BC				
Sl <sub>1</sub>	8	2	0	10
Sl <sub>2</sub>	0	8	2	10
Sl <sub>3</sub>	2	0	8	10
<b>Equ</b>	4	6	6	16
Eff	6	4	4	14

Figure A.14: Predicted outcomes under sincere voting for Societies 3 and 4 in small electorates.

*Note:* Outcomes are calculated under the assumption that subjects vote sincerely according to their induced preferences. AV<sub>2</sub> assumes that all voters approve of exactly two alternatives. AV<sub>3</sub> assumes that all voters approve of exactly three alternatives. Predicted winners are highlighted in boldface.

Society 3					↑
Type	1	2	3		
#	8	9	13		
Induced Preferences	Sl <sub>1</sub>	Sl <sub>2</sub>	Sl <sub>3</sub>		
	Eff	Eff	Equ		
	Equ	Equ	Sl <sub>2</sub>		
	Sl <sub>3</sub>	Sl <sub>1</sub>	Sl <sub>1</sub>		
	Sl <sub>2</sub>	Sl <sub>3</sub>	Eff		
PV				Votes	
Sl <sub>1</sub>	8	0	0	8	
Sl <sub>2</sub>	0	9	0	9	
<b>Sl<sub>3</sub></b>	0	0	13	13	
Equ	0	0	0	0	
Eff	0	0	0	0	
AV <sub>2</sub>					
Sl <sub>1</sub>	8	0	0	8	
Sl <sub>2</sub>	0	9	0	9	
Sl <sub>3</sub>	0	0	13	13	
Equ	0	0	13	13	
<b>Eff</b>	8	9	0	17	
AV <sub>3</sub>					
Sl <sub>1</sub>	8	0	0	8	
Sl <sub>2</sub>	0	9	13	22	
Sl <sub>3</sub>	0	0	13	13	
<b>Equ</b>	8	9	13	30	
Eff	8	9	0	17	
BC					
Sl <sub>1</sub>	32	9	13	41	
Sl <sub>2</sub>	0	36	26	62	
Sl <sub>3</sub>	8	0	52	60	
<b>Equ</b>	16	18	39	73	
Eff	24	27	0	51	

Society 4					↑
Type	1	2	3		
#	13	9	8		
Induced Preferences	Sl <sub>1</sub>	Sl <sub>2</sub>	Sl <sub>3</sub>		
	Eff	Equ	Equ		
	Equ	Eff	Eff		
	Sl <sub>3</sub>	Sl <sub>1</sub>	Sl <sub>2</sub>		
	Sl <sub>2</sub>	Sl <sub>3</sub>	Sl <sub>1</sub>		
PV				Votes	
<b>Sl<sub>1</sub></b>	13	0	0	13	
Sl <sub>2</sub>	0	9	0	9	
Sl <sub>3</sub>	0	0	8	8	
Equ	0	0	0	0	
Eff	0	0	0	0	
AV <sub>2</sub>					
Sl <sub>1</sub>	13	0	0	13	
Sl <sub>2</sub>	0	9	0	9	
Sl <sub>3</sub>	0	0	8	8	
<b>Equ</b>	0	9	8	17	
Eff	13	0	0	13	
AV <sub>3</sub>					
Sl <sub>1</sub>	13	0	0	13	
Sl <sub>2</sub>	0	9	0	9	
Sl <sub>3</sub>	0	0	8	8	
<b>Equ</b>	13	9	8	30	
<b>Eff</b>	13	9	8	30	
BC					
Sl <sub>1</sub>	42	9	0	51	
Sl <sub>2</sub>	0	36	8	44	
Sl <sub>3</sub>	13	0	32	45	
<b>Equ</b>	26	27	24	77	
Eff	39	18	16	73	

Figure A.15: Predicted outcomes under sincere voting for Societies 3 and 4 in HET.  
*Notes:* Outcomes are calculated under the assumption that subjects vote sincerely according to their induced preferences. AV<sub>2</sub> assumes that all voters approve of exactly two alternatives. AV<sub>3</sub> assumes that all voters approve of exactly three alternatives. Predicted winners are highlighted in boldface.