

**CANDIDATES, VOTERS, AND ENDOGENOUS
GROUP FORMATION:
A COLONEL BLOTTO EXPERIMENT***

by

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ABSTRACT

We experimentally study two-candidate elections with simple majority voting. Distinct groups of voters are endogenously formed by candidates' policy offers, i.e. by their distribution of a fixed budget across the voters. We allow candidates to favor some voters at the expense of others. Elections with compulsory and voluntary costly voting are distinguished. Our experimental results show that policy offers include more voters when voting is compulsory. Moreover, we observe increasing voluntary participation in the voters' benefit-differentials between both policy offers. Finally, we present evidence for the development of political bonds between voters and long-lived parties, which have the opportunity to coordinate their policy offers across legislative periods.

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1 Introduction

Tactical redistribution, or ‘pork barrel’, is an important phenomenon in everyday policy making. It describes the common practice of political candidates to favor subgroups of voters when spending budget, in the hope to receive their votes or campaign contributions in return.¹ Such redistribution can take on a variety of forms. For example, unproductive industries are often subsidized at the expense of the general public. Or, infrastructure projects like the building or improvement of highways, bridges, dams, and harbors are targeted to specific parts of the country. Next to tactical redistribution, grand (or programmatic) redistribution takes place, which is based on the ideological belief in equality and carried out using taxes and the general social welfare system (Dixit and Londregan 1996). Hence, while grand redistribution aims at decreasing inequality, tactical redistribution often creates it.²

Myerson (1993) presents a ‘pure’ model of tactical redistribution. Unlike most other theoretical studies on redistributive politics (see Persson and Tabellini 2000 for an overview) he only requires a budget constraint to be satisfied; no further restrictions are made on the feasibility and means of redistribution as taxes and transfers. His main equilibrium result is that candidates target large shares of the budget to subgroups of the electorate, causing inequalities among voters who would be otherwise alike. The intuition of his result is best caught by an example. Imagine two-candidate elections with simultaneous policy offers and simple majority voting, where voters are obliged to participate.³ Let money be the only good. The identical candidates dispose of equal (exogenous) budgets and have the same political abilities. Moreover, the voters are also identical, having equal pecuniary circumstances before the election. Assume now that the first candidate intends to make an egalitarian offer, i.e. spread the budget evenly across all voters. This offer can easily be defeated by the second candidate, however, by targeting larger budget shares to fewer (but still a majority of) voters. Hence, equilibrium policy offers create inequality.

Our work is most closely related to the two-candidate elections studied in Myerson (1993), though we use a laboratory experiment. To the best of our knowledge we are the first to experimentally investigate tactical redistribution and, at the same time, voters’ responses to

¹ E.g., ‘Citizens Against Government Waste’ report for the US a steady increase in the number of pork barrel projects and the money spent on them in the past decade, cresting with a total of 10.656 projects and \$22.9 Billion spent in 2004 (<http://www.cagw.org>).

² Grand redistribution has a long-run character and changes can be made only through major ideological shifts in the population. Tactical redistribution, on the other hand, has a short-run character and ‘favors’ are often reversed when competing candidates replace each other.

³ Myerson (1993) also studies multi-candidate cases.

this. Our ‘polity game’ has two stages. At the first stage (‘policy competition’) two candidates simultaneously announce their policy offers. These offers are binding promises to the voters, in the form of a distribution of a fixed budget (equal for both candidates) across them. At the second stage (‘election’) simple majority voting takes place, the victor receives a reward (i.e. monetary advantages of being in office) and her budget distribution is carried out.⁴ We have the three following important departures from Myerson’s model: (i) we do not restrict to compulsory voting, but also study the effect of voluntary voting on equality and efficiency; (ii) in our model there are typically voters who are excluded by both policy offers; (iii) we can distinguish between short-lived ‘politicians’ and long-lived ‘parties’, because repeated interaction is used in the experiment. Next, we will discuss the differences and similarities to Myerson’s model and their consequences in turn.

Departure (i): Whereas Myerson (1993) restricts his analysis to the case of compulsory voting, we also study voluntary voting. Since voters can choose between costly participation (e.g. costs for transportation and lost opportunities of engaging in alternative activities) and abstention at no costs in almost all elections around the world, we consider this an important modification. However, introducing this choice complicates the analysis of the game dramatically, even for relatively small electorates. To see this, let us first look at compulsory voting. In this case, though a difficult task in itself, all that matters for candidates to win is to provide more voters with a strictly positive incentive than the opponent. Suppose that voters are voting sincerely for their preferred candidate and leave aside, for the moment, the choices of voters who are indifferent between both policy offers with respect to their own pecuniary payoffs. Then, candidates face the following simplified trade-off: on the one hand, if one selects too few voters, the opponent may win by targeting the remaining voters (‘separation’); on the other hand, if one selects too many voters, he may also win; this time by targeting a majoritarian subgroup of one’s own offer (‘overlapping’ or ‘bumping in’). This basic argument already provides us with the intuition why equilibrium strategies are mixed: being predictive is disadvantageous, because the opponent can use this to shift her strategy

⁴ Compared to Myerson (1993), policy offers in our model are ‘richer’ in that candidates can decide whether or not to select a *specific* voter. In his model, candidates cannot select specific voters but each voter makes her own individual draw from a probabilistic offer distribution, which fulfills the budget constraint because a large number of voters is assumed. Policy offers in our model are ‘poorer’, however, in that all selected voters get the same share of the budget and all non-selected voters get nothing. Note that similar to the outside-the-laboratory-world, candidates cannot observe whether or not a specific voter has voted for her.

accordingly.⁵ Due to symmetry, in equilibrium both candidates have the same chance of winning the election.

Switching over to voluntary voting complicates the situation as follows. With the opportunity to save voting costs by abstaining, voters weigh the costs and expected benefits from voting.⁶ The difference between benefits of winning and losing is called the benefit-differential. The situations arising at the election stage from all possible combinations of policy offers are described by (modified) participation games (Palfrey and Rosenthal 1983) and, to a lesser extent, by (modified) volunteer's dilemma games (Diekmann 1985; 1986).⁷ Though the analysis of these games is straightforward, they typically involve multiple Nash equilibria. Using backwards induction to derive their optimal strategies, candidates must anticipate all different kinds of such games at the election stage. This is a tremendous task and, for voluntary voting, we cannot provide numerical solutions for candidate behavior even for relatively small electorates (though some equilibrium predictions can be derived).⁸ For example, Palfrey and Rosenthal (1983) show for unique benefit-differentials across groups that in the participation game equilibria may exist, where the minority is more likely to achieve a victory than the majority. Such equilibria undermine the incentive to attract more voters than the opponent as in compulsory voting. However, Großer et al. (2005) show that this result is not supported experimentally: the majority wins substantially more often than the minority, which is also predicted by the logit equilibria. Moreover, for the participation games arising at the second stage of the polity game, it is important to note that benefits-differentials often differ across groups (and even within groups). Being a majority-voter usually gives lower benefits in case of a victory, hence potentially lower incentives to participate, than being a minority-voter. As a result, the majority may lose when the benefit effect dominates the size effect. Thus, in voluntary voting it may be advantageous for candidates to seek a supporter group size which is somewhat smaller than that of the opponent, but with higher

⁵ If candidates would publicly announce their offers sequentially rather than simultaneously, the first mover's offer is perfectly predictable and the second mover could always win.

⁶ A single ballot will only matter if it changes the election outcome. However, the probability of this being the case is negligible in large elections. Thus, a voter's expected benefits fall short of the voting costs and the rational voter will abstain (Downs 1957). But this prediction is not supported by the fact that large proportions of electorates participate in most elections around the world. This contradiction between rational and observed behavior is known as the 'voter paradox'.

⁷ In the volunteer's dilemma game, there is only one 'relevant' group of which a single member, a 'volunteer', must participate in order to provide the group with a public good.

⁸ The lack of equilibrium point predictions for policy offers in voluntary voting makes the experimental method particularly attractive. It gives us a grasp of how candidates behave in complex settings, as certainly found in outside-the-laboratory political decision processes.

benefit-differentials for the own voters.⁹ In other words, compared to compulsory voting, not only group sizes but also the benefit-differentials are of central concern in voluntary voting, which makes decision making more complex.

Introducing voluntary voting also affects equality and efficiency. As in Myerson (1993), in our model with compulsory voting voters are identical *a priori* and inequality can only arise through tactical redistribution.¹⁰ Efficiency concerns are ruled out since both policy offers must satisfy the same budget constraint and each voter must bear the participation costs. With voluntary costly voting, on the other hand, equality between those who participate and those who abstain is affected, because the former bear voting costs. Moreover, the efficient outcome always requires that no one participates. Any turnout only decreases efficiency because the only efficiency losses or gains are those generated by voting costs.

Departure (ii): In Myerson's (1993) equilibrium, each voter prefers one of the two candidates. This is because a voter's probability of being excluded or promised the same benefits by both offers (yielding zero-benefit-differentials) is zero. Hence, there are no indifferent voters. In our setup, on the other hand, such indifferent voters are commonly observed. In voluntary voting, they simply abstain (assuming they seek to maximize their own pecuniary payoffs). But in compulsory voting, they must attend the voting booth and may cast their vote based on other motives, e.g. sympathy or distributive justice. We are interested in whether this kind of voting indeed occurs and, if so, whether it affects electoral outcomes in any systematic way.

Departure (iii): Finally, in our experiment we use repeated interaction with electorates facing many elections. For candidates, this allows us to distinguish between short-lived 'politicians', who frequently change across rounds and long-lived 'parties', which remain constant. Through this experimental setup we provide parties, but not politicians, with the opportunity to establish implicit bonds with voters and/or the other party beyond a single

⁹ In Campbell (1999) some minority-voters are exogenously given very high benefits (or very low participation costs), resulting in a large probability of winning the election for the minority.

¹⁰ Depending on the inequality measure applied, policy offers may be evaluated in different ways. The lower the number of selected voters of the winning offer, the more inequality there is between an excluded and an included voter. Moreover, in a sequence of elections equality considerations across rounds may arise. Within a single election, inequality occurs *ex post* whenever the winning offer excludes at least one voter. However, this inequality may be smoothed by future policy offers. Assume for example that the two candidates select opposite halves of the electorate. Then, *ex ante*, the expected benefits are the same for all voters. However, *ex post*, one candidate will win and the benefits are unequal. If, however, both candidates alternate in winning the election and the policies stay constant across rounds, the benefits will be equal in the long-run again. Here, we focus on inequality within a legislative period only.

election.¹¹ An example of more politician-oriented systems is observed in the United States and examples of more party-oriented systems are those in Germany and the Netherlands. We know from other experiments that it often matters whether subjects interact only once or repeatedly (e.g., Andreoni 1988), even though the Nash equilibrium predicts the same results for finitely repeated games. We are interested in whether parties make different policy offers than politicians and, if so, how this affects voter behavior.

Studies on tactical redistribution are quite scarce. They originate from ‘Colonel Blotto’ games, where two antagonistic generals must divide their armies over a set of battlefields (e.g., Gross and Wagner 1950; Owen 1968, pp.88-93)¹², and extend them to the election context (Sankoff and Mellos 1972).¹³ A robust finding in all these and subsequent theoretical studies is that tactical behavior of candidates yields inequalities across voters, though the extent varies with the specific electoral institutions. Next to the two-candidate elections discussed earlier, Myerson (1993) also analyses multicandidate and multiseat elections under rank-scoring rules, approval voting, and single transferable votes. Among other things, he finds that as the number of candidates increases, the redistribution becomes more unequal because the incentive to target smaller subgroups of the electorate increases. Dixit and Londregan (1996) show that candidates favor allied rather than swing voters if targeting budgets to the former, better known group is more effective. However, they favor swing voters if effectiveness does not differ across the two types. Lizzeri (1999) argues that national budget deficits accumulate because candidates use deficits to more effectively target their unequal promises to subgroups of the electorate.

¹¹ Recall that candidates are allowed to select specific voters in our setup. Of course, outside of the laboratory, parties may disappear from the political scene. Here, we only look at the extreme cases where politicians can not and parties can, at least in principle, establish bonds to investigate the importance of this opportunity on policy making. Note that in our experiment parties are represented by a single subject, hence, we do not elaborate decision making within these groups.

¹² In fact, our model with compulsory voting extends the example of Owen (1968, pp. 88-93) to more than 3 voters (‘battlefields’), but is a special case in the sense that, other than in his example, all selected voters are promised equal shares of the budget.

¹³ Friedman (1958) presents an application to the allocation of advertising funds. With respect to the allocation of campaign resources, Brams and Davis (1974) show that the US Electoral College encourages candidates to devote disproportionately more attention to larger states than would be the case in direct popular-vote elections, and provide empirical evidence for this. Young (1978) studies the allocation of funds on campaigning when two parties have unequal resources, and applies this situation to presidential campaigning for the Electoral College. Snyder (1989) shows that the allocation of campaign resources is different for winner-take-all and proportional elections.

The literature discussed so far focuses on pure redistribution effects. The following theoretical studies link tactical redistribution to efficiency.¹⁴ Dixit and Londregan (1995) argue that the opportunity to favor subgroups of voters conserves declining industries, instead of encouraging their resources to shift to more efficient uses. This is because electoral competition inhibits credible promises of future gains to those who shift. Lizzeri and Persico (2001) extend the pure redistribution model by allowing candidates to either engage in tactical redistribution or in efficient public goods. For both winner-take-all and proportional elections they report underprovision of public goods, causing inefficiencies. The more desirable public goods are, the more unequal the redistributive politics. Moreover, the Electoral College is particularly vulnerable to inefficiencies through underprovision of public goods. They also show that the probability of such inefficiencies increases in the number of candidates in multicandidate elections (Lizzeri and Persico 2005).

