



UvA-DARE (Digital Academic Repository)

Political actors playing games: Theory and experiments

Kamm, A.

Publication date

2015

Document Version

Final published version

[Link to publication](#)

Citation for published version (APA):

Kamm, A. (2015). *Political actors playing games: Theory and experiments*. Tinbergen Institute.

General rights

It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations

If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: <https://uba.uva.nl/en/contact>, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.

Chapter 4

Plurality Voting versus Proportional Representation in the Citizen-Candidate Model: An Experiment¹

4.1 Introduction

How do political institutions influence political outcomes and the resulting policies? This question has received a lot of attention in both political science and economics and led to much theoretical and empirical investigation of this question. A particular focus in this literature lies on understanding the differences in political outcomes between proportional representation and plurality (or first-past-the-post) voting. Whereas the previous chapter addressed this issue theoretically, this chapter will look for empirical evidence of the effects of these institutions.

While observational data have greatly improved our understanding of the effect of electoral institutions on political behavior it is very hard to isolate clear causal relationships with observational data since electoral rules are not randomly assigned but are the result of the specific country characteristics that most likely also have a direct effect on outcomes. Furthermore, when testing theoretical predictions it is often necessary to know the values of the underlying model parameters in order to be able to derive a clear theoretical benchmark. This often makes it hard to properly test the performance of a model with field data.

Laboratory experiments do not suffer from these challenges to the identification of causal effects since the researcher controls all relevant parameters of the political system, which enables a true *ceteris paribus* variation of the electoral rule and allows for a clear benchmark when testing a model. These advantages of the experimental method have led to a sharp increase in the use of experiments in political science (Druckman et al., 2006) and the political economy literature (Palfrey, 2012). For instance, the conventional wisdom that proportional representation leads to higher turnout than a first-past-the-post system has been studied extensively in the lab (Blais et al. 2014, Herrera et al. 2014, Kartal 2014, Labbé St-Vincent 2014 and Schram and Sonnemans 1996b). The results seem to confirm

¹ This chapter is based on Kamm (2014).

the theoretical prediction that proportional representation increases turnout only when the election is not close.

A question that has been explored much less in the experimental literature is how electoral institutions influence candidate behavior. This chapter contributes to this literature by implementing the citizen-candidate paradigm in a controlled laboratory experiment, which makes it possible to simultaneously study a candidate's entry decision and the resulting polarization of policy positions. To this aim I vary in the experiment the electoral rule and compare proportional representation to plurality voting. Additionally, I replicate two previous experiments (Cadigan 2005 and Elbittar and Gomberg 2008) by varying the costs of running for office.

The results from the experiment show the theoretically predicted differences between plurality voting and proportional representation. Proportional representation leads to more entry than plurality if the costs of running for office are low but for high costs there is no difference in entry behavior. This implies that more entry under proportional representation is an equilibrium phenomenon and not just due to some heuristic. If it were based on a heuristic (such as entering to influence the policy, without regard for payoffs) then the difference would appear independent of costs. Furthermore, as expected, an increase in the costs of running for office reduces the number of entrants. Overall the comparative statics predictions for the experiment are therefore confirmed. Nevertheless, entry rates are across the board higher than predicted.

The remainder of the paper is structured as follows. First, in the next section I present the citizen-candidate model and introduce the experimental design and the hypothesis. Next, section 4.3 presents the experimental results and section 4.4 concludes and discusses some avenues for possible future work.

4.2 Experimental design

4.2.1 The general set-up

The citizen-candidate model (Besley and Coate 1997 and Osborne and Slivinsky 1996) is based on the spatial approach of modeling politics.² An electorate of citizens is distributed over a policy space where each citizen is described by her ideal point (i.e. position) in the policy space. The defining feature of the model –from which it derives its name– is that each citizen can run for office by paying a cost c . After simultaneous decisions on whether to run for office, all the candidates and their positions in the policy space are announced and an election takes place. This election determines a policy x^* that will be implemented as well as the allocation of office rents, denoted by b .³

The utility for a citizen with ideal point x_i is assumed to take the following form

² For a more detailed discussion of the citizen-candidate paradigm, see chapter 3.

³ As in chapter 3, one can, think of these office rents as compensation for government work or perks from office but also as an improvement in opportunities upon leaving office.

$$U = -f(|x^* - x_i|) + b * W - c * R,$$

where $f \geq 0$; $f' > 0$; W is a dummy variable that is equal to 1 if the candidate secures the office rents and R is a dummy variable that is equal to 1 if the candidate runs for election.

For the experiment the model has to be somewhat simplified since I cannot implement the infinite number of potential candidates implied by a continuous distribution of citizens. Instead I choose five fixed positions with one potential candidate each as shown in Figure 4.1. Furthermore, there is a continuum of uniformly distributed voters whose voting behavior is automated in the experiment since the focus is on candidate behavior. I assume voters vote sincerely for the candidate located closest to their positions.

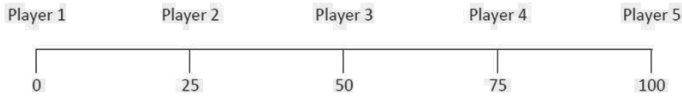


Figure 4.1: The players' positions

Notes. The figure shows the positions of the potential candidates.

The subject's payoff function is given by:⁴

$$100 - |x^* - x_i| + b \text{ (if winning the office rents)} - c \text{ (if running for office),}$$

where x^* denotes the policy implemented after the election, x_i is the subjects position in the policy space, b are the office rents and c are the costs of running for office. The constant is used to make losses unlikely so that I do not need to worry about loss aversion.

In the experiment I compare plurality voting and proportional representation. Under plurality voting the position of the candidate that receives the most votes is the implemented policy and this candidate receives all the office rents (ties are broken randomly). For modeling proportional representation I follow Hamlin and Hjortlund (2000) and assume that the implemented policy is the vote-weighted average of the candidates' positions. The office rents are awarded to the candidate that receives the most votes (ties are broken randomly).⁵ Should nobody enter, in both cases one candidate will randomly be chosen, whose position will be implemented as the policy. This candidate receives no office rents.

4.2.2 Treatments

The experiment consists of four between-subject treatments that are organized in a two-by-two structure as shown in Table 4.1. On the first dimension the costs of running for office

⁴ This implies that parties are not Downsian, i.e. completely office-motivated. For an experiment that uses purely office-motivated candidates see Bol et al. (2014).

⁵ This is obviously a stark simplification for the intricacies of proportional representation. See chapter 3 for a model that takes the coalition formation associated with proportional representation into account. I leave an experimental application of the model with coalition formation for future research.

are either low (8 points) or high (40 points). In the second dimension the voting rule is either plurality voting or proportional representation. The office rents b are 25 points and are awarded to the candidate that receives the most votes (ties broken randomly).

