Citizen Candidates in a Lab*

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Abstract

We present results of a lab experimental study of candidate entry in a citizen-candidate environment under plurality and run-off electoral systems, varying both entry costs and ideal points of the potential candidates. The comparative predictions of the citizen-candidate model are shown to hold; however, subjects exhibit substantial degree of over-entry from electorally disadvantaged positions.

Keywords: Citizen Candidates, Electoral Systems, Laboratory Experiment, Quantal Response.

JEL Codes: D72, C92, D70

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1 Introduction

The citizen-candidate model (Besley and Coate, 1997; Osborne and Slivinski, 1996) is one of the few established approaches to endogenizing the number and the identity of political candidates and proposals in elections. In this environment, a society of agents with publicly known preferences in some policy space has to decide on a common policy. Crucially, only alternatives explicitly proposed (nominated) by somebody shall be presented to voters and the nomination decision is strategic: citizens choose to nominate themselves, based on their predicted impact on the policy outcome, the cost of running for office and benefits accruing to office-holders. Once the set of candidates is fixed, the entire society votes and the elected candidate implements his/her favorite policy (as the individual preferences are public, candidates cannot commit to implementing any policy at variance with their ideal).

Unfortunately, the citizen-candidate model is not easy to test using available electoral data, as it heavily relies on exact public knowledge of the the policy preferences of potential candidates, even those who may never choose to run in actual election. Predictions of the model are, furthermore, dependent on parameters (such as the cost of running for office and the benefits of holding it) that might be difficult to measure empirically and even harder to exogenously vary in real political systems. A direct test of the model's prediction for the differential impact of different electoral systems is further complicated by the relative rarity of electoral system changes. The substantial multiplicity of equilibria for many parameter values in the model makes designing a satisfactory empirical test even harder. Many of the problems with testing the citizen-candidate model in the field can be overcome in an experimental lab. Thus, an experimentalist would have no difficulty varying office-holder benefits or nomination costs, changing the distribution of citizens in the policy space or even the electoral system. The hardest challenge is presented by the model's inherent equilibrium multiplicity for most parameter values. Still, in the lab it is also possible to design environments that minimize this problem, allowing explicit tests of the model predictions.

Surprisingly, in the quarter century since the publication of the original theoretical papers there has been little work on trying to test the model experimentally. The early experimental literature on candidate behavior in elections has concentrated on candidate platform choice.[1] There has been comparatively little research on candidate entry. In fact, T. Palfrey (2020) in his survey of the field, noted that as of that moment he was aware of only two experimental studies concentrating on entry by policy-motivated candidates in this framework; only a few studies have attempted to narrow this gap in the literature since.

Though an important advance, for being the first to attempt a laboratory testing of the model, Cadigan (2005) is somewhat limited in scope. It reports results of 2 treatments of an adaptation of the citizen-candidate model that are distinguished by the value of the cost of nomination parameter. In the high-cost treatment the unique predicted equilibrium involves a single candidate entering at the median of the voter distribution, while the low-cost treatment has, in addition to the median-candidate equilibrium, a two-candidate equilibrium with distinct policy proposals. Another experimental test of the citizen-candidate environment that we are aware of has been conducted by ourselves (Elbittar and Gomberg, 2009). Unfortunately, the equilibrium multiplicity turned out to be a particularly serious problem in that study, resulting in major coordination problems among the subjects. More recently, Kamm (2014) adds theoretical and experimental analysis of a citizen-candidate with proportional representation (confirming the tendency of this electoral system to lead to greater candidate polarization). In a similar spirit Bol et al. (2019) consider an environment where strategic entry decision is followed by a policy choice and compare a plurality and a proportional representation environment in that setting. Großer and T. R. Palfrey (2017) report the results of a laboratory study of a version of citizen-candidate environment with private information about candidate policy preferences. What remains missing from the literature is direct experimental evidence for the predictions of a standard citizen-candidate model, such as presented in Osborne and Slivinsky (1996). This is the gap which we attempt to fill in in

[1]See, for instance, the early work by Mckelvey and Ordeshook (1982) on two-candidate competition in environments with and without Condorcet winners, or a study by Aragones and T. R. Palfrey (2004) on policy platform choice by candidates of different quality.

this paper.

Our objective in this work was to design an environment, which avoids the problem of coordinating on a single equilibrium, while varying both cost parameters and electoral systems (as in Osborne and Slivinski (1996) we consider plurality and two-round runoffs).[2] In particular, the model predicts that and under the run-off electoral system there would be stronger pull for entry exclusively by politicians closest to the median of the voter ideal point distributions. The same pull to the center is implied by high candidate entry cost for both electoral systems. It is these implications of the model that we would like to test.

As it was done in some of the earlier work[3], we impose sincere voting, in order to concentrate on individual entry decisions by potential candidates. At the same time, we want to stay close to the large-electorate spatial model of Osborne and Slivinski (1996). To do this, while keeping the number of participants in an experimental game small, we decouple the potential candidates (whom we shall call "politicians") from the entire society of citizens. Only politicians may choose to run for office, while the set of voters (implemented in our experiments by a computer) is larger. In practice, not every voter would have name recognition and/or funding lined up to make him a viable candidate in a given election. Furthermore, only politicians are under a sufficient public scrutiny to make the assumption that their political views are known empirically plausible. In most elections, at least some of the potential "pre-candidates", though credible enough to be considered, choose not to enter the campaign. It is this entry decision that we study.

The rest of this paper is organized as follows. Section 2 presents the basic citizen-candidate model along the lines of Osborne and Slivinski (1996), section 3 describes the experimental design we emply, section 4 presents our experimental results, including the quantal response equilibrium analysis, section 5 concludes.