The literature on participation game experiments reports on the effects of varying group and electorate sizes (Rapoport and Bornstein 1989; Schram and Sonnemans 1996a; Hsu and Sung 2002; Levine and Palfrey, forthcoming; Klor and Winter 2006); proportional representation vs. winner-takes-all elections (Schram and Sonnemans 1996a); different tie breaking rules (Bornstein, Kugler, and Zamir 2005); group identification and communication (e.g., Bornstein and Rapoport 1988; Bornstein 1992; Schram and Sonnemans 1996b); endogenous information about other voters' turnout (Großer and Schram 2006); benefit uncertainty under various participation costs (Cason and Mui 2005) and cost uncertainty (Levine and Palfrey, forthcoming). In all these experiments, relatively high turnout is observed, albeit lower than in most general elections around the world. Except for the experiment with uncertainty about participation costs (Levine and Palfrey forthcoming), the standard (Bayesian) Nash equilibrium concept finds little empirical support. However, Goeree and Holt (2005), Cason and Mui (2005), and Levine and Palfrey (forthcoming) show that quantal response equilibria can account for some of the data. In the volunteer's dilemma game (Diekmann 1985), it is sufficient for the provision of the public good that a single member of the group, a 'volunteer', participates (at costs). Nevertheless, everybody has an incentive to free ride on the other members to volunteer. Franzen's (1995) experimental results support the Nash prediction that the probability of anyone volunteering decreases in group size, but not

¹⁴ In Coate and Morris (1995), inefficient redistribution may occur due to imperfectly informed voters. The results of the literature we briefly discuss, however, do not depend on imperfect information. Baron (1991) demonstrates how inefficiencies may arise in a legislative model with sequential proposal making through the distribution of benefits across a minimal number of districts.

the prediction that the probability of at least one member volunteering decreases too. However, Goeree and Holt (2005) and Goeree et al. (2005) show that the quantal response (logit) equilibrium can explain both observations.

The remainder of the paper is organized as follows. Section 2 describes the polity game and its (subgame-perfect) Nash equilibria and section 3 presents the experimental design. In section 4 our experimental results are given and interpreted. We conclude in section 5.

2 The polity game

The game

This section describes the polity game and summarizes the Nash equilibrium predictions that we can derive. A formal description and analysis is presented in appendix A. The polity game has two stages. At the first stage ('candidate competition') two office-seeking candidates simultaneously announce binding policy offers. In these offers, each candidate selects specific voters from an electorate of finite size E . All possible combinations of $1, 2, \dots, E$ voters are permitted. In case of a victory, a fixed budget $W > 0$ (equal for both candidates) will be spread evenly across the selected voters. Those who are not chosen will receive nothing. In case of a defeat, the offer will be of no consequence. At the second stage ('election'), the victor is determined by simple majority voting (with a coin toss in case of a tie).

In the following, we assume that voters are only interested in their own pecuniary payoffs, unless indicated otherwise. Each (risk neutral) voter faces one of the following three situations at the election stage: he may be selected (*i*) by neither candidate, hence, is indifferent between both; (*ii*) by one candidate, whom he then prefers; or (*iii*) by both candidates, where he either prefers the candidate who assigned more money to him (i.e. selected less voters) or is indifferent if he is assigned equal shares of the budget. As a result of the policy offers, a plethora of combinations of voter groups can form even in relatively small electorates. A typical combination involves two supporter groups that prefer opposing candidates and a group of indifferent voters. These groups may vary in size and in the voters' 'preference intensities', i.e. the benefit-differentials between both offers. A characterization of all possible group combinations and examples are given in appendices A and B.

We distinguish between compulsory and voluntary voting. In compulsory voting, voters are obliged to participate at costs (and are punished with an amount higher than the costs if

they abstain; hence, the alternative to abstain is strictly dominated). At the ballot box, they can choose to vote for either of the candidates or vote ‘blank’ (i.e., vote for neither). For the benefit-differential, all that matters is whether it is strictly positive or zero. In the former case, the voter prefers one of the candidates and votes sincerely (cf. the subsection ‘Nash equilibria’, below). In the latter case, the voter is indifferent between both candidates and we need to determine his decision at the voting booth, which he will attend anyway. For this, we introduce the possibility of lexicographical preferences. I.e., if a voter is indifferent with respect to the most important argument, the own pecuniary payoff, he will proceed to a (possible) second most important argument. We distinguish between four decision rules for such an indifferent voter:¹⁵ (a) in the *random* rule he votes for either candidate or neither with equal probabilities of one third; (b) in the *neutral* rule he votes blank; (c) in the *egalitarian* rule he votes for the candidate who selected more voters, and blank if both chose equal numbers; (d) in the *elitist* rule he votes for the candidate who selected fewer voters, and blank if both chose equal numbers. We will analyze the game for each of these decision rules and, for simplicity, assume the same rule for all indifferent voters in the electorate. Note that such lexicographical preferences fully determine the supporter group sizes in compulsory voting, hence the election outcome, for any given combination of policy offers.

In case of voluntary voting, each voter makes a private decision on whether to participate in the election at costs and vote for her preferred candidate, or abstain and bear no costs.¹⁶ Hence, other than in compulsory voting, voters have the opportunity to avoid the voting costs. Note that indifferent voters will surely abstain, since the voting costs only decrease their pecuniary payoff (hence, no lexicographical preferences are needed for voluntary voting). Contrary to compulsory voting, in voluntary voting the election outcome is not only determined by group sizes but also by the voters’ preference intensities, which affect their propensity to participate in the elections. Observe the important trade-off between supporter group size and preference intensity: a larger group results in lower preference intensities for its members because the budget must suffice for more people, and vice versa. We will discuss this relationship in more detail below.

Nash equilibria

¹⁵ Throughout, we refer to an ‘indifferent voter’ as a voter who is indifferent with respect to the most important argument.

¹⁶ The alternative to participate and vote for the non-preferred candidate is strictly dominated by the alternative to abstain.

Next, we present the Nash equilibrium predictions that we can derive for the polity game. We start with compulsory voting by using backwards induction, assuming for the moment that voters are only concerned about their own payoffs. For the election stage, applying iterated weak dominance yields a unique ‘fully sincere’ Nash equilibrium, in which each voter votes for his preferred candidate and, in case of indifference, according to the decision rule at hand.¹⁷ Then, the election outcome is simply determined by the group sizes that result from the policy offers and the lexicographical preferences at hand: the candidate who combines more votes by her own supporters and by indifferent voters wins. Each candidate’s action space is defined by all possible policy offers, i.e. all $2^E - 1$ combinations of voters (recall that at least one voter must be selected). Using a normalized payoff of 1 (0) in case of a victory (defeat), a constant sum normal form game can be derived for the first stage: each possible combination of policy offers is represented by a cell and its expected election outcome (or equivalently, the candidates’ winning probabilities) by the cell’s entry. It is straightforward to derive the Nash equilibria for this game (see appendix B for examples with electorate size 4 for all four decision rules).

For voluntary voting we again use backwards induction and can, analogous to compulsory voting, build a constant sum normal form game for the first stage (see appendix B for examples with electorate size 3). However, this time the cells’ entries are represented by the equilibrium predictions of participation games (Palfrey and Rosenthal 1983) and, in some cases, of volunteer’s dilemma games (Diekmann 1985). In these games, a voter will participate and vote for the preferred candidate if his expected increase in benefit exceeds the voting costs (he will abstain if the opposite holds and mix between the two actions if both values are equal). Typically, these outcomes are much more elaborate to compute than for compulsory voting and not unique for a given election at the second stage. In appendix A, we derive the equilibrium conditions for all possible subgames at the election stage, focusing on totally quasi-symmetric mixed strategy Nash equilibria (cf. Palfrey and Rosenthal 1983). Some of their properties will be discussed in section 4.2.

The following four propositions give the subgame perfect Nash equilibrium results for compulsory and voluntary voting relevant for our analysis. We refer to a pure strategy of a candidate as the selection of one specific policy offer (choice of voters) and to a *pure*

¹⁷ The alternative to vote insincerely for the non-preferred candidate is weakly dominated by the alternative to vote sincerely. Applying iterated strict dominance would result in a plethora of Nash equilibria involving at least one insincere vote. In section 4.2, we will test whether subjects do indeed vote sincerely in our experiment.

balanced strategy as the selection of a specific number of voters, where all policy offers satisfying this number are played with equal probability. Moreover, we refer to a candidate's mixed strategy as a probability distribution over all pure strategies and to a *mixed balanced strategy* as a probability distribution over all pure balanced strategies (see appendix A for more details). Note that pure, pure balanced, and mixed balanced strategies are special cases of mixed strategies.

PROPOSITION 1 (*Nash equilibrium winning probabilities*):

In any subgame perfect Nash equilibrium of the polity game, each candidate has a 50% probability of winning.

Proof: Easy to see, since each candidate can at least imitate the strategy of her opponent. \square

There are special cases among the subgame perfect Nash equilibria for electorate sizes $E = 1$ to 6. For example, if $E = 1$ each candidate must per definition select this lonely voter anyway and if $E = 2$ it is readily verified that any pair of strategies is a equilibrium, independent of the election and decision rule at hand. Moreover, if $E = 6$ there are pure strategy equilibria for compulsory voting with the random and neutral rule, but beyond this size no such equilibria exist. To give a first intuition, appendix B shows numerical examples for $E = 4$ with compulsory voting ($E = 3$ with voluntary voting). But no further laborious special cases, though straightforward, will be discussed and only cases with $E > 6$ will be considered in our propositions 2 to 4. Note that in our experiment we use $E = 12$.

PROPOSITION 2 (*Nash equilibrium policy offers per decision rule for compulsory voting*):

For compulsory voting and $E > 6$,

- (i) with the random and neutral rule, a) there exists at least one subgame perfect Nash equilibrium in which both candidates use mixed balanced strategies; b) no subgame perfect Nash equilibrium exists in strategies that can only result in a unique number of selected voters; c) no equilibrium strategy that uses with strictly positive probability any policy offer which selects $\lfloor E/4 \rfloor$ voters or less survives iterated weak dominance;
- (ii) with the egalitarian rule, a) for E even (odd) any combination of strategies by both candidates that can only result in exactly $E/2 + 1$ ($\lceil E/2 \rceil$) selected voters constitutes a

subgame perfect Nash equilibrium; b) no other subgame perfect Nash equilibria survive iterated weak dominance;¹⁸

(iii) with the elitist rule, a) there exists at least one subgame perfect Nash equilibrium in which both candidates use mixed balanced strategies; b) no subgame perfect Nash equilibrium exists in strategies that can only result in a unique number of selected voters.

Proof: See appendix A.

PROPOSITION 3 (*Nash equilibrium policy offers for voluntary voting*):

For voluntary voting and $E > 6$, a) there exists at least one subgame perfect Nash equilibrium in which both candidates use balanced strategies, pure or mixed; b) no equilibrium strategy uses with strictly positive probability a policy offer that yields benefits to the selected voters that are smaller than twice the voting costs.

Proof: The proof regarding the existence of a subgame perfect Nash equilibrium in pure balanced or mixed balanced strategies is analogous to that in proposition 2. Regarding part b), it follows from condition (A.20) in appendix A that nobody will vote with strictly positive probability for such a policy offer, yielding a winning probability of at most 50% (due to the coin toss in case of a tie). On the other hand, any policy offer that promises its selected voters benefits equal to or larger than twice the voting costs receives a strictly positive expected turnout. Hence, the latter policy offers weakly dominate the former (they do not necessarily strictly dominate, because some combinations of policy offers may yield benefit-differentials which result in zero turnout probabilities). \square

PROPOSITION 4 (*Nash equilibrium policy offers and inequality*):

For compulsory voting and $E > 6$, in any subgame perfect Nash equilibrium of the polity game with the egalitarian rule (random, neutral, and elitist rule) the winning policy offer creates (with positive probability) inequality among voters. For voluntary voting and $E > 6$, in any subgame perfect Nash equilibrium of the polity game the winning policy offer creates inequality among voters if the voting costs are larger than $W/2E$.

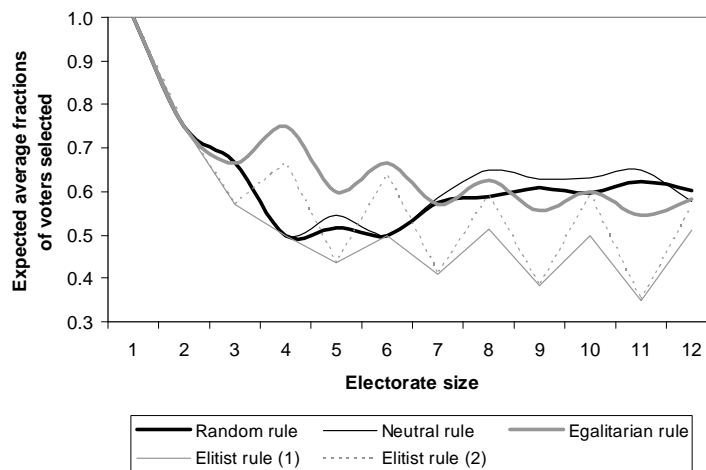
Proof: For compulsory voting, with the egalitarian rule this follows from proposition 2 (ii). With the random, neutral, and elitist rule, propositions 2 (i) and 2(iii) tell us that no subgame perfect Nash equilibrium exists in strategies that can only result in a unique number

¹⁸ For E even, next to $E/2 + 1$ the only number of selected voters that survives iterated 'strict' dominance is $E/2$.

of selected voters. Hence, the egalitarian policy offer will not be the only choice and inequality arises with positive probability (computations show that the egalitarian offer is typically used with zero or small probability). For voluntary voting, egalitarian policy offers for which the voting costs are larger than $W/2E$ are weakly dominated (cf. proposition 3). \square

For compulsory voting, figure 1 gives average fractions of voters selected as expected in the (mixed balanced strategy) subgame perfect Nash equilibria for $E = 1$ to 12.¹⁹ These are shown for the random, neutral, egalitarian, and elitist rule. Note that there are two subgame perfect Nash equilibria in mixed balanced strategies with the elitist rule for any even $E \geq 4$ denoted by elitist rule (1) and elitist rule (2).²⁰ Figure 1 indicates that only with the elitist rule for odd $E \geq 5$ do the expected average fractions of voters selected fall below the 50%-level, reaching the 35%-points for $E = 11$. For voluntary voting, we cannot present numerical examples other than those given in appendix B because computation is much more elaborate, even for small electorate sizes.