Varying the electoral rule enables me to investigate whether there is a difference in entry behavior when comparing proportional representation and plurality. Varying the cost of running for office achieves two things. First, it enables me to test the internal logic of the citizen-candidate model, i.e. whether a change in the parameters leads to the predicted change in behavior, and whether the performance of the model is different for distinct electoral rules. Second, it makes it possible to see whether a difference in entry behavior between the two electoral rules interacts with the costs of entry. This interaction is predicted for the parameters chosen, as discussed below. This can shed light on the question whether a difference in behavior is an equilibrium phenomenon or due to some non-equilibrium heuristic employed by the subjects. For instance, I expect higher entry under proportional representation only for low costs (see hypothesis (c) below). Should I observe higher entry for both costs levels this would suggest that the difference in entry is due a heuristic, f.i. entering to influence the policy, without regard for payoffs.

Table 4.1: Treatments

	Plurality	Proportional Representation
Low cost ($c=8$)	PL-low N=12	PR-low N=11
High cost ($c=40$)	PL-high N=12	PR-high N=12

Notes. Cell entries give the treatment acronym used throughout this paper, the number of independent observations ($N=\#$ groups) and the symmetric pure-strategy Nash equilibria (EQ) for each treatment.

4.2.3 Hypothesis

These treatments give rise to the Nash equilibrium predictions shown in Table 4.2 (I focus on symmetric Nash equilibria in pure strategies).⁶ Because three cells show multiple equilibria, I use a refinement based on the Quantal Response Equilibrium (QRE; McKelvey and Palfrey 1995). This refinement selects the Nash equilibrium to which the principal branch of the so-called multinomial logit correspondence converges.⁷ The predictions based on this refinement are indicated with an asterisk in Table 4.2 and imply three main treatment effects:

⁶ The reason for focusing on symmetric equilibria is that coordination on asymmetric equilibria is difficult given that positions are reassigned every round. Furthermore, only in treatment 3 (low costs and proportional representation) do asymmetric pure strategy equilibria exist where players 1, 3 and 4 or 2, 3 and 5 enter. In the experiment no group coordinated on this equilibrium. Equilibria were computed using Gambit 13.1.2, McKelvey et al. 2014.

⁷ QRE is a noisy best-response concept that has a better track record than Nash in explaining binary choice data in experiments (see Goeree and Holt, 2004). The principal branch is computed using Gambit (see fn. 6)

- (a) Cost effect: An increase in the costs of running for office leads to fewer players entering and less polarized entrants.
- (b) System effect: Under proportional representation (weakly) more players enter than under plurality voting.
- (c) Interaction effect: When costs are high the difference in entry between proportional representation and plurality voting is smaller than when costs are low.

These hypothesis follow straightforwardly from Table 4.2. Aside from these comparative statics predictions I will also investigate whether the subjects behave in line with the Nash equilibrium predictions and (in case of multiplicity) which of the equilibria are selected in the lab.

Table 4.2: Equilibrium predictions

	Plurality	Proportional Representation
Low cost ($c=8$)	50* OR 25 and 75	25 and 75* OR 0, 50 and 100
High cost ($c=40$)	50	50* OR 0 and 100

Notes. Cell entries give the symmetric pure-strategy Nash equilibria for each treatment. ‘*’ indicates the equilibrium selected by the principal branch of the QRE.

4.2.4 Experimental protocol

The experiment was conducted at the CREED laboratory at the University of Amsterdam in February 2014 and implemented using php/mysql.⁸ Participants were recruited using CREED’s subject database. In each of eight sessions, 25 or 30 subjects participated. Most of the 235 subjects in the experiment were undergraduate students of various disciplines.⁹ Earnings in the experiment are in ‘points’, which are converted to euros at the end of the experiment at an exchange rate of 100 points = 1€. The experiment lasted on average 75 minutes and the average earnings were 19€ (including a 7€ show-up fee).

After all subjects have arrived at the laboratory, they are randomly assigned to one of the computers. Once everyone is seated they are shown the instructions on their screen. After everyone has read these and the experimenter has privately answered questions, a summary of the instructions is distributed. This summary also contains a table that for all possible combination of entry decisions specifies what vote share each candidate receives and which policy will be implemented. Then, all subjects have to answer quiz questions that

⁸ For screenshots of the interface as well as the text of the instructions and the summary handout, see appendix 4.A.

⁹ 149 of the 233 participants that gave information on their field of study were students in business or economics.

test their understanding of the instructions. After everyone has successfully finished this quiz, the experiment starts. At the end of the session, all subjects answer a short questionnaire and are subsequently privately paid their earnings.

In each session the subjects participate in fifteen rounds of play and have to decide whether to run for office or not.¹⁰ Given the multiplicity of equilibria, learning and coordination are very important. To facilitate this, subjects stay in the same group of five subjects throughout the whole session (partners matching). Positions do change, however; in each round it is randomly determined which subject is located at which position in the policy space, i.e., positions are reallocated in each round.

The specific task in each round is presented as follows: subjects are informed about their position in the policy space. In all treatments I give the subjects the option to see the complete history in which they took part by clicking on a button.¹¹ Hence, they can see what they did in the past for different positions, what the other players' entry decision were and what the resulting implemented policy was. Furthermore, I provide them with a payoff calculator such that they can compute the payoffs they would get from different decisions by them and the other players, given their position in the current round.

After everyone has decided whether to enter, the computer casts the votes (according to a uniform distribution) and shows each subject the entry decision by all players, what vote share each candidate received, what policy is implemented, who received the office rents, and the payoff from the current round as well as the accumulated payoffs from past rounds.

4.3 Results

I start with presenting results for each treatment separately to investigate the degree to which the Nash equilibrium predictions are supported and, in case of multiple equilibria, which equilibrium was selected. Subsequently, I turn to the comparative statics predictions. An analysis of subject behavior at the individual level concludes the discussion of the results.

4.3.1 Within treatment analysis

Plurality voting with low costs

The theoretical prediction is that either only player 3 (the median player) enters (this is the equilibrium selected by the QRE refinement) or that the moderate players 2 and 4 enter. Figure 4.2 depicts per group the fraction of times that each position entered. This clearly shows that the one-candidate equilibrium is not selected (there are many entrants at other positions). Instead the moderate players have the highest entry rates. Using a Wilcoxon rank-sum test with the group average as unit of observation I find that the moderates have significantly higher entry rates than the median player ($p < 0.01$) and the median player has

¹⁰ I decided to not use a neutral frame but talk about 'candidates' and 'entry' to make it easier for subjects to understand the task.