[2]Our analysis may be viewed as complementary to the recent experimental work of Bouton et al. (2019), which analyses voter behavior across these two electoral systems; in contrast, we concentrate our attention on the behavior of candidates.

[3]For instance, Cadigan (2005) and Elbittar and Gomberg (2009).

2 Model

Our model adapts the one originally introduced in Osborne and Slivinski (1996). While Besley and Coate (1997) provide a similar model which allows for a small number of agents (a setting which would seem to be easier to implement in a lab), we follow the Osborne and Slivinski approach, as we are interested in large elections, where voting may be assumed to be non-strategic (allowing for strategic voting would introduce additional equilibrium multiplicity which we are trying to avoid). In addition, like in Osborne and Slivinski (1996), we concentrate on the comparison of candidate entry under distinct voting rules.

We consider a society that has to implement a single policy x on a unidimensional $[0, 100]$ continuum. Heterogenous voters have single-peaked preferences, with ideal points distributed over the continuum according to some distribution F (for the rest of the paper it shall be assumed to be uniform). Our main departure from Osborne and Slivinski is in limiting the set of possible candidates to a small finite subset of citizens with corresponding ideal points $Q = \{q_1, ..., q_n\}, q_i \in [0, 100]$.

Potential candidates, or politicians, may choose to nominate or not to nominate themselves for the office. As in Osborne and Slivinski (1996) it is assumed that agent preferences are known by everyone and that there is no commitment, so that the politicians can only promise that if elected they would implement their ideal policies. The rest of the voters are assumed to never run for the office, but simply to vote for the candidate whose ideal policy is the closest to their own (in experimental treatments we shall automate this part of the set-up).

Hence, the game has $N = \{1, 2, ...n\}$ politician players. Each player i has a 2-point strategy space $S_i = \{0, 1\}$, where $s_i = 1$ means the agent nominates him/herself, and $s_i = 0$ means the agent stays out of the election. Potential candidates consider the cost of participation c, the possible benefits of being elected or "ego rent" b, and the distance between their ideal policy and the final policy implemented. As in Osborne and Slivinsky (1996) we assume that if everybody decides not to enter the resultant outcome is "catastrophic": a large negative payoff $-D$ for everyone. To summarize, individual payoff in this game is given by 1 represent the preferences of citizens:

$$u_i(x, q_i) = \begin{cases} -D, & \text{if } s_i = 0, \forall i \in Q \\ -\alpha||x - q_i|| - cs_i + bw_i(s), & \text{otherwise} \end{cases} \tag{1}$$

where α is a parameter reflecting the relative importance of policy vis-a-vis non-policy payoffs and w_i takes value of 1 if the agent wins and 0 otherwise. Notice, that whether a candidate wins depends on the voting system, voter ideal point distribution, and the profile of individual entry decisions ($s = \{q_1, ..., q_n\}$).

Unlike the politicians, who have a strategic role to play, regular voters in our experiment will be computerized robots, who always vote sincerely. We assume there are 101 such voters, with a single voter having an ideal point at every integer between 0 and 100 (we chose to use a discrete voter space in order to avoid explaining the notion of a continuous distribution to subjects who were, for the most part, not exposed to calculus or probability theory). The robot voters always vote for a nominated candidate whose ideal point is closest to their own (in case $m > 1$ candidates are at the same distance from a given voter, s/he shall randomly select a candidate, with every one of the closest candidates having a probability $\frac{1}{m}$ of being chosens).

The winner of the election is determined by the voting of a larger society. In this paper we consider two voting rules:

- **Simple Plurality**: The candidate who gets most votes wins, with ties resolved randomly, with every one of the leading candidates having equal probability of winning.

- **Runoff**: The two candidates with highest votes from a first round are presented for the same set of voters to choose from in the second round, in which the winner is determined as in the plurality rule and ties in both rounds resolved randomly, with equal probability of being chosen among the tied candidates.

Following the bulk of the earlier literature, we shall concentrate on the pure strategy Nash equilibria. An important role in our setting shall be played by the distance between the politician ideal points and the meidan of the voter distribution m. The following proposition, which follows from the results of Osborne and Slivinski (1996), describes some of the equilibrium possibilities in our setting. It is these implications of the model that we shall try to test in the lab.

Proposition 1 *a) If there is a unique politician closest to , then for both voting rules there exists an equilibrium in which he is the only candidate.*

b) In every two-candidate equilibrium under the plurality rule the candidates are located symmetrically around m. Furthermore, such an equilibrium will exist only if there are symmetric politicians located close enough to m , or if the symmetric politicians are the closest ones to m.

c) If there are exactly two potential candidates closest to m, then under the run-off system there exists an equilibrium in which they are the only entrants if only if $2c \leq b$.

3 Experimental Design and Predictions

Our experimental design directly measures the relative performance of the Citizen-Candidate model under different parametrizations and voting rules: simple plurality and runoff.

Subjects. For each session, the subjects were drawn from a wide crosssection of students at the Instituto Tecnolgico Autónomo de México (ITAM) in Mexico City. Subjects participated in only one session. All (computerized) sessions were run at ITAM.

Practice and real periods. In each experimental session we consecutively ran 30 elections in groups with three potential candidates. At the beginning of each session, subjects played three practice trials.

Matching procedure and positions. The distribution of subjects ideal points was defined within the interval 0 to 100. This distribution was either constant across rounds within the same treatment or varied only once during a session for some treatments. Each subjects ideal point was randomly chosen for each period, which corresponded to an election. In each election subjects, having observed their ideal points, had to decide whether to nominate themselves as possible candidates. All voter decisions were taken by the computer. After each election subjects got the feedback about the ideal points of the entrants and the winner in their election, as well as the vote shares received by every candidate and their own monetary payoff.