FIGURE 1: EQUILIBRIUM EXPECTED AVERAGE FRACTIONS OF VOTERS SELECTED PER DECISION RULE IN COMPULSORY VOTING



3 Experimental design

¹⁹ We used Gambit (McKelvey et al. 2005) to compute the subgame perfect Nash equilibria.

²⁰ For the random and neutral rule, we also derived two Nash equilibria in mixed balanced strategies for electorate size 8. However, since the differences in expected fractions are small (0.625 vs. 0.588 with the random rule and 0.667 vs. 0.650 with the neutral rule), figure 1 only shows the lower fractions.

The computerized²¹ experiment was run at the laboratory of the Center for Research in Experimental Economics and political Decision making (CREED), University of Amsterdam. 184 undergraduate students were recruited in 12 sessions of 14 or 18 subjects. Each session lasted about 2 hours (cf. appendix C for the read-aloud instructions). Earnings in the experiment were expressed in tokens. At the end of a session token earnings were transferred to cash at a rate of 4 tokens to one Dutch Guilder. Subjects earned an average of 38.31 Dutch Guilders (\approx €17.38).

Each session used one ‘polity’, i.e., a combination of two candidates and one electorate (12 voters). Given that we do not know the structure of the correlations across observations, we treat the polity as the only independent unit of observation. Hence, each session provides us with one independent observation, giving us 12 such observations. Each subject was either of type ‘candidate’ or ‘voter’ throughout the session and knew her role from the beginning of the first round.²²

Our first treatment variable (‘candidate matching’) manipulates the matching protocol of candidates in a between subjects design, where we distinguish between ‘partners’ and ‘strangers’ (cf. Andreoni 1988). In partners (strangers), 2 (6) subjects from a subject-pool of 14 (18) were randomly appointed ‘A’ and ‘B’²³ (‘potential’) candidates once and for all at the beginning of the first round. The remaining 12 subjects of the subject pool were voters, leaving the electorate unchanged throughout. From the pool of potential candidates in strangers, 2 were randomly appointed ‘actual’ A and B at the beginning of each round, with equal probability for each.²⁴ However, potential candidates were only informed about being an actual A or B after all of them had decided. By this design, they were not able to implicitly coordinate their policy offers across rounds. A natural interpretation in this context is that strangers represents short-lived *politicians*, who are frequently replaced across elections, and partners represents long-lived *parties*, acting over many legislative periods.²⁵

Our second treatment variable (‘electoral system’) compares ‘compulsory’ to ‘voluntary’ voting, also in a between subjects design. In compulsory voting, each voter automatically

²¹ The experimental software was programmed using RatImage (Abbink and Sadrieh 1995).

²² For simplicity, in the remaining part of this paper we refer to ‘candidates’ and ‘voters’ as both ‘players’ in the game theoretical context and ‘subjects’ in the experimental context. The context at hand will be clear.

²³ In the experiment they were labeled ‘X’ and ‘Y’, respectively.

²⁴ The random sequence was predetermined (see table D.1 in appendix D) but not known to the subjects. Each of the ‘potential’ candidates was an ‘actual’ candidate 15, 17, or 19 times.

²⁵ For politicians, we wanted to create a decision making situation that is close to a one-shot encounter. Of course, outside of the laboratory politicians may implicitly coordinate their decisions by using predecessors’ policy offers as a clue.

participated (at costs) and decided whether to vote for a candidate or vote blank. In voluntary voting, on the other hand, each voter decided whether to costly participate and vote for a candidate, or to abstain (hence, not vote for either candidate) and bear no costs. Types and decisions were anonymous in all treatments.

Each session consisted of 51 rounds with two decision stages each. At the first stage, the 2 respectively 6 candidates simultaneously made their policy offers by selecting specific voters. At the second stage, both (actual) candidates' offers were announced and the electorate determined a winner by simple majority voting (with a coin toss in case of a tie). Thereafter, a fixed budget of 18 tokens was evenly divided across the winner's selected voters, and nothing (0 tokens) was given to those not selected. The loser's policy offer was of no consequence. In addition to these benefits, each voter received 1 token independent of the election outcome. This was done to avoid negative payoffs, since participation costs were 1 token. Recall that these costs had to be paid anyway in compulsory voting but could be avoided by abstaining in voluntary voting. Voters were paid for each round. As for the candidates, the winner received 20 tokens and the loser nothing (0 tokens). Whereas in strangers the candidates were paid for each round they were an actual candidate (15, 17, or 19 rounds), in partners they were paid for 17 rounds, randomly selected at the end of the session. These earning schemes of voters and candidates were known to all subjects.

It is important to note that although candidates selected specific voters, they could not observe the individual vote decisions. The only public information available was the aggregate level of support for each candidate. Moreover, before candidates made their policy offers they saw for each specific voter whether (or not) and by whom this voter had been selected in the previous round. This information was given by buttons on the screen, each of which represented one specific voter whose position remained constant across rounds. For the voters, before making their decisions they were not only informed about the budget shares assigned to themselves, but also about those to all others. In contrast to the candidates, however, voters were not able to track any other specific voter's shares in previous rounds. For more details about the procedures and screens, see the instructions in appendix C.

Table 1 summarizes our treatments and parameters.

TABLE 1: SUMMARY OF TREATMENTS AND PARAMETERS*

Treatment	Acronym	Candidate	Voter payoffs	# Actual
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		payoffs: victory (defeat)	Benefits (+ if selected by winner)	Partici- pation costs	(potential) candidates
Compulsory Partners	CP	20 (0)	1 (+18/ P)	1	2 (2)
Voluntary Partners	VP	20 (0)	1 (+18/ P)	1	2 (2)
Voluntary Strangers	VS	20 (0)	1 (+18/ P)	1	2 (6)

* P \equiv number of voters selected by the winner. All treatments had 51 rounds and electorates of 12 voters. We have observations from 4 independent polities (= sessions) per treatment.

For these parameters, we can derive the following (subgame perfect) Nash equilibrium predictions (hypotheses H1-H4) based on our propositions 1 to 4:

Policy offers:

- H1:** In voluntary voting, there is no difference in policy offers between politicians and parties.²⁶
- H2:** Policy offers create inequality among voters (on average). In compulsory voting, 7 voters (58%) are selected by candidates in case of the egalitarian rule and on average 60% (58%; between 51% and 56%) are selected by candidates in case of the random (neutral; elitist) rule. In voluntary voting, no policy offer selects 10 voters or more.
- H3:** In any treatment, each (actual) candidate has a winning probability of 50%.

Voter behavior:

- H4:** Non-indifferent voters vote sincerely in compulsory voting. In voluntary voting, voters with benefit-differentials below 2 will abstain. Those who have benefit-differentials larger than or equal to 2 and participate will vote sincerely.

4 Experimental results

This section presents and analyzes our experimental results. We start with aggregate candidate and voter behavior across treatments. Then, we will elaborate on voter behavior in more detail. In particular, we will investigate whether preference intensity, group size difference, and being repeatedly favored (more) by the same candidate have an impact on voting decisions. Further analysis will be devoted to behavior of indifferent voters. Thereafter, we will look more closely at policy offers, with an emphasis on simple dynamics. Finally, we will investigate whether political bonds, i.e. a sequence of mutual ‘support’ within pairs of candidates and voters, develop. For our analysis, we use nonparametric statistics as described

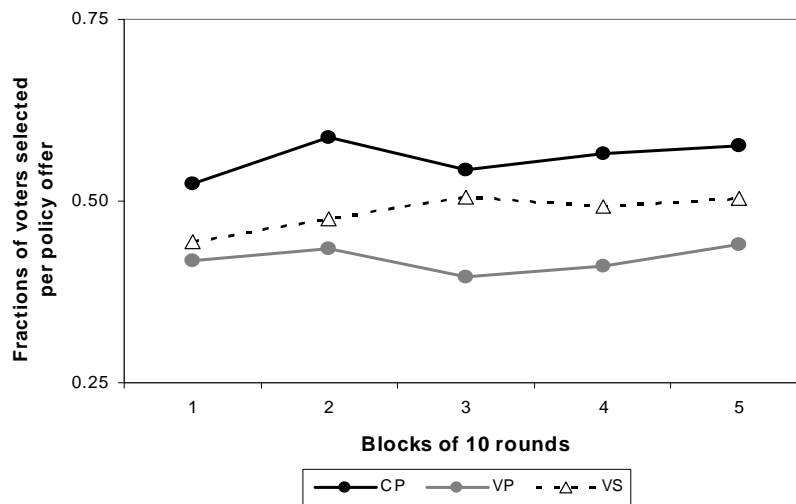
²⁶ This follows from using backwards induction.

in Siegel and Castellan, Jr. (1988). For the reasons mentioned above all of our nonparametric tests will be conducted at the polity level. In addition, random effects probit estimations will be used to analyze voter behavior at the individual level.

4.1 Aggregate results

We first consider candidate behavior. Figure 2 gives aggregate fractions of voters selected per policy offer averaged over blocks of 10 rounds each (11 rounds in the last block) for each treatment. For voluntary strangers the policy offers of all 6 ‘potential’ candidates are included.²⁷

FIGURE 2: AGGREGATE FRACTIONS OF VOTERS SELECTED PER POLICY OFFER



RESULT 1: *Policy offers include more voters when voting is compulsory.*

Figure 2 shows that the aggregate fractions of voters selected per policy offer are higher for compulsory than for voluntary voting in all blocks of rounds (overall: 56% vs. 42%). CP and VP start at fractions of 52% and 42%, respectively, establishing a difference of approximately 15%-points in blocks 2 to 5. A Wilcoxon-Mann-Whitney test rejects the null hypothesis of no

²⁷ There is no statistically significant difference in VS between the data using the policy offers of all 6 ‘potential’ candidates and the two ‘actual’ candidates only. A Wilcoxon signed ranks test cannot reject the null hypothesis of no difference at the 10% significance level (two-tailed test). Moreover, the statistical results reported in result 2 are not affected when switching to data for actual candidates only.

difference in favor of higher fractions of selected voters per policy offer in compulsory at the 5% significance level (one-tailed test).

RESULT 2: *Parties and politicians include similar numbers of voters.*

In all blocks of rounds, aggregate fractions of voters selected per policy offer are smaller for parties than for politicians (overall: 42% vs. 48%; cf. figure 2). The fractions are with 42% (44%) in VP and 44% (48%) in VS quite similar in the first (second) block of rounds, but larger gaps from 6 to 11%-points occur in the last three blocks. A Wilcoxon-Mann-Whitney test cannot reject the null hypothesis of no difference between overall fractions in VP and VS at the 10% significance level (one-tailed test). The same holds for the last three blocks of rounds only.

We can use results 1 and 2 together with figure 1 to test our first two hypotheses.

Test of H1: H1 predicts that there is no difference in policy offers between parties and politicians in voluntary voting. At the aggregate level, this is supported by result 2 (cf. section 4.2 and 4.3 for a more detailed analysis).

Test of H2: H2 predicts that policy offers create inequality (on average). This is supported by our data; in all three treatments the aggregate fractions of voters selected per policy offer are substantially lower than the egalitarian 100% (cf. figure 1). Moreover, in CP the rate is close to the 60% (58%; 58%; 56%) predicted for the random rule (neutral rule; egalitarian rule; elitist rule (2)). Out of 408 decisions in CP, only 25 are egalitarian offers. Hence, inequality arises on no other grounds than tactical redistribution (cf. Myerson 1993). Policy offers are even more unequal when voting is voluntary: the fractions of voters selected per policy offer are smaller in VP and VS than in CP (cf. result 1; the difference between VS and CP is also statistically significant: one-tailed Wilcoxon-Mann-Whitney test, 10% level). Out of 408 decisions in VP, 10, 11, and 12 voters are selected only 3, 1, and 13 times (in VS: 3, 2, and 18 times), supporting the last part of H2.

Next, we look at aggregate voter behavior. Figure 3 gives aggregate voting rates²⁸ for blocks of 10 rounds (11 rounds in the last block) for all treatments. The lines without markers give

²⁸ When a ballot is cast for either candidate, as opposed to voting blank, we will refer to ‘vote for’ in both compulsory and voluntary voting. Consequently, we will refer to ‘voting rates’ as rates of votes cast for either candidate. Note that in voluntary voting to ‘vote for’ implies ‘participation’ in our setup, since there was no option to participate and then vote blank.