¹¹ Subjects did not use this option very much. Overall, subjects only checked the history in 5% of the rounds.

a significantly higher entry rate than the extreme players ($p < 0.01$).¹² Figure 4.2 also clearly shows that the two-candidate equilibrium is not perfectly attained since the median player still enters quite often. In fact only 37% of the rounds (50% in the last 5 rounds) correspond perfectly to the two-candidate equilibrium (the one-candidate equilibrium is never observed). The likely reason for this over-entry by the median player is that given the low costs of entry the median player enters in the hope that one of the moderates will not enter which would make the median player the winner of the election (this only works in 5% of the elections).

The difference between the entry rates for all rounds and for the last five rounds indicates some learning. A Wilcoxon signed-rank test reveals that the median player is significantly less likely to enter in the last five rounds compared to the first five rounds ($p < 0.01$).¹³ Therefore behavior converges over time towards the two-candidate equilibrium.

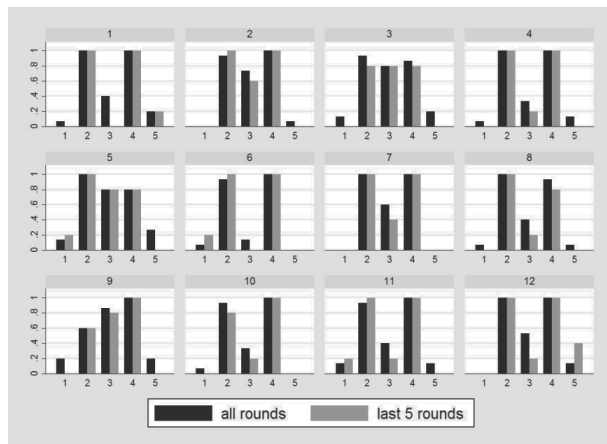


Figure 4.2: Entry under plurality voting with low costs

Notes. The figure shows the average entry rates by position (1 is position 0, 2 is position 25, 3 is position 50, 4 is position 75 and 5 is position 100) and group.

Regarding the election outcomes, I find that in 95% of the elections, one of the moderate candidates wins the election while in the remaining cases the median player does.¹⁴ This leads to an average policy of 49.0 and an expected distance of the policy to the median's preferences of 23.8 (very close to 25 predicted for the two-candidate equilibrium). Therefore, the election outcomes are in line with the Nash equilibria both in terms of the

¹² This result (as well as all other results for the within treatment analysis if not stated otherwise) are also significant at the 5%-level when restricting attention to the last five rounds (allowing for learning in earlier rounds).

¹³ For the extreme ($p=0.12$) and moderate ($p=0.62$) players no significant difference between entry rates in the first five and last five rounds is detected.

¹⁴ Given that for a risk-neutral player at the median position entry is only worthwhile if she wins more than 32% of the elections, the observed over-entry by the median player is not a best-response to the behavior observed in the experiment.

winner of the election and the policy outcomes, but do not support the equilibrium selected by the QRE refinement.

Plurality voting with high costs

For this parameter configuration the unique pure strategy equilibrium is for only the median player to enter. Figure 4.3 shows that this is predominantly the outcome for four of the nine groups (1,3,8 and 10). In three more groups (7, 9, 11) the median player has the highest entry rate. Nevertheless, behavior is quite heterogeneous across groups. Overall a Wilcoxon rank-sum test with the average per group as the unit of analysis shows that the median player has a significantly higher entry rate than the moderate players ($p=0.03$) and the extreme players have a significantly lower entry rate than the moderate players ($p<0.01$).

Again, behavior does not perfectly correspond to the prediction since only in 27% (for the last 5 rounds 36%) of the rounds the median player is the sole entrant.¹⁵ The reason for the deviation is that the moderates enter quite often. This could be attributed to a ‘joy of winning’. Given that the extreme players rarely enter, an entering moderate will win the election regularly (37%, see below), which might lead players to enter even though for the high entry costs it would be better to stay out and let the median player reap the office rents.

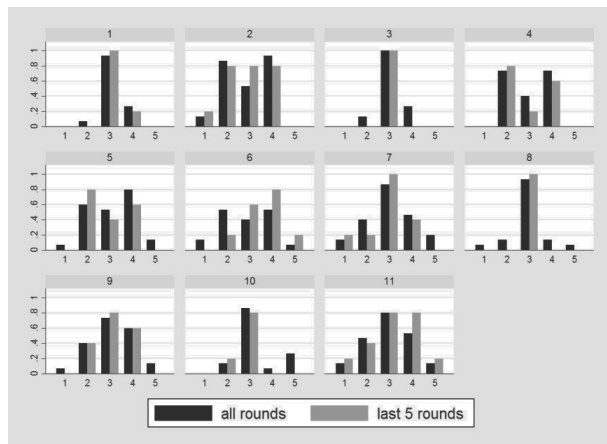


Figure 4.3: Entry under plurality voting with high costs

Notes. The figure shows the average entry rates by position (1 is position 0, 2 is position 25, 3 is position 50, 4 is position 75 and 5 is position 100) and group.

Regarding the election outcomes, I find that the average implemented policy is 51.1 and the observed distance to the median player’s position is 10.3. While the average policy is therefore close to the predicted value, its variance is larger than predicted. Furthermore, I

¹⁵ In this treatment no significant learning seems to occur since the entry rates do not significantly differ between the first five and last five rounds. The p-values of the Wilcoxon signed-rank test are $p=0.13$ for the extreme players, $p=0.14$ for the moderate players and $p=0.59$ for the median.

find that the median player wins only 59% of the elections (where the only symmetric pure strategy Nash equilibrium predicts that she will win all elections). In almost all of the remaining elections (37%) a moderate candidate wins.

Proportional representation with low costs

For this treatment the QRE refinement predicts a two-candidate equilibrium with the moderate players entering and the other Nash equilibrium consists of a three-candidate equilibrium where the extremes and the median player enter.¹⁶ Inspecting Figure 4.4 shows no support for the three-candidate equilibrium since in aggregate the extremes enter less than half the time. At the same time there is some (albeit quite weak) evidence for the two-candidate equilibrium since two groups (6 and 10) exhibit high entry rates by the moderates and low entry rates by the other players. In most other groups both the median and the moderate players enter frequently with the extremes having lower entry rates. A Wilcoxon rank-sum test shows that the moderates have significantly higher entry rates than the median player ($p < 0.01$) which is in line with the structure of the two candidate equilibrium. Overall 15% (for the last 5 rounds 27%) of the rounds exhibit entry by only the moderate players. The reason for this low rate of equilibrium play is the substantial entry by the median player. It is difficult to rationalize this behavior since the moderates have entry rates close to 100% which implies that the median player will not win the office rents and she has no influence on the implemented policy.