Initial capital and bankruptcy rules. All payments were in Mexican Pesos (MN11 = USD1 at the time).[4] We started each experimental session by allocating every agent MN140 pesos of initial capital, to which the payments corresponding to the model parameter values were added and subtracted. Participants were allowed to continue until they finished a trial with negative balance. If the number of session participants at that point (possibly due to some of the participants losing their entire initial endowment) was not divisible by 3, some of them would skip a round. Therefore, the number of observations we have per subject varies. If a subject went bankrupt, s/he had to wait in the room until the experimental session was finished.

Experimental treatments and parameter values. We ran six experimental treatments. Table 1 summarizes each treatment parameters. All six experimental treatments had three potential candidates with different ideal points within the interval 0 to 100. Each point within the interval represented a sincere voter (the votes were sincerely cast by the computer and aggregated according to the voting rule employed in the treatment).

- **Simple plurality v. Runoff**: The first four treatments have the same ideal positions (Left: 20, Center: 30, Right: 80), while changing the participation cost and the voting rule.

[4]All the experimental treatments were conducted in 2008; the PLCS and PLCA treatments were part of the project we presented at the June 2008 Workshop on the Political Economy of Democracy, which was published in the accompanying volume (Elbittar and Gomberg 2009). The remaining treatments were conducted later that year, in part in response to the difficulties with experimental implementation of citizen-candidate environments we reported in that study.

Table 1: Parameters and NE in each game

Game	Voting Rule	c	*Ideal points:* Left	Center	Right	NE
PL	Plurality Rule	5	20	30	80	(30), (20, 80)
PH	Plurality Rule	20	20	30	80	(30)
RL	Run-Off	5	20	30	80	(30)
RH	Run-Off	20	20	30	80	(30)
PLCS	Plurality Rule	5	30	50	70	(50), (30, 70)
PLCA	Plurality Rule	5	30	50	80	(50)

Note: All games share the parameters: $\alpha = 0.1$, $b = 25$, and $D = 40$

Table 2: Treatments Summary

Treatment	Identification	Sessions ID	No. Participants	No. Bankruptcy
Simple Plurality / Low Cost	PL	$1, 2, 3$	$19, 18, 20$	$0, 0, 0$
Simple Plurality / High Cost	PH	$4, 5, 6$	$15, 20, 23$	$9, 13, 16$
Runoff / Low Cost	RL	$7, 8, 9$	$26, 16, 27$	$0, 0, 2$
Runoff / High Cost	RH	$10, 11, 12$	$15, 15, 15$	$4, 5, 6$
Simple Plurality Symmetric followed by Asymmetric Ideal Points	PLCS/PLCA	$13, 14$	$18, 15$	$0, 0$
Simple Plurality Asymmetric followed by Symmetric Ideal Points	PLCA/PLCS	$15, 16$	$21, 12$	$1, 0$

Table 3: Average payoffs in the stage games

	Relative Position		
	Left	Center	Right
PL	-5.194	5.735	3.402
PH	-7.266	-0.903	-11.508
RL	-2.878	19.145	-7.144
RH	-6.197	3.974	-10.226
PLCS	5.733	-2.015	3.170
PLCA	7.591	4.239	-6.955

- **Simple plurality symmetric v. Simple plurality asymmetric**: For the remaining two treatments, subjects participated under the same voting rule for two kinds of ideal position distributions, each for 15 periods. In the first treatment, subjects moved from participating in a symmetric structure of position (Left: 30, Center: 50, Right: 70) to an asymmetric structure (Left: 30, Center: 50, Right: 80). In the second treatment, subjects moved from an asymmetric structure of position (Left: 30, Center: 50, Right: 80) to a symmetric structure (Left: 30, Center: 50, Right: 70).

In the last column of Table 1, we present the Nash equilibria in pure strategy for the 3-candidate entry games for all six treatments. The only games with a two-candidate equilibrium are PLCS and PL, which are those with low cost, under the plurality voting rule. The following are the main models predictions:

Prediction 1: Only the candidates from the central position should enter: i) under the runoff voting rule (RL and RH treatments), ii) under the simple plurality rule with high-cost entry (PH treatment), or iii) under the simple plurality with an extreme candidate (PLCA treatment).

Prediction 2: Potential candidates at the central position may abstain from entering either: i) under the simple plurality rule with low-cost entry (PL treatment) or ii) under the simple plurality with symmetric candidates around the center candidate (PLCA treatment).

Table 2 summarizes all the experimental sessions with an ID number, the number of participants in each session and the number of subjects that went bankrupt, respectively. Meanwhile, Table 3 summarizes the average payoffs (initial capital not included) for each position and for each type of stage game.

4 Results and Discussion

This section compares the experimental results of the six treatments presented in light of the comparative statics derived from the citizen-candidate model.

Table 4 shows the number and the proportion of entries in each position (left, center and right) for treatments under the simple plurality rule with low (PL) and high (PH) entry costs and under the runoff voting rule with low (RL) and high (RH) entry costs. For example, 47% (254/540) is the proportion of potential candidates that that actually decided to participate in the election in the left position under the plurality rule. Table 5 shows the number and the proportion of entries in each position for the last two treatments under the simple plurality rule when the positions of the extreme potential candidates are symmetric (PLCS) and asymmetric (PLSCA) with respect to the central position.