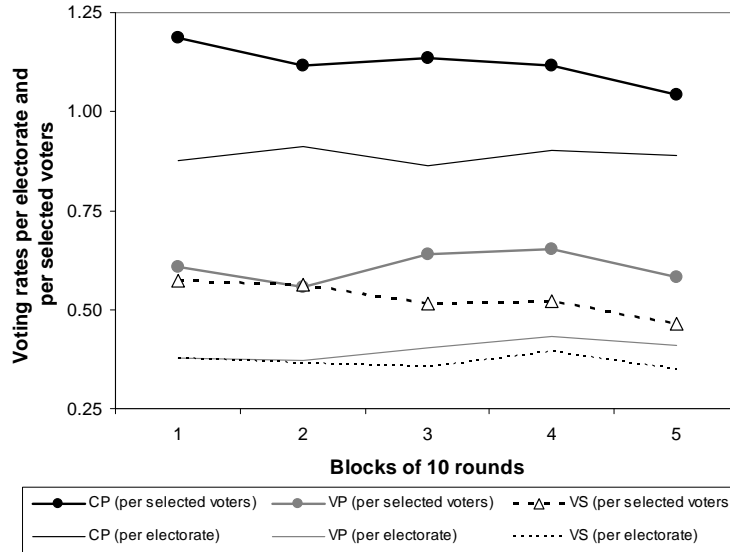
these rates *per electorate* (i.e., the total number of votes cast for either candidate divided by the size of the electorate). For compulsory voting, this rate is smaller than 1 if there is at least one blank vote. It is also interesting to look at voting rates *per selected voter* (i.e., the total number of votes cast for either candidate divided by the number of voters selected by at least one candidate), as depicted by the lines with markers. For compulsory voting, this rate is larger than one if the non-selected voters voting for either candidate outnumber the selected voters voting blank.

RESULT 3: *Voter participation is similar in case of parties and politicians.*

For voluntary voting, figure 3 shows that the aggregate voting rates per electorate are very similar for parties and politicians in the first two blocks of rounds (38% and 37% in VP; 38% and 36% in VS) and somewhat larger for parties in the last three blocks (VP: 40%, 43%, and 41%; VS: 36%, 39%, and 35%). A similar pattern occurs for the rates per selected voter: these are close in the first two blocks (VP: 61% and 56%; VS: 57% and 56%), but more than 10%-points higher for parties in the last three blocks (VP: 64%, 65%, and 58%; VS: 51%, 52%, and 46%). Wilcoxon-Mann-Whitney tests neither reject the null hypothesis of no difference between voting rates per electorate in VP and VS for all blocks of rounds nor for the last three blocks only (both 10% significance level, one-tailed tests). The same holds for voting rates per selected voter. As expected (cf. H4), the rates per selected voter are substantially higher than those per electorate in both VP (overall 61% vs. 40%) and VS (53% vs. 37%).²⁹

FIGURE 3: AGGREGATE VOTING RATES

²⁹ Note that for elections outside of the laboratory only the voting rates per electorate are reported. It is interesting to compare the voting rates per selected voter to previous experiments on participation games (e.g., Schram and Sonnemans 1996a) and the volunteer's dilemma game (Franzen 1995; Goeree et al. 2005), where voters are pre-selected and have a strictly positive benefit-differential. Compared to these studies, the observed participation rates per selected voter of 61% in VP and 53% in VS appear high, but one should bear in mind that in our study groups sizes (preference intensities) are on average smaller (higher), affecting participation levels (cf. section 4.2, below). The deliberate decision to include or exclude voters by candidates itself may also influence participation behavior in our experiment.



In compulsory voting, voting rates per electorate (per selected voter) are below (above) 100% in all blocks of rounds. For the rates per selected voter, this indicates a vote for either candidate by a substantial number of indifferent voters. The rate is highest (119%) in the beginning, settles at 111%, 114%, and 112% in blocks 2-4, and ends at its lowest level of 104%. Moreover, there are three electorates with aggregate voting rates per selected voter above and one below 100% (99%, 108%, 117%, and 123%). We infer that once at the ballot box anyway, indifferent voters do not just withhold their vote. This will be discussed further in section 4.3.

4.2 Voter behavior

In the previous section, we analyzed voter behavior at the aggregate level. However, for many of the various subgames at the election stage in voluntary voting we can derive distinct theoretical predictions (cf. appendix A).³⁰ We will give the frequencies of elections observed for each class of subgames and describe some of the Nash equilibrium properties. Then, we will check whether voting is indeed sincere, as predicted. Thereafter, we will investigate in particular whether preference intensity, group size difference, and being repeatedly favored (more) by the same candidate have an impact on voting decisions. Moreover, we will elaborate on victory rates of minorities and majorities. A final analysis will be devoted to the behavior of indifferent voters.

³⁰ Due to computational limitations, we cannot provide theoretical point predictions for candidate behavior in voluntary voting.

Classification of elections

In section 2 we described how voter groups are formed by the electorate's (endogenous) structure of benefit-differentials (cf. appendix A). For compulsory voting, we know that there always exists a Nash equilibrium in which each voter sincerely votes for his preferred candidate and according to the second most important argument if he is indifferent between both candidates (cf. section 2). For voluntary voting, on the other hand, voter behavior is more difficult to analyze because the preference intensities, i.e. the levels of benefit-differentials (BD), are important too. Given our experimental parameters, we predict that voters with $BD < 2$ will abstain; their expected benefit from changing the outcome cannot exceed the participation costs (cf. H4 in section 3). Separating these abstainers from potential participants results in group patterns that are 'relevant', often different from the 'original' patterns, for deriving equilibrium participation probabilities. For example, switching to relevant groups may change an original majority into a minority, because their voters with $BD < 2$ need to be disregarded.

Considering relevant group patterns, the various possible subgames at the election stage can be classified as follows (cf. lemmas 1 and 2 in appendix A):

- (a) *'Standard' participation games*: two supporter groups, each having at least one voter with $BD \geq 2$ and homogeneity within groups: there is only a single $BD \geq 2$ in each group;
- (b) *'Modified' participation games*: two supporter groups, each having at least one voter with $BD \geq 2$ and there are two distinct $BD \geq 2$ (heterogeneity) in one group;
- (c) *'Standard' volunteer's dilemma games*: one supporter group has at least one voter with $BD \geq 2$ and homogeneity within this group: there is only a single $BD \geq 2$; all other voters in the electorate have $BD < 2$;
- (d) *'Modified' volunteer's dilemma games*: one supporter group has at least one voter with $BD \geq 2$ and at least one other voter with a distinct $BD' \geq 2$, $BD \neq BD'$ (heterogeneity); all other voters in the electorate have $BD < 2$;
- (e) Games where all voters in the electorate have $BD < 2$ (hence everybody abstains).

In our experiment, we observe 75.5% (81.4%; 71.1%) standard participation games in VS (VP; CP for comparison), 5.9% (3.9%; 2.0%) modified participation games, 11.3% (11.3%; 12.7%) standard volunteer's dilemma games, 0% (0%; 0%) modified volunteer's dilemma games, and 7.3% (3.4%; 14.2%) games with full abstention. Hence, the vast majority of

elections are standard participation games.³¹ Therefore, we will mainly describe equilibrium properties for these games.

Further equilibrium predictions

In addition to our hypotheses H4 (cf. section 3), we have more specific predictions for the standard participation game based on theory and previous experiments. Throughout, we will focus on *totally quasi-symmetric mixed strategy* Nash equilibria (cf. Palfrey and Rosenthal 1983). Though these cannot always be numerically calculated, in which case asymmetric equilibria must be derived, they provide us with valuable qualitative predictions that we can use to test all subgames at the election stage. For identical preference intensities and participation costs in the electorate, one or two totally quasi-symmetric mixed strategy equilibria may arise in which expected turnout is strictly positive (Palfrey and Rosenthal 1983). With two equilibria, one exhibits a lower participation level ('low') than the other ('high'). Analyzing these equilibria (numerical computations show that these properties survive when allowing for asymmetric benefit-differentials across groups) allows us to derive three additional comparative static predictions for voluntary voting in class (a) (standard participation games):

- (1) *Benefit-differentials*: With two equilibria, a joint increase in the benefit-differential (or decrease in the participation costs; cf. (A.20) in appendix A) increases the probability to participate in the low equilibrium and decreases that in the high equilibrium, and vice versa for a joint decrease in the differential. If the change occurs only in one group, the same holds for the members of this group but the opposite is predicted for members of the other group. In a participation game experiment, Cason and Mui (2005) vary the participation costs but keep the (asymmetric) benefits fixed. They derive both a low and high equilibrium, but only the former is supported by the data. In our polity game benefits are endogenously varied and costs are fixed. Accordingly, we expect participation to increase in the benefit-differential (even for elections where two equilibria are present).
- (2) *Group size differences*: With two equilibria the majority wins more (less) often than the minority in the high (low) equilibrium. In a participation game experiment with fixed benefits and costs, Großer et al. (2005) observe the majority winning more often even

³¹ Note that our classification of 'standard' participation games goes one step beyond those analyzed in Palfrey and Rosenthal (1983). The only asymmetry they analyze in the games with simple majority voting is group size difference, whereas we also allow for differences in benefit-differentials across groups. A distinction 'modified' indicates heterogeneity within groups, where members have different benefit-differentials.

though the only equilibrium predicts the opposite. In the polity game experiment, minority members typically have the higher benefit-differentials, which may outweigh this observed majority advantage. Overall, we expect ‘original’ minorities and majorities to have approximately equal winning probabilities, because in theory candidates use well tuned mixed strategies concerning the number of selected voters. Furthermore, contrary to our theoretical predictions, Großer et al. (2005) also report that participation decreases for both minority and majority members when the group size difference increases. Given this result, we expect the same negative effect for the polity game experiment. (Note that in their study group size is varied exogenously, whereas its variation is endogenous in the polity game.)

- (3) *Favoritism*: We are interested in whether being repeatedly favored (more) by the same candidate stimulates the beneficiary to vote more often for that candidate. Note that this makes only one part of ‘political bonds’ between pairs of candidates and voters, because the behavior of candidates is not analyzed yet (cf. section 4.3). Using backwards induction, our prediction is that repeated favoritism *per se* does not enhance participation.

Of course, we can also derive comparative static equilibrium predictions for the other classified games (b) to (d) for voluntary voting. For example, for the standard volunteer’s dilemma game we predict that participation will increase in the benefit-differential and decrease in the group size, and that favoritism has no effect. Most of these properties are related to those discussed in (1) to (3). However, we will not elaborate on them further here, since a large majority of subgames that occur in our experiment are standard participation games.

Sincere voting

Before testing these predictions we will check whether our subjects indeed voted sincerely, as expected for both voluntary and compulsory voting. When voting is voluntary, $BD > 0$ is observed in 66.2% of the cases in VS (69% in VP). In 49.9% (43.3%) of these cases the voter abstained, in 48.8% (54.8%) he voted sincerely, and in 1.3% (1.9%) we observed an insincere vote. The remaining 33.8% (31.0%) of the decisions involved $BD = 0$, and we observed 7.1% (7.2%) votes and 92.9% (92.8%) abstentions. In compulsory voting, 77.7% of the votes were made with a $BD > 0$, of which 89.2% were sincere (7.0% insincere; 3.8% blank). Of the

22.3% votes with $BD = 0$, 63.6% were cast for a candidate (36.4% blank). This gives our next result.

RESULT 4: *When voting is voluntary, those non-indifferent voters who participate vote sincerely and indifferent voters sometimes participate. When voting is compulsory, non-indifferent voters mostly vote sincerely and indifferent voters vote in almost two thirds of the cases for one of the candidates.*

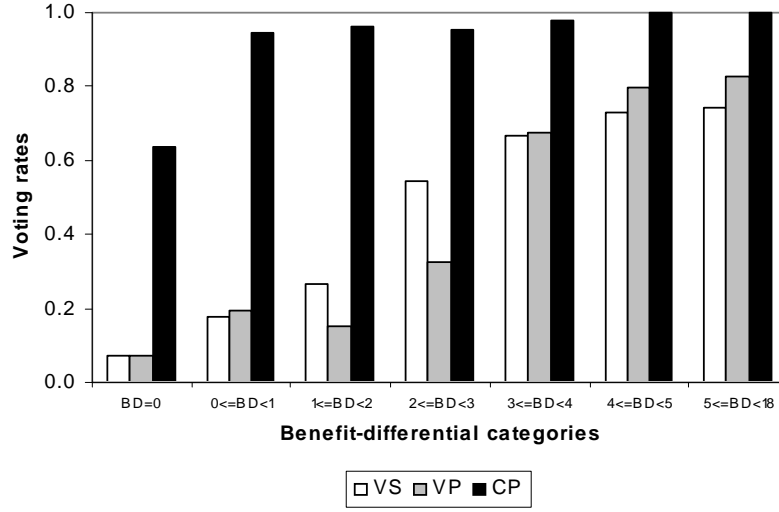
Test of H4: H4 predicts that in voluntary voting only sincere votes are observed and indifferent voters abstain. This is mainly supported by result 4. The observed fraction of insincere votes is low. However, the 7.1% (7.2%) of indifferent voters turning out to vote lies somewhat above the 0% expected. For compulsory voting, we assumed lexicographical preferences and predicted sincere voting. This is supported by our data. Whether or not the decisions rules that we suggested for indifferent voters can account for the almost two third of votes for either candidate will be discussed, below.

Because the number of insincere votes is relatively low in both compulsory and voluntary voting, our following data analysis of voter behavior will be simplified by assuming sincere voting.

Voting decisions

Since our strongest predictions are with respect to benefit-differentials (cf. H4 in section 3), figure 4 gives average voting rates per benefit-differential category distinguished by treatment.