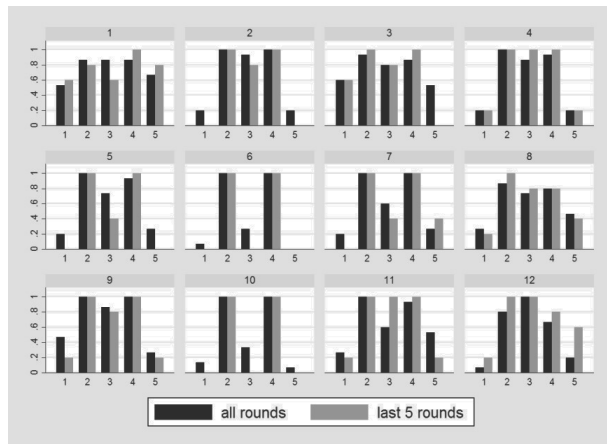


Figure 4.4: Entry under proportional representation with low costs

Notes. The figure shows the average entry rates by position (1 is position 0, 2 is position 25, 3 is position 50, 4 is position 75 and 5 is position 100) and group.

Analyzing learning over time by comparing behavior in the first five and last five rounds using a Wilcoxon signed-rank test shows that the extreme players significantly reduce their entry rates over time ($p = 0.01$) and that the median player enters weakly significantly ($p = 0.09$) less often in later rounds while the moderates significantly increase their entry

¹⁶ There are also two asymmetric equilibria where either players 1, 3 and 4 or players 2, 3, and 5 enter.

rates ($p=0.04$). These findings taken together imply that behavior may be converging towards the two-candidate equilibrium.

The election outcomes are broadly in line with the equilibrium selected by the QRE refinement since a moderate wins 86% of the elections while the median only wins 13% of the elections.¹⁷ Furthermore, the mean policy of 50.0 and the very low variance with a mean distance between the policy and the median of 2.0 are also in line with the theoretical prediction.

Proportional representation with high costs

In this treatment two pure strategy Nash equilibria exist. In the one selected by the refinement, only the median enters while in the other the two extreme players enter. Figure 4.5 clearly shows that the polarized equilibrium is not selected and five of the twelve groups (1,2,3,5,6,12) converge to a situation where the median player has the highest entry rates. Overall the entry rates of the median player are significantly higher than of the moderates ($p=0.04$) but in the last five rounds this difference is only weakly significant ($p=0.09$). In 25% of the rounds (30% for the last 5 rounds) behavior corresponds to the one-candidate equilibrium and most of the off-equilibrium behavior is due to very low entry rates across the board which might be due to the high entry costs combined with the complexity of the situation.

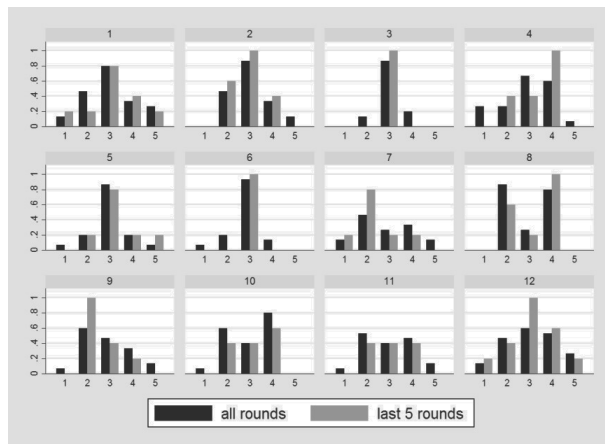


Figure 4.5: Entry under proportional representation with high costs

Notes. The figure shows the average entry rates by position (1 is position 0, 2 is position 25, 3 is position 50, 4 is position 75 and 5 is position 100) and group.

Investigating behavior over time I find that the moderates and the median players do not significantly change their behavior going from the first five to the last five rounds ($p=0.17$ for moderates and $p=0.84$ for the median player) while the extreme players reduce their

¹⁷ This winning rate is clearly below the cut-off of winning 32% of the elections that would make entry beneficial for a median player.

entry rates over time ($p=0.02$). The average policy of 49.4 is in line with the Nash equilibrium but the observed distance between implemented policy and the median is 9.4 which is larger than predicted. Furthermore the median player wins only 52% of the elections while a moderate player wins 42% of the elections.

Overall picture

Combining the results across treatments yields two conclusions. First, over time behavior converges towards equilibrium, which is an indication of learning. This is not necessarily the equilibrium selected by the refinement, however. Second, entry rates are substantially higher than theoretically predicted. This is a common finding in experiments on entry decisions, such as market entry games (Fischbacher and Thöni, 2008) or contest games (Cason et al., 2010), and was also found in previous experiments on the citizen-candidate model in a first-past-the-post setting (Cadigan, 2004, Elbittar and Gomberg, 2008).¹⁸ It is not my aim in this chapter to explain over entry per se. Instead, I now turn to the treatment effects observed in my data.

4.3.2 Comparative statics across treatments

The cost effect (hypothesis a) predicts that entry rates with high costs are lower than with low costs. Table 4.3 shows that this is the case in the experiment and a Wilcoxon rank-sum test shows that this difference is highly significant ($p<0.01$).¹⁹ The second part of the hypothesis predicts more polarized outcomes for low costs. Table 4.3 shows that this is indeed the case with the difference being significant using a Wilcoxon rank-sum test ($p\text{-value}=0.01$ for both proportional representation and plurality). Next, the system effect (hypothesis b) predicts that proportional representation leads to (weakly) higher entry while the interaction effect (hypothesis c) posits that the effect is positive for low costs and zero for high costs. Both predictions are supported since there is a significant difference for low costs ($p<0.01$) and no significant difference for high costs ($p=0.39$).²⁰

Table 4.3: Average number and polarization of entrants by treatment

	aver. number of entrants		Polarization	
	All rounds	Last 5 rounds	All rounds	Last 5 rounds
PL-low	2.6	2.4	22.0	22.5
PL-high	1.8	1.6	14.6	11.9
PR-low	3.2	3.0	23.3	23.0
PR-high	1.7	1.6	16.4	14.4

Notes. This table shows average number of entrants and their polarization across treatments. Polarization is defined as the average distance of an entrant's positions to the median voter's location.

¹⁸ The two most prominent explanations for this finding of over entry are risk attitudes and joy of winning. I did not measure risk-attitudes in this experiment but given that in treatment 3 (PR-low) the median player enters even though the entry rates of the moderates are close to 100%, risk cannot be the whole story (which is in line with Fischbacher and Thöni (2008) who find that risk-attitudes do not predict individual behavior in their market-entry experiment).

¹⁹ This reproduces the finding in Cadigan (2004) who also found less entry for higher costs of entry.

²⁰ There is no significant difference in the polarization of entry across electoral rules for either cost level.