Table 4: Total number of entries by positions for the plurality and runoff voting rules under different entry costs

Position	PL	PH	RL	RH
Left	254	89	254	82
%	47%	23%	39%	91%
Center	468	332	630	337
%	87%	87%	97%	96%
Right	468	218	278	82
%	87%	57%	43%	23%
No. Elections	540	380	648	350

Table 5: Total number of entries by positions for the plurality voting rule under symmetric and asymmetric extreme positions

Ideal positions	PLCA/PLCS		PLCS/PLCA	
	PLCA-1	PLCS-2	PLCS-1	PLCA-2
Left	146	149	147	82
%	88%	90%	89%	23%
Center	137	92	72	337
%	83%	56%	44%	96%
Right	77	147	150	82
%	47%	89%	91%	23%
Total	165	165	165	165

4.1 Voting rules and entry costs

Our first set of comparisons is between voting rules and entry costs. In general, we would expect the run-off rule to generate entry rates at the centrist position as compared with plurality, while the converse would be expected at the extreme positions. For both voting rules, we would expect higher entry rates at the central position (and, correspondingly, lower entry rates at the extreme positions) when the entry cost is higher.

Table 6 reports pairwise z-tests among the first four treatments. In this table, the proportion of entries at each position for the plurality voting rule with low entry cost is compared against those for the plurality with high entry cost and the runoff voting rule (with high and low cost). Thus, for instance, the result in the third row and second column is (-7.294) indicates indicates that the proportion of entry in the left position is significantly higher for the plurality voting rule once the entry cost decreases for a p-value less than 0.1%. A similar result is obtained on the right position. For the central position (result in the third row and third column) the pairwise z-test is not significant for a p-value less or equal to 5%. Hence, we do not observe a significant change in behavior for the central candidates.

When we compare the simple plurality with the runoff voting rule (both with low entry cost) we obtain significant differences in the entry rates for all positions. In particular, for the extreme left and right positions there is a significantly higher entry rate under the plurality rule than under the runoff voting rule. In contrast, we obtain a higher proportion of entries in the central position under the runoff rule. Similar results to the previous ones are obtained for the runoff rule with higher entry costs: more participation in the center and less participation at the extremes.[5] Figure 1 reports the aggregate proportions of entries (for all positions and entry costs) under the plurality and the runoff voting rules.

In order to obtain a clearer understanding of our experimental results while controlling

[5]Additionally, when we compare the plurality voting rule with the runoff voting rule (both with high entry costs), we obtain similar results to those reported when the entry cost is low, with the exception of the position of the extreme left, in which we did not find a significant difference for a p-value less or equal to 5%.

Table 6: Pairwise z-tests of significant differences, PL and PH, RL and RH

	PL		
	Left[2]	Center[1]	Right[2]
PH	-7.294***	-0.311	-10.047***
RL	-2.720**	-6.846***	-15.540***
RH	-7.097***	-4.769***	-18.966***

Note: *p<0.05; **p<0.01; ***p<0.001
[1] Null $H_0 : PL \geq PH, PL \geq RL$ or $PL \geq RH$
[2] Null $H_0 : PH \geq PL, RL \geq PL$ or $RH \geq PL$

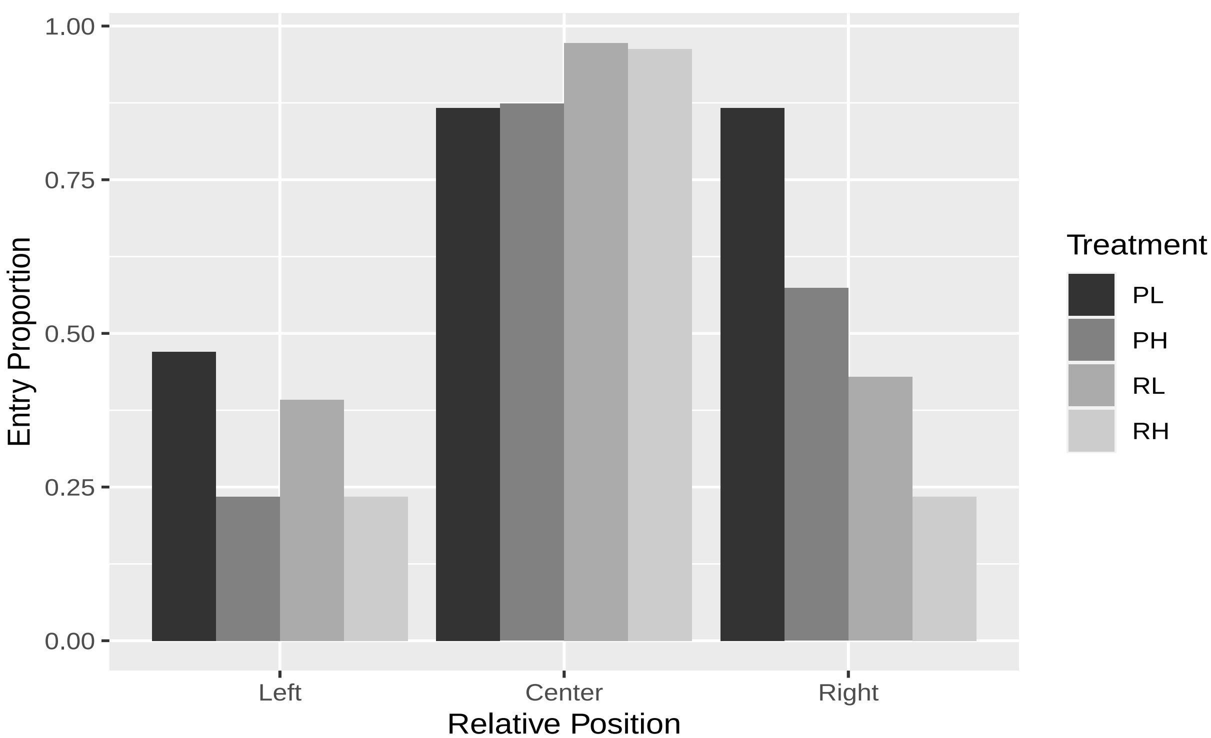

Figure 1: Entry proportion in the runoff rule treatments for each candidate characterized by their relative position among their competitors.