FIGURE 4: AVERAGE VOTING RATES PER BENEFIT-DIFFERENTIAL CATEGORY



It appears that benefit-differentials have a large impact on voting decisions in both voluntary and compulsory voting. Very similar participation patterns are observed in VS and VP. Their voting rates are (with one exception in VP) increasing in the benefit-differential category. The most obvious difference between both treatments is that in VS the largest increase occurs at $2 \leq BD < 3$ (27.7%) whereas in VP it is found at $3 \leq BD < 4$ (34.9%). Note that the second largest increase in VP at $2 \leq BD < 3$ (17.2%) is also quite large.

For compulsory voting, figure 4 shows that a strictly positive benefit-differential does indeed induce voting rates close to the 100% predicted (overall: 96.2%). As expected, the largest increase is observed at $0 < BD \leq 1$ (30.8%). Once again, a high ‘activity’ of indifferent voters is indicated by the 63.6% of votes for either candidate at $BD = 0$.

To investigate voting behavior further, we use random effects probit estimations to statistically test our various hypotheses. We do so separately for the three treatments. The panel model we estimate is based on our predictions of the impact on voting of preference intensity, group size difference, and repeatedly being favored (more) by the same candidate as well as on our assumption of lexicographical preferences for compulsory voting. For voluntary voting it is given by

$$\begin{aligned}
D_{i,t}^V = & \beta_0^V + \beta_1^V \frac{t}{100} + \beta_2^V BD_{i,t} + \beta_3^V BD_{i,t}^{\geq 2} + \beta_4^V (BD_{i,t} \times BD_{i,t}^{\geq 2}) \\
& + \beta_5^V (GSD_{i,t}^{O,neg} \times BD_{i,t}^{(0,2)}) + \beta_6^V (GSD_{i,t}^{O,pos} \times BD_{i,t}^{(0,2)}) \\
& + \beta_7^V (GSD_{i,t}^{R,neg} \times BD_{i,t}^{\geq 2}) + \beta_8^V (GSD_{i,t}^{R,pos} \times BD_{i,t}^{\geq 2}) + \beta_9^V FAV_{i,t} + \varepsilon_{i,t} + \mu_i
\end{aligned} \tag{1}$$

and for compulsory voting by

$$\begin{aligned}
D_{i,t}^C = & \beta_0^C + \beta_1^C \frac{t}{100} + \beta_2^C BD_{i,t} + \beta_3^C BD_{i,t}^{>0} \\
& + \beta_4^C (GSD_{i,t}^{O,neg} \times BD_{i,t}^{>0}) + \beta_5^C (GSD_{i,t}^{O,pos} \times BD_{i,t}^{>0}) \\
& + \beta_6^C INEQ_{i,t} + \beta_7^C (INEQ_{i,t} \times BD_{i,t}^{>0}) + \beta_8^C FAV_{i,t} + \varepsilon_{i,t} + \mu_i,
\end{aligned} \tag{2}$$

where i denotes the voter and t denotes the round. $D_{i,t}^V$ ($D_{i,t}^C$) is a dummy variable equal to 1 if i votes for either candidate, and 0 otherwise. The term $t/100$ is included in the regression to test for a trend across rounds. $BD_{i,t}$ is the absolute value of i 's benefit-differential, whereas $BD_{i,t}^{>0}$, $BD_{i,t}^{(0,2)}$, and $BD_{i,t}^{\geq 2}$ are dummy variables equal to 1 if $BD_{i,t} > 0$, $0 < BD_{i,t} < 2$, and $BD_{i,t} \geq 2$, respectively, and 0 otherwise. The interaction term $BD_{i,t} \times BD_{i,t}^{\geq 2}$ measures the impact of BD from the threshold level of 2 onward. $GSD_{i,t}^{O,neg}$, $GSD_{i,t}^{O,pos}$, $GSD_{i,t}^{R,neg}$, and $GSD_{i,t}^{R,pos}$ measure (absolute) supporter group size differences from the perspective of a non-indifferent voter. Superscript ‘ O ’ refers to the difference in ‘original’ group sizes of an individual with $0 < BD_{i,t} < 2$ (who theoretically should not participate in voluntary voting) and superscript ‘ R ’ refers to the difference in ‘relevant’ group sizes of an individual with $BD_{i,t} \geq 2$. Superscripts ‘ neg ’ (‘ pos ’) to GSD indicate that i 's group is smaller (larger) than the other group, i.e. the minority (majority).³² Note that for indifferent voters no supporter group size is defined. $FAV_{i,t}$ is a dummy variable equal to 1 if i had a $BD > 0$ in favor of the same candidate in both the current and previous round, and 0 otherwise. $INEQ_{i,t}$ is a measure of ‘inequality’ in terms of the absolute difference in the number of selected voters between both policy offers. It is added to the regression of CP, to test our hypothesis on lexicographical preferences. $\varepsilon_{i,t}$ and μ_i are error terms, where the latter is a random effect used to correct for the panel structure in our data. Finally, the β 's are coefficients to be estimated. Table 2 gives the results of our random effects probit estimations for voting behavior aggregated over all elections per treatment.³³

TABLE 2: RANDOM EFFECTS PROBIT ESTIMATIONS OF VOTING BEHAVIOR

Constant and Independent variables	Coefficients		
	VS	VP	CP

³² The interaction term $GSD_{i,t}^{O,neg} \times BD_{i,t}^{(0,2)}$ ($GSD_{i,t}^{O,pos} \times BD_{i,t}^{(0,2)}$) measures the impact on turnout of being in a minority (majority) for voters with $0 < BD < 2$. And similar for $GSD_{i,t}^{R,neg} \times BD_{i,t}^{\geq 2}$ ($GSD_{i,t}^{R,pos} \times BD_{i,t}^{\geq 2}$) and $GSD_{i,t}^{O,neg} \times BD_{i,t}^{>0}$ ($GSD_{i,t}^{O,pos} \times BD_{i,t}^{>0}$).

³³ Considering only standard participation games (the majority of elections occurring in the experiment) gives very similar results. Because of low numbers of observations, separate estimates for each of the classified games (b) to (e) are not very meaningful.

Constant	-1.72 (10.73)***	-1.72 (13.04)***	0.15 (0.88)
$t/100$	-0.18 (0.76)	-0.16 (0.67)	0.36 (1.13)
$BD_{i,t}$	0.78 (8.70)***	0.57 (4.86)***	0.16 (1.93)*
$BD_{i,t}^{>0}$	-	-	1.69 (6.35)***
$BD_{i,t}^{\geq 2}$	1.97 (11.76)***	2.18 (10.06)***	-
$BD_{i,t} \times BD_{i,t}^{\geq 2}$	-0.62 (6.36)***	-0.40 (3.07)**	-
$GSD_{i,t}^{O,neg} \times BD_{i,t}^{>0}$	-	-	-0.07 (1.19)
$GSD_{i,t}^{O,pos} \times BD_{i,y}^{>0}$	-	-	-0.05 (1.03)
$GSD_{i,t}^{O,neg} \times BD_{i,t}^{(0,2)}$	-0.05 (0.50)	0.28 (1.29)	-
$GSD_{i,t}^{O,pos} \times BD_{i,y}^{(0,2)}$	-0.06 (1.52)	0.02 (0.31)	-
$GSD_{i,t}^{R,neg} \times BD_{i,t}^{\geq 2}$	-0.23 (3.91)***	-0.46 (7.43)***	-
$GSD_{i,t}^{R,pos} \times BD_{i,y}^{\geq 2}$	-0.12 (3.75)***	-0.34 (8.39)***	-
$INEQ_{i,t}$	-	-	0.13 (2.76)**
$INEQ_{i,t} \times BD_{i,t}^{>0}$	-	-	-0.06 (1.09)
$FAV_{i,t}$	-0.12 (1.57)	-0.06 (0.73)	-0.02 (0.12)

Notes: The independent variable is the voters' binary choice between voting for one of the candidates (= 1) and abstention respectively voting blank (= 0). Absolute z-values are given in parentheses. * (**; ***) indicates significance at the 5% (1%; 0.1%)-level. Results for the random effects estimates are available on request.

For the two voluntary treatments, the estimations show very similar results. Significance levels and the signs of significant coefficients are identical in VS and VP. The results show no effect on participation of the time trend ($t/100$) or preferring the same candidate twice in a row ($FAV_{i,t}$). As predicted (cf. H4) $BD = 2$ seems to separate the willingness to participate; the coefficients of $BD_{i,t}^{\geq 2}$ are large and significant. But contrary to our prediction that $BD < 2$ induces abstention, we observe a positive effect of the level of BD on turnout for these voters (because we include the interaction term $BD_{i,t} \times BD_{i,t}^{\geq 2}$, the effect for $BD < 2$ is captured by the term $BD_{i,t}$). The interaction term $BD_{i,t} \times BD_{i,t}^{\geq 2}$ shows that the effect of the level of BD is reduced substantially once the threshold $BD = 2$ is reached. Moreover, an increase in the group size difference decreases turnout for voters with $BD \geq 2$ in both the minority and majority, as also observed in the participation game experiment of Großer et al. (2005). Note that the effect is somewhat stronger for minorities ($GSD_{i,t}^{R,neg} \times BD_{i,t}^{\geq 2}$) than majorities ($GSD_{i,t}^{R,pos} \times BD_{i,y}^{\geq 2}$) and that both effects are larger with parties than with politicians. As predicted, turnout of voters with $BD < 2$ (who are expected to abstain; cf. H4) is not affected significantly by the group size difference.

For compulsory voting, the estimates support most of our predictions. We observe a large and significant effect on voting of having a $BD > 0$. However, unexpectedly, the level of the

BD has a small positive but significant effect on voting as well. Moreover, as expected neither voters in the minority nor in the majority are affected by group size differences. Our conjecture that indifferent voters may make decisions based on inequality concerns once at the ballot box anyway is supported: whereas voting by non-indifferent voters ($INEQ_{i,t} \times BD_{i,t}^{>0}$) is hardly affected by our inequality measure, we observe a small positive but significant effect for indifferent voters ($INEQ_{i,t}$). Hence, inequality concerns seem to stimulate indifferent voters to vote for one of the candidates. We will return to this result, below.

We summarize our findings from the random effects probit estimations in

RESULT 5: *When voting is voluntary, participation is increasing in the benefit-differential and decreasing in group size differences (in both the minority and majority). A large upward shift in participation occurs at the threshold where the benefit-differential is equal to 2. Finally, being repeatedly favored (more) by the same party or politician does not affect participation.*

When voting is compulsory, voting for a candidate is slightly increasing in the benefit-differential. A large upward shift in voting for a candidate occurs where the benefit-differential turns strictly positive. Indifferent voters vote somewhat more, the more policy offers differ in the number of selected voters. Finally, being repeatedly favored (more) by the same party does not affect voting.

Test of H4: For voluntary voting, H4 predicts that only voters with a $BD \geq 2$ will participate and those with a $BD < 2$ will abstain. The former is supported by result 5, but not the latter. Possible explanations of the (low) voter turnout observed for $BD < 2$ are that voters make small mistakes, i.e. a quantal response equilibrium (McKelvey and Palfrey 1995) would give better predictions, or that they follow group-utilitarian rules (Feddersen and Sandroni 2004). We will not further investigate these explanations here.

Minority and majority victories

We conjectured that minorities and majorities will win approximately the same numbers of elections in voluntary voting. This is because minority members typically have higher benefit-differentials than majority members, which may offset the size advantage of the latter. For ‘original’ supporter group sizes, minorities indeed win 45.5% and 50.8% of the elections against majorities in VS and VP, but not surprisingly, they win substantially fewer when only votes of ‘relevant’ groups are considered (27.3% and 39.2%). One-tailed Wilcoxon signed

ranks test cannot reject the null hypothesis of no difference in victory rates for original group sizes at the 10% significance level but reject it for relevant sizes at the same level in both VS and VP. For comparison, in compulsory voting ‘original’ (‘relevant’) minorities win 21.4% (57.1%) of the elections against majorities. Both results are significant at the 10% level (one-tailed Wilcoxon signed ranks tests). Note that out of 204 elections, 59 (80; 78) had supporter groups of equal ‘original’ sizes and 43 (56; 71) of equal ‘relevant’ sizes in VS (VP; CP).