The Nash equilibria predict for the distinct positions that increasing the entry costs under plurality rule has no effect on the extremes' entry decisions (since their entry is not part of the equilibrium under either cost of entry), it decreases the entry by moderates (since with high costs their entry is off-equilibrium) and it increases the entry for the median player (since with high costs her entering is the unique equilibrium). All three predictions are confirmed since the p-values are 0.41 for the extremes, $p < 0.01$ for the moderates and $p = 0.04$ for the median.

In equilibrium, increasing costs under proportional representation should decrease the entry for the moderates since their entry is not part of an equilibrium with high costs. I expect no effect for the extremes since the equilibrium in the high cost case where they would enter is quite unstable (and not selected by the refinement). For the median I would then expect more entry under high costs since the others are entering less. While for the moderates ($p < 0.01$) the expectations are confirmed for the extremes and for the median I do not find the predicted effect. For the extremes I find a significant reduction in entry ($p < 0.01$) when costs increase and for the median the sign of the effect is opposite to the prediction, though the effect is insignificant ($p = 0.37$). A reason might be that there is a general tendency to reduce entry when costs increase and this dominates the effect of the change in equilibrium.

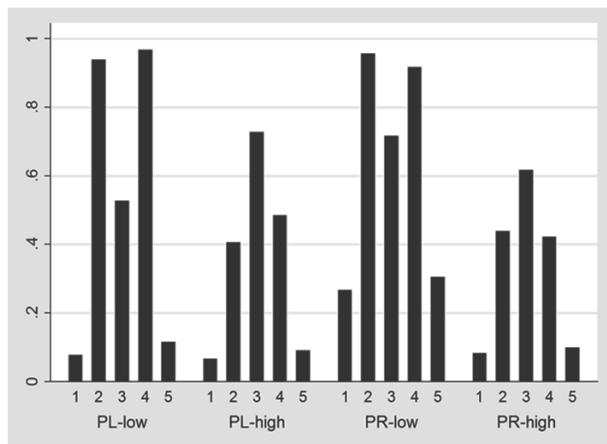


Figure 4.6: Entry by position and treatment

Notes. The figure shows the entry rates by position (1 is position 0, 2 is position 25, 3 is position 50, 4 is position 75 and 5 is position 100) averaged over rounds and groups for each treatment.

Comparing entry rates across electoral rules I find that the higher entry rates under proportional representation compared to plurality rule when the costs of entry are low are driven by an increase in the entry rates of the extreme ($p < 0.01$) and median ($p = 0.07$) while there is no difference for the moderate players ($p = 0.41$). When entry costs are higher there is no difference across electoral rule in the entry rate for any of the positions. The p-values are 0.69 for the extremes, 0.94 for the moderates and 0.25 for the median.

In summary, my data provide support for the three main hypothesis. With high costs of running for office, entry is lower and entrants are less polarized (cost effect), and proportional representation leads to more entry (system effect) but only if costs are low (interaction effect).

4.3.3 Individual level analysis

The analysis at the individual level focuses on two questions. First, are the observed patterns of behavior at the aggregate level also present at the individual level? Second, how do subjects learn in the game and what can explain that behavior evolves towards equilibrium over time?

To investigate the treatments effect at the individual level, Table 4.4 presents the results from logit regressions by voters' positions with standard errors clustered at the group level. As independent variables I include treatment dummies and to test for learning over time I also include the round a decision was made as independent variable.

Table 4.4: Logit regressions for entry decision by position

	0 or 100	25 or 75	50
PL-high	-.02	-.65 ^{***}	.18 ^{**}
PR-low	.18 ^{***}	-.06	.17 ^{**}
PR-high	-.01	-.65 ^{***}	.08
Round	-.01 ^{***}	-.01 ^{**}	-.01 ^{***}

Notes. The table shows the marginal effects of treatment dummies in a logit regression with the entry decision as the dependent variable. 'Round' denotes the round a decision was made in. Standard errors are clustered at the group level. * (**, ***) denotes that the coefficient is significantly different from zero at the 10% (5%; 1%)-level.

As at the aggregate level, in line with learning I find that for all positions entry significantly decreases over time. For the players at the extremes of the policy space I find that high costs decrease entry for both electoral rules but this effect is only significant for proportional representation. The insignificant difference for plurality voting is in line with theory since under both cost levels extreme players are predicted to stay out. Furthermore, for low costs proportional representation leads to more entry which can be explained by entry being a possible equilibrium choice under proportional representation while it is not so for plurality voting.

For moderate players higher costs significantly reduce entry but the electoral rule has no significant effect. This is in line with the results at the aggregate level that the effect of the electoral rule is driven by the extremes' and median's behavior. For the median player I find in line with the results at the aggregate level that proportional representation significantly increases entry for low costs but not for high costs ($p= 0.25$). Furthermore, costs of entry matter for plurality voting ($p= 0.04$) but not for proportional representation ($p= 0.29$) which was not predicted by theory. Overall, the results at the individual level are in line with the result found in the analysis at the aggregate level.

To further analyze the learning process I employ logit regressions with standard errors clustered at the group level. As independent variables I include a subject's position in a given round ('extreme' if the position is 0 or 100 and 'moderate' if the position is 25 or 75) and the round of a decision. Furthermore, to capture myopic best-response behavior I include 'BR', a dummy variable that is equal to one if entry is a best response to the previous round's choices, and to capture learning by imitation I include 'Copy', a dummy variable that is equal to one if the player at this position entered last round. Table 4.5 shows the resulting marginal effects.

Table 4.5: Logit regressions for entry decision by treatment

	PL-low	PL-high	PR-low	PR-high
Extreme	-.48 ^{***}	-.50 ^{**}	-.28 ^{***}	-.38 ^{***}
Moderate	.48 ^{***}	-.15	.25 ^{***}	-.09
Round	-.02 ^{***}	-.01 ^{**}	-.01 ^{**}	-.01 ^{**}
BR	.17 ^{***}	.11 ^{**}	.13 [*]	.12 ^{**}
Copy	.20 [*]	.15 ^{**}	.25 ^{***}	.15 ^{**}

Notes. The table shows the marginal effects of a logit regression with the entry decision as the dependent variable. 'Extreme' ('Moderate') denotes a subject's position of 0 or 100 (25 or 75), 'BR' is equal to one if entry is a best-response to last rounds behavior, 'Round' denotes the round a decision was made in and 'Copy' is equal to one if the player at this position entered in the previous round. Standard errors are clustered at the group level. * (**, ***) denotes that the coefficient is significantly different from zero at the 10% (5%; 1%)-level.

In all treatments entry becomes less likely over time, which is in line with the observed convergence of behavior to equilibrium and the initial over-entry relative to equilibrium entry rates. Furthermore, in all treatments entry being a best response to previous rounds' behavior increases the probability of entry by about 13 percentage points and this difference is (marginally) significant. Also the variable capturing learning by imitation leads to an increase in the entry probability of around 20 percentage points and this effect is (marginally) significant.