for individual behavior, we consider the following random effect logit model for estimating the likelihood of individual i at time t located at the ideal position *j: left, center, right* to enter conditional on the entry cost level and the prevalent voting rule:

$$Entry^{j}_{it} = 1\{intercept = \delta_1 d_{HighEntryCost} + \delta_2 d_{Runoff} + \delta_3 Period + v_i + \epsilon_{it} \geq 0\}$$

For each entry decision, 1{.} is an indicator function that takes the value of one if the left-hand side of the inequality inside the brackets is greater than or equal to zero, otherwise it takes the value zero. $d_{HighEntryCost}$ is a dummy variable equal to one when the entry cost is high; d_{RunOff} is a dummy variable equal to one when runoff is the prevalent voting rule; period represents the period (time trend), treating time as a continuous variable. We use a random-effect logistic model, where ϵ_{it} are i.i.d. logistic distributed with mean zero and variance $\sigma^2_\epsilon = \pi^2/3$, independently of v_i.

Taking the plurality rule with low entry cost (PL) treatment as a baseline, we could expect δ_1 to be negative when a potential candidate position is extreme (either left or right) and positive when a his/her position is central. In other words,

If we observe δ_2 to be positive for a central position and a negative sign for the extreme positions, it would support the conclusion that the runoff voting rule has a positive effect promoting the entrance of the central candidate while dissuading the entry of the extreme positions (our theoretical prediction in this case).

The results of our estimations are presented in Table 7. Notably, agents with ideal points at the extreme right are less willing to participate in an election under the run-off rule (we do not, however, obtain a significant result for the potential candidates on the left). Agents with centrist ideal points are more likely to participate under the runoff. Agents at both extremes are also less likely to enter when the cost of entry is high. However, centrists do not enter at a significantly higher rate under high costs. Finally, we observe that overtime entry rates decrease at the extremes and increase at the center. To sum up, we obtain the following:

Result 1 (Voting rules and entry cost) The runoff voting rule tends to promote on average less competition from extreme candidates than the simple plurality rule. On the other hand, higher entry costs induce less entry by the extreme candidates.

Table 7: Likelihood of potential candidates deciding to participate in the election controlling for entry cost and voting rule

	Dependent variable:		
	Entry Decision		
	Left	Center	Right
	(1)	(2)	(3)
HighCost	-1.221^{***}	0.072	-1.875^{***}
	(0.277)	(0.321)	(0.284)
RunOff	-0.199	1.896^{***}	-2.862^{***}
	(0.269)	(0.348)	(0.293)
Round period	-0.984^{***}	1.118^{***}	-1.922^{***}
	(0.133)	(0.221)	(0.154)
Constant	0.237	2.043^{***}	3.695^{***}
	(0.236)	(0.277)	(0.294)
Observations	1,918	1,918	1,918

Null $H_0 : \delta = 0$
Note: *p<0.05; **p<0.01; ***p<0.001

Table 8: Pairwise z-tests of significant differences PLCS and PLCA

	PLCS		
	Left[2]	Center[1]	Right[2]
PLCA	0.392	-8.063***	-11.281***

[1] Null $H_0 : PLCS \geq PLCA$
[2] Null $H_0 : PLCA \geq PLCS$
Note: *p<0.05; **p<0.01; ***p<0.001