Indifferent voters

Finally, indifferent voters’ decisions in compulsory voting will be investigated. Recall that they show high voting activity, casting a vote for one of the candidates in almost two thirds of all cases (cf. result 4). This is to some extent stimulated by inequality concerns (cf. result 5). Because the simulation is much less for non-indifferent voters (from table 2 it can be derived that a coefficient measuring the effect for these voters is $0.13 - 0.06 = 0.07$), our assumption of lexicographical preferences receives some support. A closer look reveals the following: we observe indifference in 547 out of 2448 cases (4 CP sessions with 12 voters and 51 rounds each), of which 218 (329) are situations where the two policy offers select equal (different) numbers of voters, hence, have the same (different) inequality levels. Given our assumption that only one decision rule is used in the electorate, we predict for the random rule (neutral rule; egalitarian and elitist rule) that 66.7% (0%; $329/547 \times 100\% = 60.1\%$) of the votes by indifferent voters are cast for a candidate. Hence, the predictions for the random, egalitarian, and elitist are all close to the observed 63.6%, but the neutral rule can be dismissed as a prevailing rule.³⁴

Next, we will investigate whether or not indifferent voters affect election outcomes and, if so, whether this is in favor of the more egalitarian policy offer. For this, we compare actual outcomes with ‘hypothesized’ outcomes where *ex post* all votes by indifferent voters are

³⁴ For the 218 cases where policy offers have the same inequality levels, there are 134 votes for either candidate and 84 blank votes. And, for the 329 cases where policy offers have different inequality levels, 133 (81) votes by indifferent voters are for the more (less) egalitarian offer and 115 are blank. A one-tailed Wilcoxon signed ranks test rejects the null hypothesis of no difference in favor of more votes by indifferent voters for the more egalitarian offer at the 10% significance level. These numbers suggest that most voters ‘follow’ the random rule, where they either give somewhat more probability weight to the more than the less egalitarian offer, or they are accompanied by some voters following the egalitarian rule. Both alternatives are basically supported at the individual level. We find that all 48 voter-subjects in CP were indifferent at least once. Among them, 4 (7; 1) voted strictly according to the neutral rule (egalitarian rule, elitist rule) when facing policy offers that differed in the number of selected voters. However, for 0 (2; 1) of them we have at most two observations. The remaining 36 voter-subjects were ‘mixing’ between the three alternatives with varying frequencies, but a tendency to support the more rather than the less egalitarian policy offer is also found for these voters (105 vs. 78 votes, in addition to 101 blank votes).

excluded. If the winners differ for both situations, we can conclude that these votes matter. We also provide this comparison for both voluntary treatments. When excluding the decisions of indifferent voters, the outcome may be a tie. Since we have no realizations of a coin toss in this case, our analysis uses ties as a third possible outcome. Then, all possible cases are considered by looking at those candidates whose outcomes change from ‘a victory to a tie’, ‘a victory to a defeat’, and ‘a tie to a defeat’. We find that in CP 49 (VP: 25; VS: 22) outcomes out of 204 elections change when the decisions by indifferent voters are excluded. Note that this involves approximately 25% of all elections with compulsory voting. Hence, the impact of these votes is quite high in CP, about twice as large as in the two voluntary treatments. However, about half of these hypothesized changes (CP: 24; VP: 11; VS: 11) occur where both policy offers have the same inequality level, a situation which favors ties. For these cases egalitarian motives cannot play a role. Of the remaining cases in CP (VP; VS) there are 11 more victories (4 less, 1 more) for the more than the less egalitarian offer. In these cases, egalitarian motives are decisive, but note that only 5.4% (2.0%; 0.5%) of all 204 elections are involved. We summarize our findings for indifferent voters in the following result:

RESULT 6: *When voting is compulsory, indifferent voters cast more votes for the more egalitarian policy offer. However, though approximately one out of four elections is ‘decided’ by indifferent voters, only 5.4% of the election outcomes are influenced by the egalitarian tendency.*

4.3 Candidate behavior

In this subsection, we will analyze candidate behavior in more detail. First, we will elaborate on their victory rates. Thereafter, simple dynamics will be investigated by considering the similarity of policy offers across rounds. Finally, we will analyze the patterns of transitions between the voter states, i.e. the possible situations of being in- or excluded by both policy offers.

Victory rates

For each treatment, we have four polities. For each polity, we determine the percentage of victories for the more successful candidate. Note that because the number of rounds is odd (51 rounds), there is always a more successful candidate with a minimal victory rate of 51.0%. The percentages we observe, are 52.9%, 54.9%, 60.8%, and 64.7% in CP; 52.9%, 54.9%, 54.9%, and 62.7% in VP; 51.0%, 54.9%, 56.9%, and 62.7% in VS.

RESULT 7: *One third of the candidates win more often than their opponents.*

In 4 out of 12 polities one candidate dominates the other in terms of the number of victories and, hence, (expected) payoff. One-tailed Binomial tests reject the null hypothesis of equal victory probabilities for three polities at the 5% significance level (CP: 64.7%; VP: 62.7%; VS: 62.7%) and for one polity at the 10% level (CP: 60.8%), but not for the remaining polities (10% level). Recall that there are six potential candidates in each of our VS sessions. Considering each of these 24 politicians individually, 13 (11) win more (less) than half of their candidacies. The deviation from the 50%-benchmark is statistically significant for 4 (3) politicians (one-tailed Binomial tests, 10% significance level and better).

Test of H3: H3 predicts that each (actual) candidate has a winning probability of 50%. This is not supported by our result 7.

Similarity of policy offers

Next, we consider simple dynamics of policy offers by comparing the similarity of two consecutive offers. In particular, each current offer will be compared to the previous own and opponent's offer by looking at (i) the *difference in the number of selected voters* and (ii) the *number of replacements* (i.e., the number of exchanges of selected by unselected voters). We calculate the latter as follows. First, we determine which of the two offers has the smaller number of possible replacements.³⁵ Then, we subtract from this the number of overlapping voters. For both measures, we consider only relative numbers. More precisely, we divide (i) by the maximum possible difference in the number of selected voters given the previous offer and (ii) by the maximum possible number of replacements given the current and the previous offer. For example, if 5 voters were selected in the previous offer the largest difference occurs when the candidate switches to one or all twelve voters. Therefore, the maximum possible difference in the number of selected voters is $\max[(5-1), (12-5)] = 7$. If the current offer selects 3 voters, the *relative* difference in the number of selected voters is $|3-5|/7 = 2/7$. The maximum possible number of replacements is $\min[3, (12-3), 5, (12-5)] = 3$ and if, for example, both offers overlap for two voters the *relative* number of replacements is

³⁵ Using the smaller number of selected voters of the compared policy offers assures that the difference between both numbers, which is already measured by (i), is not considered by the replacement measure (ii) once more.

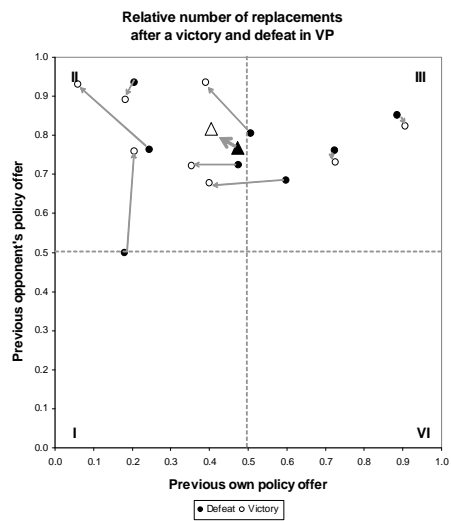
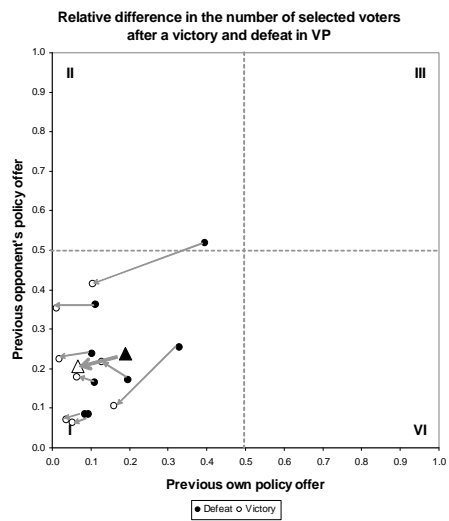
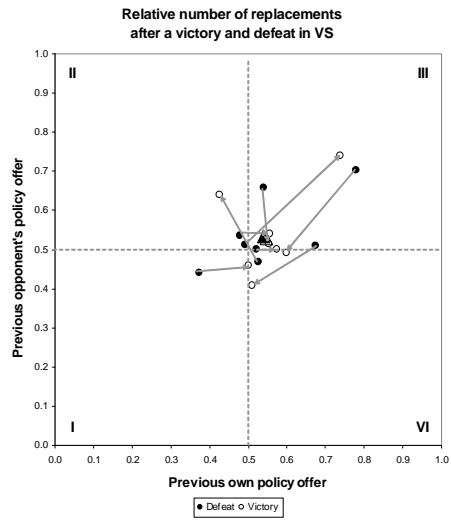
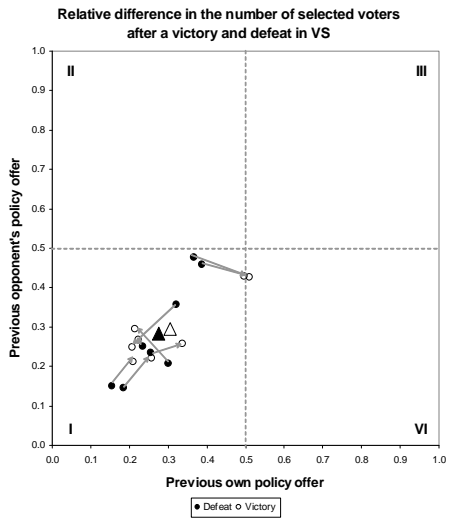
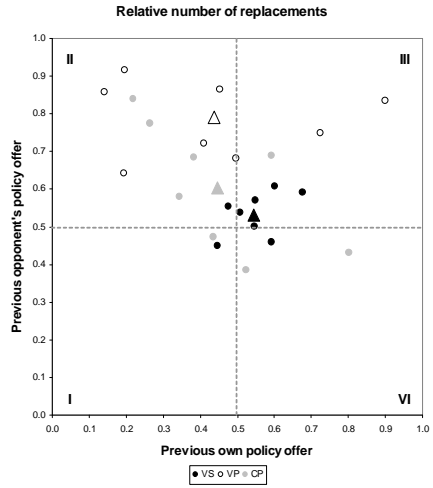
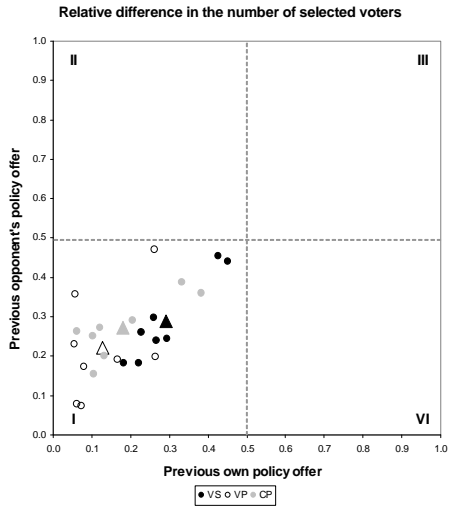
$(3 - 2)/3 = 1/3$.³⁶ Obviously, both measures are in the $[0,1]$ interval. The lower their values the more similar are the policy offers compared. Each measure will be analyzed separately for a victory and defeat of the own previous offer.

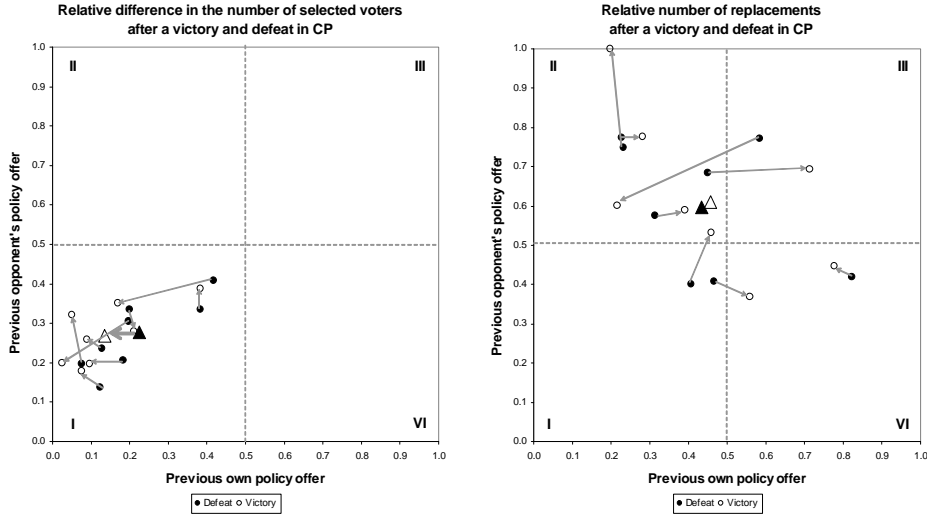
Figure 5 gives the observed values for both similarity measures. The top left (right) panel shows on the horizontal axis the average relative differences in the number of selected voters (average relative numbers of replacements) between the current and the previous own policy offer per candidate for all treatments. The analogous values for the comparison with the previous opponent's policy offer are given on the vertical axis. Observed aggregate values per treatment are depicted by triangles. The dashed lines show the 50% benchmarks, assuming that each number of selected voters is randomly drawn from a uniform distribution and that each replacement of the maximum possible number takes place with 50% chance. We use these benchmarks to distinguish four parts for each panel: in part 'I' ('III') the values for the own and opponent's previous offer are both smaller (larger) than 50%, indicating that the current offer is more (less) similar to both of them than our random prediction; in part 'II' ('IV') the current offer is more (less) similar to the own previous offer and less (more) similar to the opponent's previous offer, compared to our benchmark.

The other 6 panels in figure 5 give the relative measures per candidate and per treatment, this time distinguishing between a victory and defeat of the own previous offer. Each candidate's average values for the victory and defeat case are connected by an arrow, starting at the defeat value (black circle) and pointing to the victory value (white circle). The aggregate values for a victory and defeat are represented by triangles. Recall that the closer the values are to the origin, the more similar the compared policy offers are with respect to the measure at hand.

FIGURE 5: SIMILARITY OF POLICY OFFERS

³⁶ Note that the relative number of replacements is not defined if at least one of the compared policy offers is the egalitarian offer.





In the following, the two relative measures will be compared (i) between treatments using Wilcoxon-Mann-Whitney tests, (ii) within-candidates for the own and opponent's previous policy offers using Wilcoxon signed ranks tests, and (iii) within-candidates for a previous victory and defeat using Wilcoxon signed ranks tests. We will only report results that reject the null hypothesis of no difference in similarities at the 10% significance level or better (one-tailed tests).