The results at the individual level for the differences across positions are again in line with what I observed at the aggregate level. Both for plurality voting and proportional representation low costs lead to significantly higher entry rates for the moderates than for the median while the extreme players are least likely to enter. This is in line with the equilibrium predictions since in both cases there exists an equilibrium where only the moderate players enter. For the treatments with high costs I find that the median player has the highest entry rates but the difference with the moderates' entry rates is not significant. The sign of the effect is in line with the predictions; the non-significance of the result likely stems from the observed over-entry. Again, the extremes have significantly the lowest entry rates when costs are high.

4.4 Conclusions

In this chapter I implement the citizen-candidate model in the laboratory with the aim of investigating how candidate entry behavior differs between proportional representation and plurality voting. I find that (as predicted by the model) when entry costs are low, proportional representation increases entry compared to plurality rule. As also predicted there is no such effect for high costs. This indicates that the higher entry under proportional representation with low costs can be attributed to strategic play in line with equilibrium as opposed to using some simple heuristic like entering to influence the policy. Furthermore, I find support for the prediction of a cost effect since for higher entry costs fewer candidates enter and their positions are less polarized. Finally, I replicate the well-known finding of over-entry compared to Nash equilibrium predictions.

Overall, the experimental results are in line with the citizen-candidate model (notwithstanding the substantial over-entry), which supports the usefulness of the citizen-candidate approach. Obviously, experiments can only be one part of an empirical evaluation of the predictive power of the paradigm. But, given the advantages of laboratory control and the difficulties involved with testing the model in the field (especially with a multiplicity of equilibria), experiments can play an important role by offering a test bed for different institutional environments. In this spirit this paper offers the first experimental analysis of proportional representation in the citizen-candidate paradigm. Nevertheless, many other aspects of the citizen-candidate paradigm remain to be explored. Future experimental work should try to investigate the robustness of the model's predictions to changes in the underlying assumptions, f.i. with respect to the available information²¹ or the institutional framework. Given the results from the theoretical analysis of proportional representation with coalition formation presented in chapter 3 a natural next step would be to implement the model of proportional representation with coalitions in the current experimental design and to investigate which of the rich pattern of comparative statics predicted in chapter 3 is observed when human subjects participate in such a laboratory experiment.

²¹ A good starting point are the results found by Großer and Palfrey (2014).

Appendix 4.A: Instructions and screenshots of the experiment

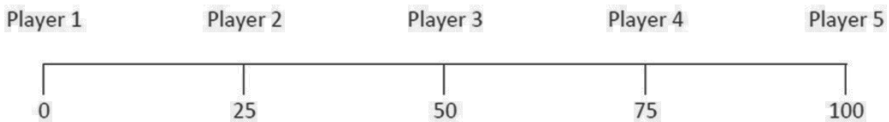
In this appendix, I provide the instructions that the subjects read on their computer monitors. I also give the summary of the instructions that was handed out to subjects after they had read these on-screen instructions. Finally, I provide screenshots of the user interface of the experiment.

4.A.1 Instructions²²

Welcome to this experiment on decision-making. Please carefully read the following instructions. If you have any questions, please raise your hand, and we will come to your table to answer your question in private.

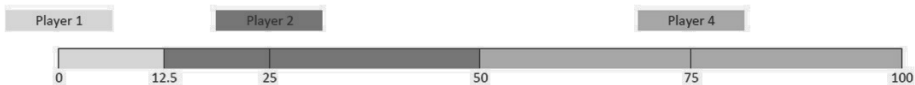
In this experiment you will earn points. How many points you earn depends on your choices and the choices of the other participants in this experiment as well as potentially chance. At the end of the experiment, your earnings in points will be exchanged for money at a rate of two eurocent for each point. This means that for each 50 points you earn, you will receive 1 euro. Your earnings will be paid privately to you in cash at the end of the experiment.

In this experiment you will play the role of a potential candidate that has to decide whether to run in an election or not. Your goal is to influence the implemented policy in your favor and to get as many votes as possible. Specifically in each election there are five types of players (i.e. potential candidates) that are located along the line from 0 to 100. You can see where they are located in the figure below.



The share of votes that a candidate receives depends on the entry decision by the other players. A candidate receives the part of the line that is closest to him. Below you see a few examples that show what this means.

Example I

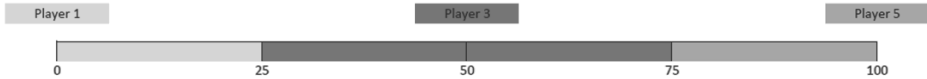


Players 1, 2 and 4 enter in this situation. The vote share for candidate 1 is given by the proportion of the line that is closest to him. Everything to the left of the midpoint between

²² I provide here the instructions used for the treatment Plurality-low. The instructions for other treatments are analogous and available upon request.

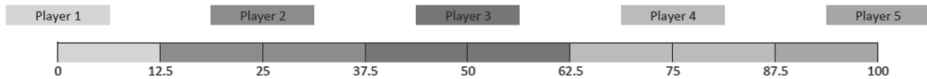
her position (0) and player 2's position (25) is closest to candidate 1. This implies that her vote share is given by 12.5% (the length of the yellow area). For candidate 2, we can note that everything to the right of the 12.5 (the midpoint to candidate 1) and her own position is closest to him. Furthermore everything between her position and 50 (the midpoint between her and candidate 4's position) is closest to him. This implies a total vote share of 37.5% (12.5% from the left and 25% from the right of her position, the red area). Finally candidate 4's vote share is given by the remaining 50% (the green area).

Example II



In this case players 1, 3 and 5 enter. Candidate 1 receives a vote share of 25% since the midpoint between her own and candidate 3's position is at 25 (the yellow area). Also candidate 5 receives 25% of the votes since the difference between 100 (his own position) and 75 (the midpoint between candidate 3 and 5's positions) is 25. Therefore candidate 3 receives the remaining 50% of the votes.

Example III



Now we consider a situation where everyone enters. Candidate 1 receives 12.5% of the votes since the midpoint between her own and candidate 2's position is 12.5. Since in this situation candidates 1 and 5 are completely symmetric candidate 5's vote share is also 12.5%. Candidate 2's vote share (the length of the blue area) is given by the difference between 25 and 12.5 (the midpoint to candidate 1) and the difference of 37.5 (the midpoint between candidate 2 and 3's position) and 25. The vote share is therefore 25%. Since also candidate 2 and 4 are symmetric candidate 4's vote share is 25% as well. Finally candidate 3 receives the remaining 25% of the votes.