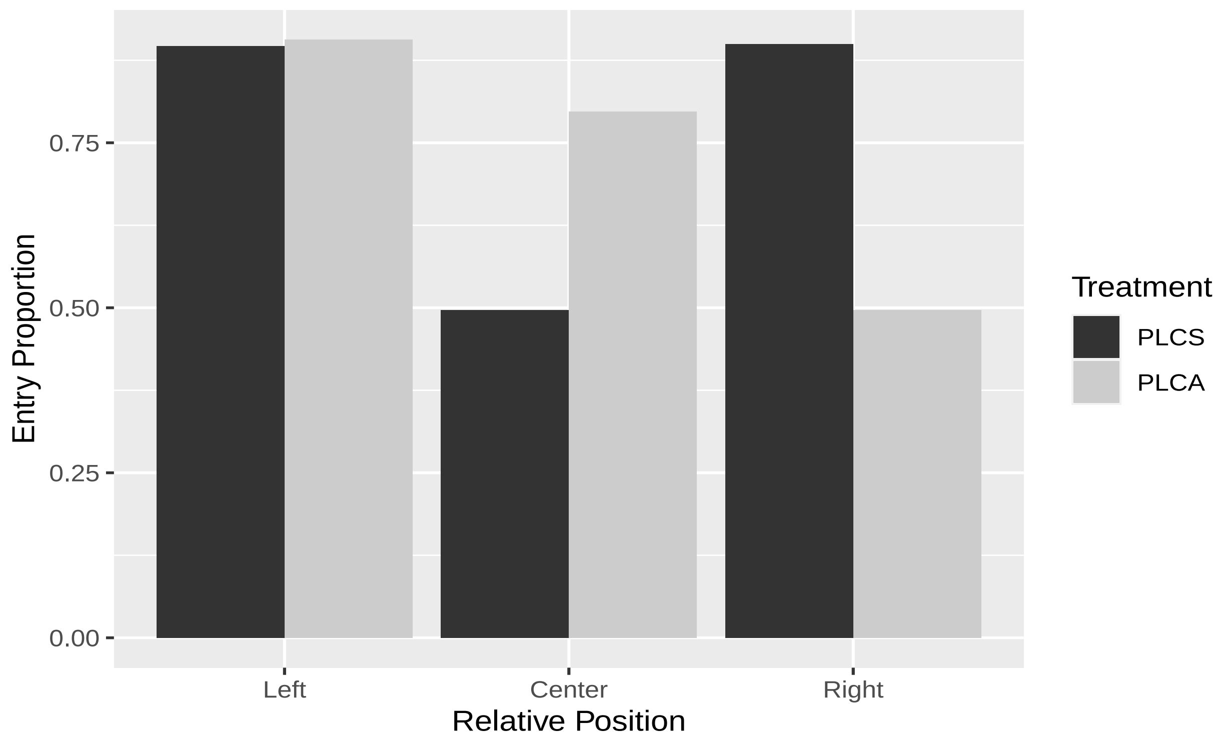

Figure 2: Entry proportion in the runoff rule treatments for each candidate characterized by their relative position among their competitors.

4.2 Role of asymmetry in ideal points

The last two treatments were designed to explore the incentives provided by variable ideologies of potential candidates. The logic of the citizen-candidate model suggests higher entry rates when the potential extreme candidates are located symmetrically on the ideological space, as compared with the environment in which their ideal points are asymmetric. Table 8 reports pairwise ztests between these two treatments.[6]

Considering pairwise z-tests between treatments for each position, we observe that participants under the asymmetric treatment entered more frequently in the central position and less frequently in the extreme right (with no significant difference at the extreme left). Figure 2 reports the aggregate proportions of entry (for all positions) for the plurality rule

[6]The PLCS and PLCA treatments were run in the same sessions, so that the same subjects faced both treatment, with the order of the treatments variable across sessions; as we did not observe any difference in behavior based on this variation, we present here the results by treatment, pooling the data from various sessions together

under the symmetric and the asymmetric treatments.

Table 9: Likelihood of potential candidates deciding to participate in the election controlling for asymmetry of extreme positions

	Dependent variable:		
	Entry Decision		
	Left	Center	Right
	(1)	(2)	(3)
Asymmetric treatment	0.079	2.048^{***}	-2.444^{***}
	(0.304)	(0.238)	(0.239)
Treatment order	0.765	-0.488	0.385
	(0.589)	(0.448)	(0.315)
Constant	2.732^{***}	0.177	2.325^{***}
	(0.441)	(0.328)	(0.279)
Observations	660	660	660

Null $H_0 : \delta = 0$
Note: *p<0.05; **p<0.01; ***p<0.001

We also present the results of estimating the following random effect logit model:

$$Entry_{it}^{j} = 1\{Intercept + \delta_1 d_{Asym} + \delta_2 d_{Order} + v_i + \epsilon_{it} \geq 0\}$$

As in the other regression, for each entry decision, $1\{.\}$ is an indicator function that takes the value of one if the left-hand side of the inequality inside the brackets is greater than or equal to zero, otherwise it takes the value zero. d_{Asym} is a dummy variable equal to one when the asymmetric treatment is implemented; d_{Order} is a dummy variable equal to one when a symmetric treatment is implemented before asymmetric treatment. We again use a random-effect logistic model, where ϵ_{it} are i.i.d. logistic distributed with mean zero and variance $\sigma_\epsilon^2 = \pi_2/3$, independently of v_i.

In Table 9, results of this regression are presented. We observe low entry rates from the right, and correspondingly higher entry rates at the center in the asymmetric treatment.

However, we do not find significant difference between the treatments for the entry from the leftist ideological position.

Result 2 (Asymmetry of ideal points) Asymmetry in ideal points of the potential candidates results in less entry from the extremes and more entry at the center.

4.3 Quantal Response Analysis

In order to better understand the patterns observed in the entry decisions of the candidates we calculated the the Quantal Response Equilibrium (QRE) making an estimation of each game separately, and considering all the games together (McKelvey and T. R. Palfrey, 1995; Goeree, Holt, and T. R. Palfrey, 2016). We considered the logit quantal response function to describe participant's choices. This functional specification is the most commonly used in the literature:

$$\sigma_{ij} = \frac{e^{(\pi_j(\sigma_{-i}))\lambda}}{e^{(\pi_j(\sigma_{-i}))\lambda} + e^{(\pi_{i\neq j}(\sigma_{-i}))\lambda}} = \frac{1}{1 + e^{(\pi_{i\neq j}(\sigma_{-i}) - \pi_j(\sigma_{-i}))\lambda}} \tag{2}$$

Where σ_{ij} is the probability player i chooses option $j \in \{\textit{Enter}, \textit{ Not Enter}\}$. The expected payoff of this option is a function the probability of entry from other players $\pi_j(\sigma_{-i})$, and the parameters in each game. Then, we can define the function $\sigma(\sigma, \lambda)$ as the vector of probabilities each player chooses to enter for a given λ, and the vector of beliefs about others' mixed strategies σ. A QRE is defined as a fixed point of $\sigma(\sigma, \lambda)$ for a fixed value of λ. A detailed description of the QRE framework can be found in Goeree, Holt, and T. R. Palfrey (2016).

An important feature of the model is that as λ increases, the probability of choosing the most profitable option increases as well, and when $\lambda = 0$ the response is completely random. The Nash Equilibria of the games in this experiment are approachable: there is a sequence of QRE that converges to them as $\lambda \to \infty$. For the games with a unique Nash Equilibrium, we can interpret λ as a relative measure of approach to equilibrium. Even in the case of multiple equilibria, we can still consider λ as a measure of the degree of optimization in participants' behavior (for large enough values of λ the PL and PLCS games have two QRE which converge to the Nash Equilibria described in Table 1).