We start by considering the relative differences in the numbers of selected voters. The top left panel in figure 5 shows that all observations lie inside of part 'I', indicating a tendency towards stability and conformity of policy offers across treatments. The observed values are smallest in VP (i.e. the values are closer to the origin), followed by CP and VS. For the own previous offer, the relative difference in the number of selected voters is smaller in VP and CP than in VS (Wilcoxon-Mann-Whitney tests, 1% and 5% level). For the opponent's previous offer, it is smaller in VP than in CP (the same test, 10% level). Comparing the measures for the own and opponent's previous offers, the top left panel shows that the candidates' values are scattered closely around the 45°-line in VS. This is not surprising since politicians were not able to coordinate across rounds. In VP (CP), all values but 1 (1) lie above the 45°-line. For these treatments, the relative difference in the number of selected voters is smaller for the own than the opponent's previous policy offer (Wilcoxon signed ranks tests, 5% and 1% significance level in VP and CP, respectively). Splitting the data in situations with a previous victory and defeat (cf. the three lower left panels of figure 5), we find that parties make policy offers that are more similar to their own previous offer after winning than after losing. This

holds for all parties, except one in compulsory voting, and is statistically significant at the 0.5% level in VP and the 5% level in CP (Wilcoxon signed ranks tests).

Next, we investigate the relative numbers of replacements. The top right panel of figure 5 shows that the values are farthest away from the 50% benchmark in VP, followed by CP and VS. In both VP and CP most values are found in part ‘II’ (6 respectively 4 out of 8 values), suggesting more similarity to the own previous policy offer and less similarity to the opponent’s previous offer than the 50% benchmark. For the own previous offer, the relative number of replacements is smaller in VP and CP than in VS (Wilcoxon-Mann-Whitney tests, both 10% significance level). For the opponent’s previous offer, this number is larger in VP than in CP and VS (the same tests, 5% and 0.05% significance level). When comparing for each candidate, we find that the relative number of replacements is smaller compared to the own than to the opponent’s previous policy offer in VP (Wilcoxon signed ranks test, 1% significance level). Moreover, looking at the three lower right panels of figure 5, policy offers are more similar to the own previous offer after winning than after losing in VP (Wilcoxon signed ranks test, 10% significance level). Finally, policy offers are more similar to the opponent’s previous offer after losing than after winning in CP (the same test, 10% level). We can summarize our observations for both relative similarity measures in the following result.

RESULT 8: *Policy offers generally tend to be similar in the number of selected voters across legislative periods, but most so for parties in voluntary voting. This number is more similar to the own previous number, in particular after a victory, than to the opponent’s previous number for parties in both compulsory and voluntary voting. Moreover, whereas in voluntary voting parties tend to stick more to their previously selected voters after winning, in compulsory voting they tend to bump more into the opponent’s policy offer after losing.*

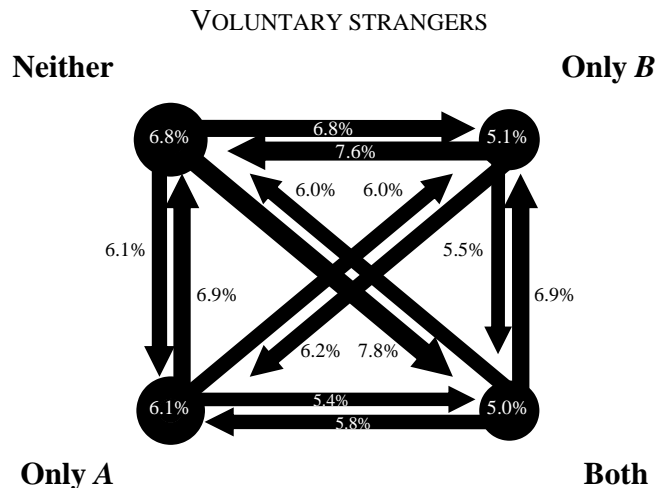
Voter states and transitions

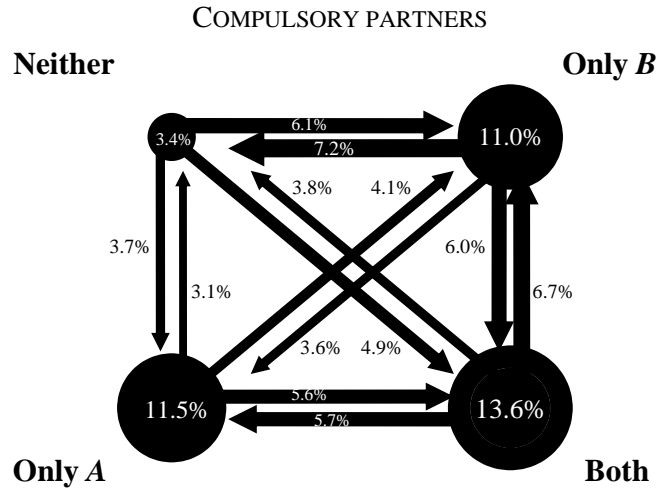
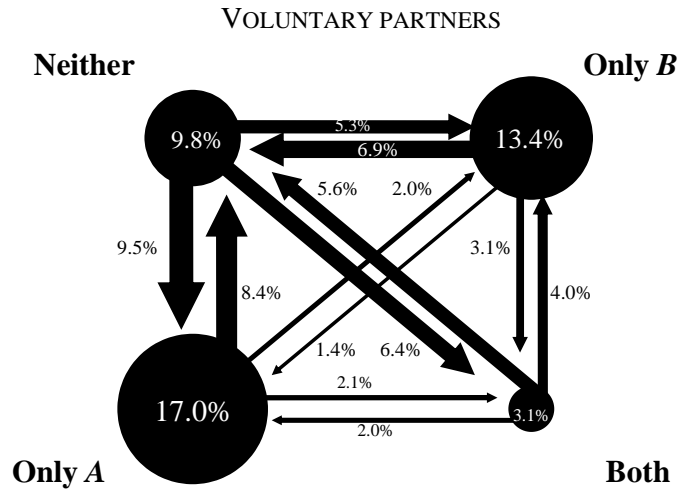
Next, we investigate whether current policy offers are based on previous ‘voter states’. A voter state is defined by the offers a voter receives in an election. We distinguish four such

states: a voter may be selected by candidate *A* or *B* only (*only A* and *only B*), by *neither* of the candidates, or by *both* candidates. Moreover, between two consecutive rounds his state may remain unchanged or change to one of the other three states.

For each treatment, figure 6 depicts each voter state as a ‘circle’. Transitions between states are given by ‘arrows’, directed from the previous to the current state. Each state has 3 outgoing and 3 incoming arrows. The fractions of unchanged states from one round to the next (transitions to another state) are shown by a percentage and the size of the respective circle (arrow). As a random benchmark, each voter is selected with a probability of 50% by each policy offer, independent of his previous state. Then, he will enter each of the 4 states with equal probability of 25% (‘state fractions’). In aggregate, a random process between two consecutive rounds will generate equal probabilities of 6.25% for remaining in any of the 4 states and for each of the 12 transitions between distinct states (‘transition fractions’, which are depicted in figure 6). Note that the state fractions are not shown in figure 6. Considering rounds 1 to 50, however, for each state they can be derived as the sum of the fraction of remaining in that state and the fractions of its three outgoing transitions. For example, in the top panel (*voluntary strangers*), the transition fraction for *neither* is 6.8% and that for *both*→*neither* is 6.0%. Moreover, the state fraction for *neither* is 27.5% (= 6.8% + 6.1% + 6.8% + 7.8%).

FIGURE 6: TRANSITIONS BETWEEN VOTER STATES





To compare our data with the random benchmark (“null hypothesis”) for the state and transitions fractions, we will use two-tailed Binomial tests and consider significance levels of 1% ($z = 2.576$), 0.1% ($z = 3.291$) and 0.001% ($z = 4.417$), indicated by *, **, and ***, respectively.³⁷ The top panel of figure 6 shows that all state (transition) fractions in VS are close to the 25% (6.25%) predicted by the random benchmark. Only the state fraction of 27.5%* for ‘neither’ and the transition fractions of 6.9%* for ‘both→only B’ and 7.6%** for

³⁷ For the state fractions, each observed fraction is tested using $p = 0.25$ and $n = 2400$ observations (4 sessions \times 12 voters \times 50 rounds). For the transition fractions, each observed fraction is tested using $p = 0.25$ and n_{actual} , the number of actual entries for the state where the transition departs.

‘only $B \rightarrow$ neither’ show significantly higher values than the 5.9% respectively 6.1% benchmark.³⁸

For partners (cf. the two lower panels of figure 6), most of the observed state (transition) fractions differ substantially from the random benchmark. In VP (CP) these differences are statistically significant for 3 (3) out of 4 state fractions and for 12 (10) out of 16 transition fractions (all * or better). In particular, the fractions of remaining in ‘only A ’ and ‘only B ’ are with 17.0% and 13.4% in VP (11.5% and 11.0% in CP) much higher than predicted (all ***). The numbers imply that of all voters only selected by party A in a round in VP, $57.6\% = 17.0\% / [17.0\% + 8.4\% + 2.0\% + 2.1\%]$ will be selected by A again in the next round. For B , this holds for 54% of the previously selected voters. In CP, these numbers are 47.3% and 39.6%. The most striking difference between parties in both treatments is the opposite relative importance for ‘neither’ and ‘both’. In voluntary voting, on average 30.9% of voters are not selected by either party (‘neither’) in any round, and only 14.8% are selected by both. In compulsory voting, only 18.1% are selected by neither and 29.8% by both (both differences ***). Similar results hold for the fractions of remaining in these states (cf. the sizes of the circles for ‘neither’ and ‘both’ in the two lower panels of figure 6; all * or better except for ‘both’ in VP).

In voluntary voting, we also find that parties avoid recruiting voters who were previously selected by the opposing party (for A , the 1.4% and 3.1% for the transitions ‘only $B \rightarrow$ only A ’ and ‘only $B \rightarrow$ both’ are smaller than the 6.2% benchmark and for B , the 2.0% and 2.1% for ‘only $A \rightarrow$ only B ’ and ‘only $A \rightarrow$ both’ are smaller than the 7.4% benchmark; all ***). Moreover, the number of ‘accidental’ entries from ‘neither’ into ‘both’ (6.4%*, which is smaller than the 7.7% predicted) is approximately returned (5.6%***, which is larger than the 3.7% predicted). Finally, in compulsory voting the transition fraction of ‘both’ is with 13.6%*** much higher than the 7.45% random prediction, and also much higher than in voluntary voting (3.1%, insignificant).

We can draw the following conclusions from figure 6. In both voluntary and compulsory voting, parties stick considerably more to voters who were previously only selected by themselves, yielding a separation of policy offers. Segregation is enhanced by avoiding recruitment of voters who have previously been selected by the opposing party in voluntary

³⁸ The random benchmark is determined as follows. First we calculate the percentage of voters in a state at the start of a round (the actual ‘state fraction’). For ‘both’, this is 23.7% (= 5.0% + 5.8% + 6.9% + 6.0%). In the benchmark, these are evenly divided across the four possible ‘transition fractions’. Hence, the benchmark fraction for the transition ‘both \rightarrow only B ’ is 5.9%.

voting, but a substantial overlap of policy offers is sustained in compulsory voting (cf. result 8). This behavior makes sense for both treatments. For parties in voluntary voting, by separating policy offers and including relatively few voters in the budget spending (cf. result 1 and figure 2), they provide their voters with turnout incentives that are high enough (recall that at least the participation costs must be offset on expectation). For compulsory voting, these incentives can be low because participation costs are sunk. Hence, more voters are included in the budget spending. The observed tendency to separate policy offers is the outcome of implicit coordination between parties on favoring or avoiding specific voters (cf. the following subsection). We can summarize our findings in

RESULT 9: *Parties condition policy offers on previous voter states. While in voluntary voting opposing parties seek to separate their policy offers, in compulsory voting they seek a combination of separation and overlap.*

4.4 Political bonds

So far, we have treated candidate and voter behavior more or less separately. Here, we will investigate mutual effects within pairs of specific candidates and voters. In particular, we will analyze whether ‘political bonds’ arise, i.e., sequences where candidates and voters favor each other by their selection and vote decisions. Note that the way information is provided in our experiment is not very supportive of the development of political bonds: while voters can observe each candidate’s policy offer, candidates can hardly be sure about specific voters’ reactions because only aggregate election outcomes are provided. Moreover, political bonds are vulnerable if the opposing candidate bumps into one’s own policy offer (cf. result 9). Nevertheless, due to repeated interaction we may expect some implicit coordination between parties and voters (and between parties; cf. section 4.3) across rounds.

For parties, figure 7 provides a detailed and comprehensive picture of four of our polities (examples 1, 3, and 4 for VP; example 2 for CP). Each panel shows all decisions of each candidate and voter. The policy offer of party A (B) is given on the left (right) hand side of each panel, where each voter $1, 2, \dots, 12$ has his own ‘column’ and each round is represented by a ‘row’. If in a particular round a specific voter was selected by a party, his rectangle for this round is colored black (gray) in case he voted (did not vote) for that party. And, if in a particular round a specific voter was not selected by a party, his rectangle for this round contains an ‘M’ (is colored white) in case he voted (did not vote) for that party.