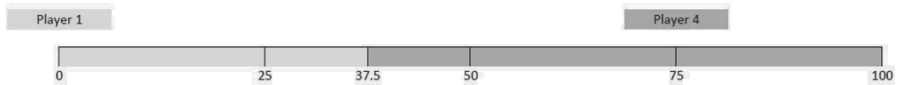
Example IV



Compared to the situation in example III player 2 is now not entering. We can note that this does not influence the vote shares for candidates 4 and 5. This is easiest seen by realizing that the length of the orange and green area does not change between example 3 and 4. The reason is that only the closest entrant to your position, i.e. candidate 3 and 5 (4) for player 4 (5) matter for the size of the vote share. Player 1's vote share does change since she now gets some of the votes that candidate 2 used to get. she now receives 25% of the votes

(doubling her vote share) since the midpoint between her position and the one of the closest entrant (candidate 3) is 25. Also candidate 3 gets some of the votes that candidate 2 used to get and now has a vote share of 37.5%.

Example V

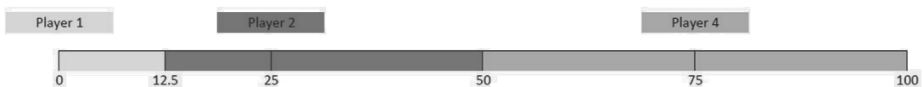


Finally, let consider a situation where only two candidates enter. Player 1's vote share is equal to the length of the yellow area and is given by the distance between 0 (his own position) and the midpoint between 0 and candidate 4's position of 75. This means that she receives 37.5% of the votes and candidate 4 receives the remaining 62.5% of the votes.

On the back of the handout with the summary of the instructions you can find a table that gives you the vote share for all possible situations that can arise in this experiment.

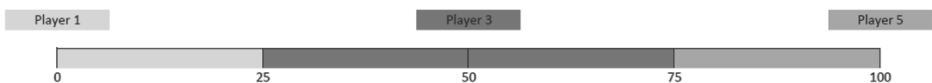
Depending on the vote shares that the different candidates received a policy (which is a point on the line) will be implemented. The implemented policy will be equal to the position of the candidate that received the highest vote share. Should there be multiple candidates with the largest vote share one candidate's position will be randomly picked to be the winner and her position will be the implemented policy. Should no player enter one player's position will randomly be picked to be the implemented policy. Below you can see (with the examples from the previous page) how it works.

Example I



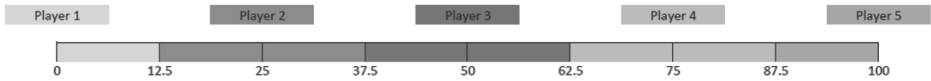
Player 4 received 50% of the votes and therefore has the highest vote share of all candidates. Player 4's position of 75 will therefore be the implemented policy.

Example II



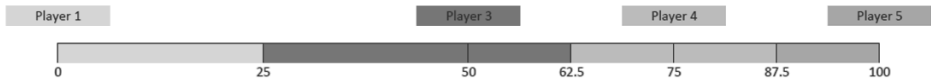
The implemented policy is 50 since player 3's vote share of 50% is the highest any candidate received in this election.

Example III



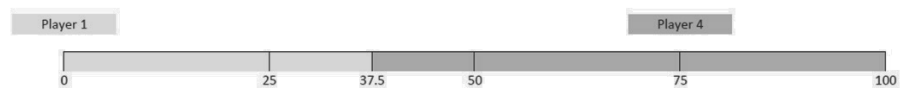
Players 2, 3 and 4 all received 25% of the votes. We are therefore in a situation where chance decide which candidate's position. With equal probability the implemented policy will be 25, 50 and 75.

Example IV



Player 3 received 37.5% of the votes which is more than any other candidate received. So the implemented policy will be 50.

Example V



Player 4 received an absolute majority and therefore she has won the election and her position of 75 will be implemented.

Your earnings (in points) in a given election are given by the following equation:

100 – distance between the implemented policy and your position – 8 (if you decided to run in this round) +25 (if you received the highest vote share in this round)

The costs of eight points you only have to pay if you decide to enter the election and the bonus of 25 points you earn if you receive the highest vote share in the election. Should there be multiple candidates with the highest vote share one will be randomly picked to receive the bonus. Furthermore if nobody enters nobody will receive the bonus. Below you find a calculator tool (which will also be available during the experiment) which gives you the opportunity to compute the payoff for a given player type for a given configuration of players' behavior.

Here you can compute the (expected) earnings for each possible combination of entry decisions.

Player 1 (choose one) ▼ Player 2 (choose one) ▼ Player 3 (choose one) ▼ Player 4 (choose one) ▼ Player 5 (choose one) ▼

The experiment will last for 15 rounds each consisting of a single election. For all rounds you will stay in the same group, meaning that the players in your group do not change during the experiment. In each round it will be randomly determined which type of player

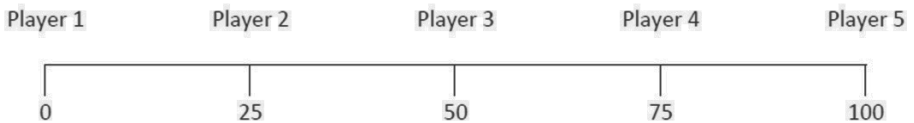
each of the group members is (i.e. at which position they are located) but there will always be one player of each type.

After all 15 rounds have been played your earnings will be added up and exchanged at a rate of two eurocent for each point.

4.A.2 Printed summary of instructions

Summary Instructions

- The experiment lasts for 15 rounds
- You will stay in the same group of five players throughout all 15 rounds
- In each round you will be randomly assigned to one of the five positions shown in the figure below. In your group there will always be one player at each of the five positions.