4.3.1 Maximul Likelihood Estimation of λ

The maximum likelihood estimator for λ was calculated as described by Goeree, Holt, and Palfrey (2016) using the equilibrium correspondence approach: when optimizing for λ, the QRE was calculated in every iteration. This required to solve a non-linear equations system to find a fixed point of $\sigma(\sigma, \lambda)$. We used the R packages *optim* and *nleqslv* to do all the calculations.

We optimized over the next log Likelihood function:

$$logL(\lambda) = \Sigma_{i=1}^{n=3}\Sigma_{j=1}^{J_i=2} f_{i,j} log(\sigma^*_{ij}(\lambda)) \tag{3}$$

where $f_{i,j}$ are the times each i-th candidate choose their j-th option. This likelihood was constructed under the assumptions of independence of decisions and equal λ for all candidates.

The parameter λ was estimated for each game and assuming it was equal across games (global estimate). These estimates and its standard deviations are reported in Table 10.

Table 10: MLE estimators of λ in each game. The global estimator considers the parameter equal across games.

	PL	PH	RL	RH	PLCS	PLCA	Global
$\hat{\lambda}$	0.0836	0.0723	0.0984	0.0832	0.2216	0.0748	0.0783
SD	0.0028	0.0014	0.0040	0.0024	0.0072	0.0044	0.0010

Figure 3 displays the $\sigma(\lambda)$ functions (QRE paths) for each game, with λ in the horizontal axis and the probabilities of entry in the vertical axis. According to the model, all players choose to entry with 0.5 probability if $\lambda = 0$, and the QRE approaches smoothly towards a NE as λ grows. Each line corresponds to the QRE predicted for each position; the green line for the centrist, and the blue and red lines for the left and right relative positions repectively. Games PH, RL, RL and PLCA have only one equilibrium, as indicated in Table 1 and therefore they have only one QRE path. For PL and PLCS games, the dotted lines represent the second QRE convergent to the NE that was more distant from the proportion observed in the data. This proportions are included in the graphs as solid horizontal lines with the colors corresponding to different positions. Figure 3 also shows the global estimate λ_G with a dotted vertical line, and the estimated λ_g within each game with a solid line. We can observe the prediction of the estimation as the place where the QRE path and the vertical lines cross each other. It is apparent that the difference between the prediction and the actual proportion of entry is not that large.

In general, the estimated value of λ is similar between games, as we can observe when comparing the difference between λ_G and λ_g. Even, when the only estimated λ_g not statistically different from λ_G are PL and PLCA, the general pattern of entry for different positions is preserved. The striking exception comes for the PLCS game where the estimate is larger than λ_G. The prediction from QRE with the estimated of the game λ_{PLCS} is very close to the proportion observed, the predictions when considering λ_G are far from the actual proportions observed. In this game, the equilibrium where the extreme positions participate is reached. The worst adjustment is in the PLCA game where the proportion of entry of the extreme position (q_{30}) is higher than the centrist (q_{50}), a phenomenon that QRE cannot explain.

5 Conclusion

The citizen-candidate model of political competition has long provided a compelling framework for analyzing the decision to participate in an election. However direct empirical tests of the model's predictions have been few. In part this is due to the fact that the benchmark model is known to suffer from large equilibrium multiplicity, complicating the interpretation of any empirical results.

The main objective of this paper has been to design a testable version of the citizen-candidate environment in a lab, which could be used to explore the reaction of potential candidates to the main driving forces of the model. Our environment allowed us to directly test the model predictions about the variation in electoral rules, costs of running for office and the distribution of the potential candidate ideal points.

Our empirical findings largely confirm the theoretical predictions. In particular, we observe that the run-off electoral systems strongly encourage entry and the center of the ideological spectrum and discourage entry by extremists. We also demonstrate a similar effect of the elevated entry costs. Finally, we confirm the crucial role in encouraging extremist entry played by the symmetry of the ideal point distribution. Deviations from the Nash Equilibrium predictions are largely driven by over-entry from "hopeless" ideological positions and is matches quite well with the predictions of the QRE.

Perhaps the main empirical puzzle that we identify concerns the issue of equilibrium selection. Both the PL and PLCS treatments have multiple equilibria: one in which only the centrist candidate enters, and another in which both of the potential extreme candidates enter, keeping the centrist out of the election. It seems that the former equilibrium consistently emerges in PL, while the latter best describes the results in PLCS. The reason for this difference remains to be understood.