We do not define precisely for how many successive rounds mutual favors must occur between a party and a voter to constitute a political bond. A ‘looser’ definition will suffice to describe our examples. Figure 7 shows that political bonds indeed arise, typically starting after about half of the rounds. In *example 1* (VP - session 6) party *A* consistently selects voters 2, 8, and 9 from round 22 onwards, and adds voter 10 from round 29 onwards. Overall, 74.3% of these favors are returned by a vote for *A*. However, since voter 8 does not do so very often, political bonds are only observed between party *A* and voter 2, 9, and 10. In contrast, party *B* selects on average more voters in rounds 22 to 51 than party *A* (5.11 vs. 3.77 voters per round), and chooses each voter less persistently. Only 45.2% of these favors are returned by a vote for *B*. Because the sequences of ‘mutual favors’ between party *B* and the voters she selects are quite small (the longest persist for 5 rounds between *B* and voter 5 and 6, respectively), no political bonds are observed for this party. Interestingly, we find implicit coordination between the parties: a clear separation of policy offers takes place from round 22 onwards (there are only two cases of voter overlap, in round 48). Though party *B* wins only 9 out of 30 of these elections, she does not consider bumping into party *A*’s political bonds as a means to increase her victories.³⁹

Example 2 (CP - session 12) shows that political bonds can also arise in compulsory voting. Party *A* (*B*) focuses on voters 7 to 12 (1 to 5) starting in round 38 (25). Moreover, while from round 38 onwards policy offers frequently overlap for voters 6 and 7 (cf. result 9), all other voters remain clearly separated (except for three cases). Because voting rates for these rounds are high (as generally observed for compulsory voting), political bonds develop between the parties and the voters they focus on (note that voter 7 bonds with party *A*, although *B* frequently selects him too).⁴⁰

A comparison of *example 3* (VP - session 7) and *example 4* (VP - session 8) illustrates some of our results reported in earlier subsections. In *example 3* (*example 4*), party *A*’s overall average of selected voters is 5.27 (4.25) and that of party *B* is 4.57 (3.92), where policy offers overlap on average for 2.69 (0.94) voters. But the higher number of selected voters and overlaps in *example 3* than in *example 4* creates lower incentives for voters to participate, i.e. because their benefit-differentials are lower. This is what we observe in their decisions, as

³⁹ For example, *B* could select 5 voters and bump 4 of them into *A*’s policy offer. This gives a supporter group size of 4 voters for *A* and $BD = 0.9$ each and a supporter group size of 1 voter for *B* and $BD = 3.6$ for this voter. However, theoretically all of *A*’s voters would then abstain because they have $BD < 2$, yielding a victory for *B*, because her only voter participates. Hence, the observed political bonds for party *A* are not stable in theory.

⁴⁰ These bonds are theoretically not stable, because both *A* and *B* could select 4 of the separated voters with whom the opponent established a bond, but no other voters, and win the election.

reflected by substantially fewer ‘black’ than ‘gray’ rectangles for both policy offers in example 3. Note that the overall voting rate per electorate is lower in example 3 than in example 4 (38.1% vs. 52.6%). Moreover, we find no evidence for political bonds in either example (the only exception may be party *B* and voter 9 in the first half of rounds in example 4). Parties rarely focus on specific voters in their policy offers, but typically replace them across rounds. From the voters’ side, participation is too low for political bonds to arise in example 3, but seems high enough in example 4. The latter occurs despite the relatively high number of replacements in both policy offers. This supports our result 5 that the preference intensity matters for the turnout decisions, but not whether or not one has been frequently favored (more) by the same party. Figure 7 shows that typically voters immediately stop voting for a candidate when the pecuniary incentive gets too low. It is also important to note that the development of political bonds demands implicit coordination between both parties across rounds, i.e. segregation, because otherwise the voters’ incentives are not persistent or too low.

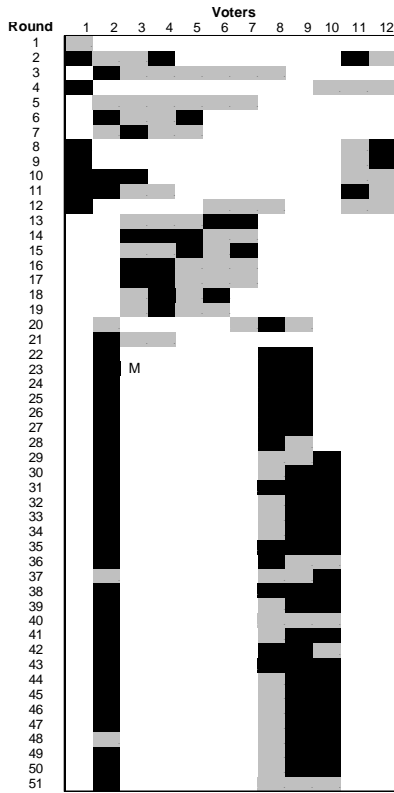
We have arrived at our final result:

RESULT 10: *With the opportunity to implicitly coordinate across legislative periods, some political bonds arise between parties and specific voters. Political bonds are rational in the sense that they require sufficient pecuniary rewards for both the party and voter involved.*

FIGURE .7: POLITICAL BONDS

Policy offer A

Policy offer B



Policy offer A

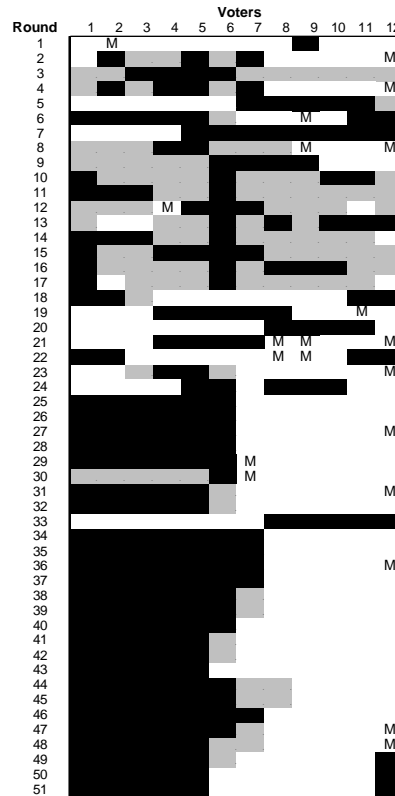


Policy offer B

Example 1:
VP - session 6

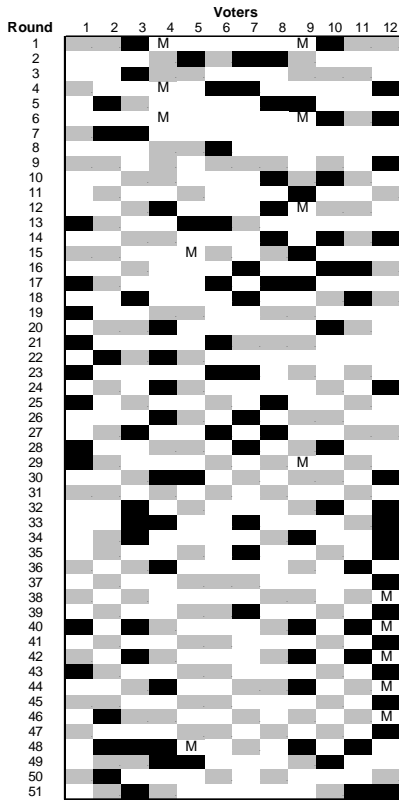


Policy offer A

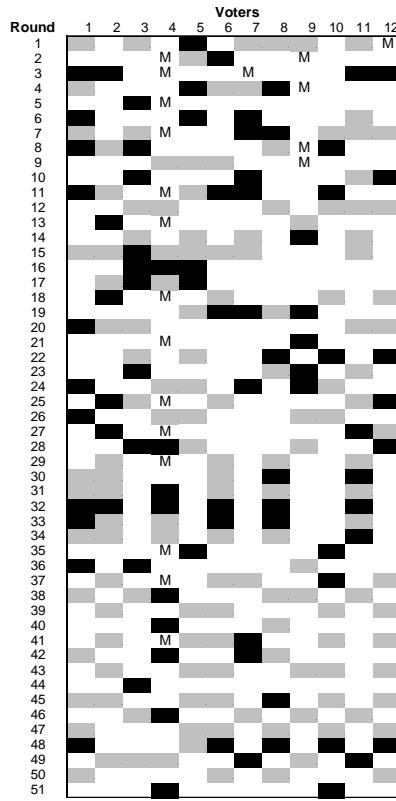


Policy offer B

Example 2:
CP - session 12

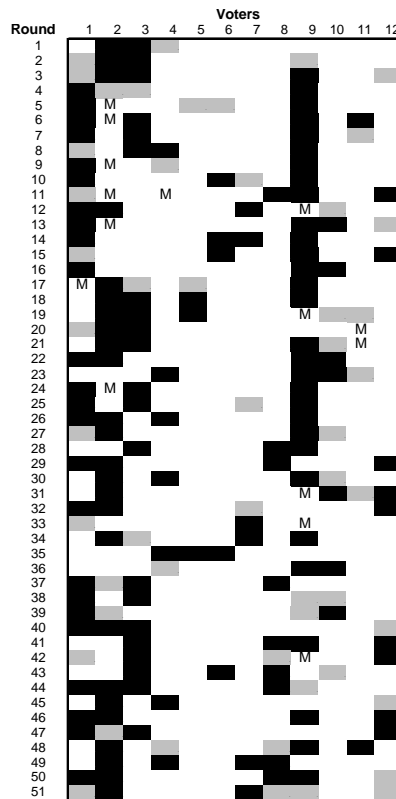
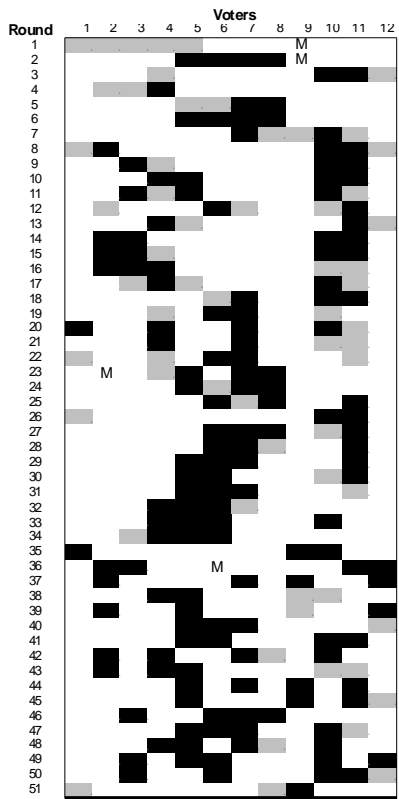


Policy offer *A*



Policy offer *B*

Example 3:
VP - session 7



Example 4:
VP - session 8

5 Conclusions

For compulsory voting, it has been shown theoretically that if political candidates have the opportunity to favor some voters in the budget spending at the expense of others (e.g. pork barrel), tactical redistribution produces inequality across people who are *a priori* alike (cf. Myerson 1993). This outcome originates from the candidates' need to remain unpredictable, because otherwise they can easily be defeated by the opponent. Our study departs from the previous literature in three ways. First, contrary to Myerson (1993) in our model there are typically voters who are indifferent between both candidates because neither offers them anything (or both offer them the same share of the budget). But even indifferent voters must go to the voting booth when voting is compulsory. This may cause them to make decisions based on motives for which they would not turn out if voting were voluntary. Second, in most elections around the world voting is a voluntary act. Consequently, our model also considers voluntary costly voting. Third, some political systems are dominated by short-lived politicians and others by long-lived parties. In our experiment this is implemented by keeping parties constant across legislative periods, while politicians are frequently replaced.

In this paper, we studied the effects of these variations theoretically and experimentally. Our data show that tactical redistribution does indeed produce inequality across voters. This not only holds for compulsory voting, but even more so for voluntary voting. The reason is that for the latter candidates must increase the voters' incentives, which means including fewer of them in the budget spending, in order to offset the voting costs and stimulate their participation.

When voting in compulsory, voters with a strict preference for one of the candidates vote sincerely in about 90% of the cases (as compared to our predictions that 100% do so). Moreover, our conjecture that indifferent voters will not simply withhold their vote (i.e. vote blank) is supported. In aggregate, they vote for either candidate in almost two thirds of the cases, affecting about 25% of the election outcomes. Their tendency to support more egalitarian policy offers, however, is only reflected in 5.4% of all outcomes.

For voluntary voting, voters who participate almost always vote sincerely. The preference intensity plays the most important role in the turnout decision: participation increases in the preference intensity, where an upward shift is observed at the benefit-differential 'two'. Moreover, we find decreasing participation in group size difference for both the minority and majority (as in Großer et al. 2005). Note that in our paper both the benefit-differentials and group-size differences are the outcome of endogenous policy making. Contrary to our

predictions, however, some participation is observed for benefit-differentials below two. Perhaps a quantal response equilibrium (McKelvey and Palfrey 1995), allowing voters to make ‘small’ mistakes, or group-utilitarianism (Feddersen and Sandroni 2004) may explain this behavior, but we did not pursue these alternatives.

Finally, when there is an opportunity to implicitly coordinate across legislative periods, we find evidence for political bonds between parties and voters. We observe sequences where specific parties and voters favor each other by inclusion in the budget spending and voting, respectively. This contradicts the parties’ maxim of being unpredictable, as expressed also in the mixed balanced strategies used in equilibrium. Because only aggregate election outcomes are provided, hence, specific voters’ favors are not observable, and because bonds also demand implicit coordination between both parties (i.e., segregation), we consider this a strong result.

Overall, our experimental results show that both candidates and voters make decisions that react to ‘economic’ incentives in a way that makes sense. Given the complexity of the experiment and the theory behind it, i.e. many different election games occur as the result of endogenous policy making, we have surprisingly clean results. In particular, our findings that compulsory voting induces more inequality among voters than voluntary voting and that political bonds develop in a rather anonymous setup, deserve, in our view, further empirical and theoretical research.

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