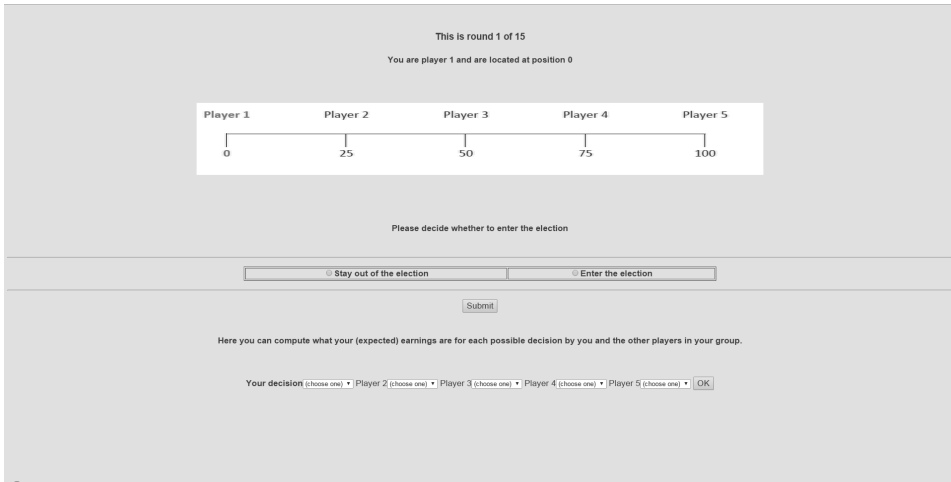


- Your choice is whether to pay the entry costs of 8 points to run in the election or to stay out of the election
- Based on the decision of all players in your group the computer will cast votes for each of the candidates running for election. On the back of this sheet you can see what the vote shares for the different players will be for all possible configuration of decisions.
- Based on the vote share a policy will be implemented in a given round. The policy is equal to the position of the candidate that receives the highest vote share. Ties are broken randomly.
- Furthermore the player that receives the highest vote share receives a bonus of 25 points. Ties are again randomly broken. If nobody enters no player receives the bonus.
- Your payoff per round is
100 – distance between the implemented policy and your position – 8 (if you decided to run in this round) +25 (if you received the highest vote share in this round)
- Your final payoff is 1 Euro for every 50 points.

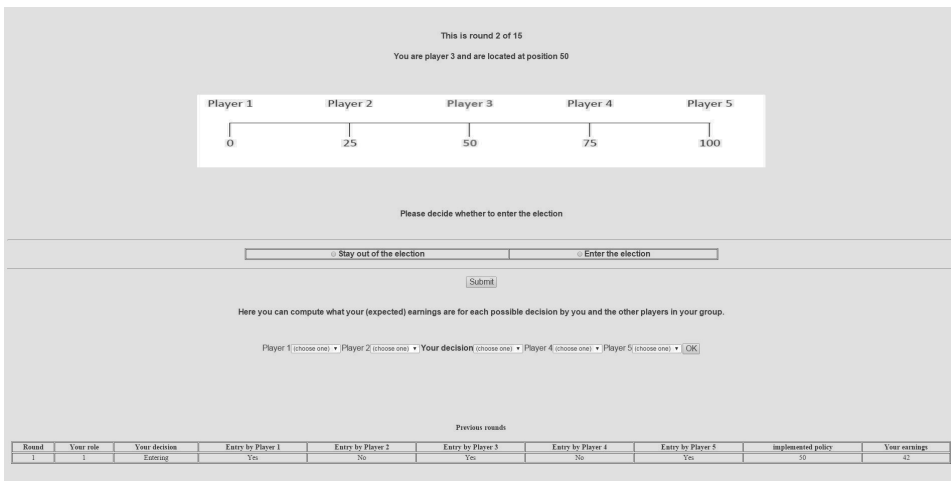
PX denotes player X and VX the vote share she receives. Yes (No) denotes that this player is (not) entering.

P1	P2	P3	P4	P5		V1	V2	V3	V4	V5
Yes	Yes	Yes	Yes	Yes		12.5%	25.0%	25.0%	25.0%	12.5%
Yes	Yes	Yes	Yes	No		12.5%	25.0%	25.0%	37.5%	0.0%
Yes	Yes	Yes	No	Yes		12.5%	25.0%	37.5%	0.0%	25.0%
Yes	Yes	Yes	No	No		12.5%	25.0%	62.5%	0.0%	0.0%
Yes	Yes	No	Yes	Yes		12.5%	37.5%	0.0%	37.5%	12.5%
Yes	Yes	No	Yes	No		12.5%	37.5%	0.0%	50.0%	0.0%
Yes	Yes	No	No	Yes		12.5%	50.0%	0.0%	0.0%	37.5%
Yes	Yes	No	No	No		12.5%	87.5%	0.0%	0.0%	0.0%
Yes	No	Yes	Yes	Yes		25.0%	0.0%	37.5%	25.0%	12.5%
Yes	No	Yes	Yes	No		25.0%	0.0%	37.5%	37.5%	0.0%
Yes	No	Yes	No	Yes		25.0%	0.0%	50.0%	0.0%	25.0%
Yes	No	Yes	No	No		25.0%	0.0%	75.0%	0.0%	0.0%
Yes	No	No	Yes	Yes		37.5%	0.0%	0.0%	50.0%	12.5%
Yes	No	No	Yes	No		37.5%	0.0%	0.0%	62.5%	0.0%
Yes	No	No	No	Yes		50.0%	0.0%	0.0%	0.0%	50.0%
Yes	No	No	No	No		100.0%	0.0%	0.0%	0.0%	0.0%
No	Yes	Yes	Yes	Yes		0.0%	37.5%	25.0%	25.0%	12.5%
No	Yes	Yes	Yes	No		0.0%	37.5%	25.0%	37.5%	0.0%
No	Yes	Yes	No	Yes		0.0%	37.5%	37.5%	0.0%	25.0%
No	Yes	Yes	No	No		0.0%	37.5%	62.5%	0.0%	0.0%
No	Yes	No	Yes	Yes		0.0%	50.0%	0.0%	37.5%	12.5%
No	Yes	No	Yes	No		0.0%	50.0%	0.0%	50.0%	0.0%
No	Yes	No	No	Yes		0.0%	62.5%	0.0%	0.0%	37.5%
No	Yes	No	No	No		0.0%	100.0%	0.0%	0.0%	0.0%
No	No	Yes	Yes	Yes		0.0%	0.0%	62.5%	25.0%	12.5%
No	No	Yes	Yes	No		0.0%	0.0%	62.5%	37.5%	0.0%
No	No	Yes	No	Yes		0.0%	0.0%	75.0%	0.0%	25.0%
No	No	Yes	No	No		0.0%	0.0%	100.0%	0.0%	0.0%
No	No	No	Yes	Yes		0.0%	0.0%	0.0%	87.5%	12.5%
No	No	No	Yes	No		0.0%	0.0%	0.0%	100.0%	0.0%
No	No	No	No	Yes		0.0%	0.0%	0.0%	0.0%	100.0%
No	No	No	No	No		One player's position is randomly implemented				

4.A.3 Screenshots of the interface



Notes. The screen subjects saw when making a decision.

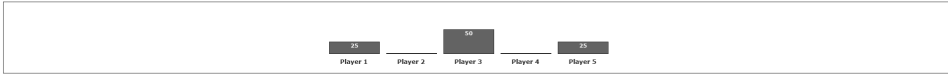


Notes. The screen subjects saw when making a decision; the table at the bottom of the screen shows an example of the history box.

Election outcome in round 1

In this round you decided to enter the election

The distribution of votes received by the players in this round is:



This voting pattern led to an implemented policy located at 50. Furthermore player 3 won the election and earned the bonus.

Given that your position is 0 and you decided to enter the election, your earnings for this round are $100 - 50 - 8 = 42$ and your accumulated earnings are 134

Click [here](#) to go to the next round.

Notes. The screen subjects saw after an election was over.