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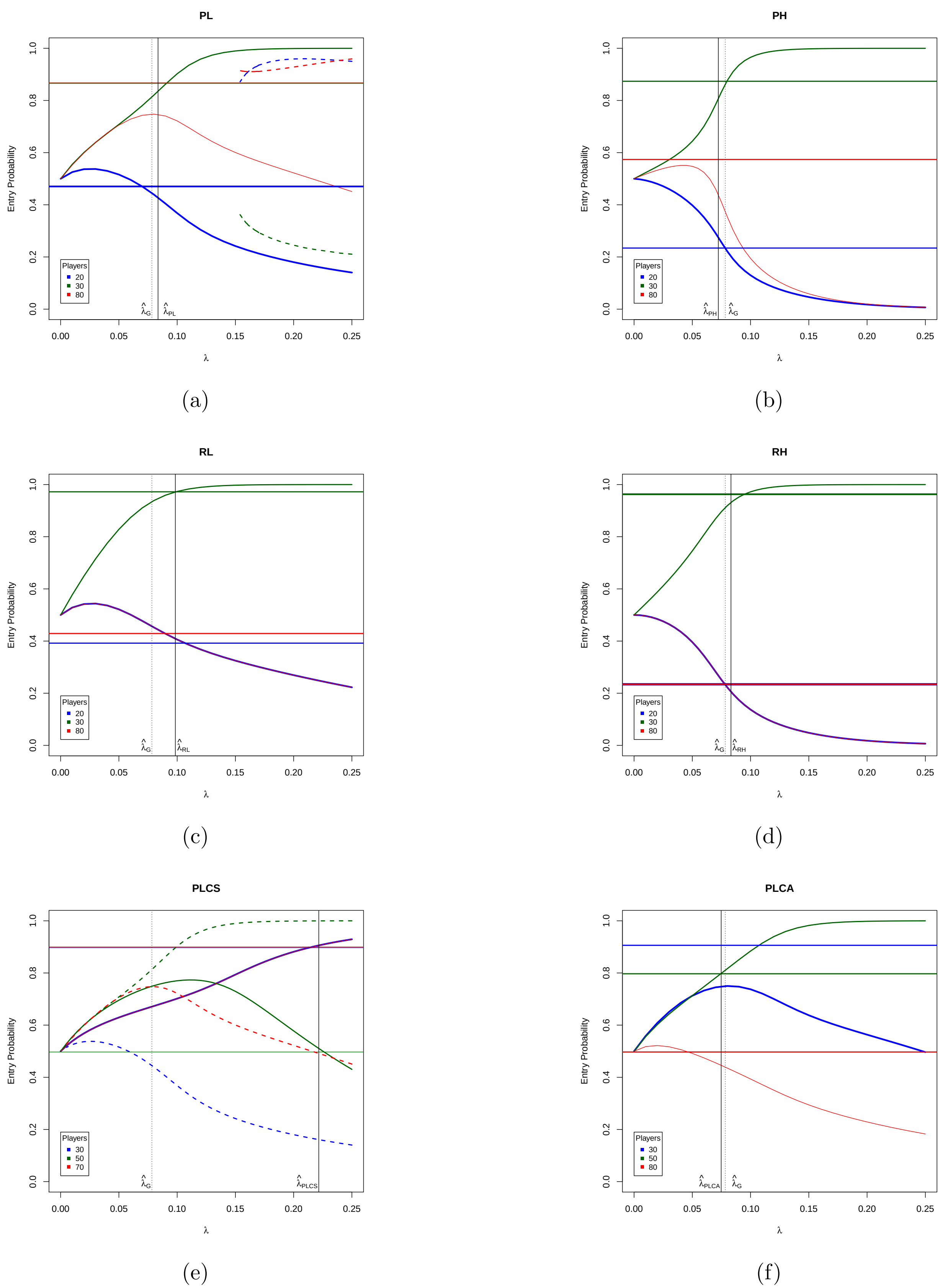


Figure 3: QRE paths for the treatments

Appendix A.

Instructions

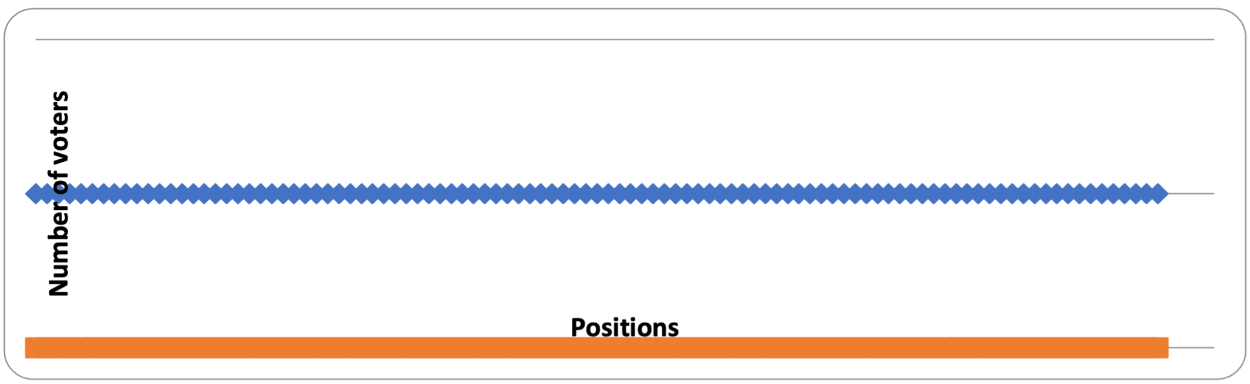
This is an experiment about decision making in elections. CONACYT has provided funds for this research. The instructions are simple and if you follow them carefully and make good decisions, you will be able to earn a CONSIDERABLE AMOUNT OF MONEY, which will be PAID TO YOU IN CASH privately at the end of the session.

After we read the instructions, you will have a chance to make your decisions.

- General procedure

In this experiment you will have to decide whether or not to compete as a candidate in each of the 30 elections that we will carry out at the end of the instructions.

In each of the elections, one of 3 possible alternatives will be chosen the winner by a population of voters (simulated by the computer), according to the voting procedure that we will see later. The 3 alternatives are represented by positions 20, 30 and 80 located on the following line from 0 to 100:



- Group Formation

In each election, you will be part of a group of 3 participants. The composition of each group of participants will change randomly, so that the same group will be made up of different participants in each election. You will never know the identity of who you are participating with.

- Allocation of Alternatives

In each election, one of the mentioned alternatives will be assigned to you as your ideal position. Each participant in your group will be assigned a different position. Thus, a participant will be assigned position 20; to another, position 30; and to another, position 80. The allocation of alternatives for each election will be determined randomly.

- Candidate Application Procedure

To be considered an eligible candidate by the voters, you must decide whether or not to run for your ideal position in each of the elections. That is, you must decide whether or not to compete to be chosen by the voters in each of the elections.

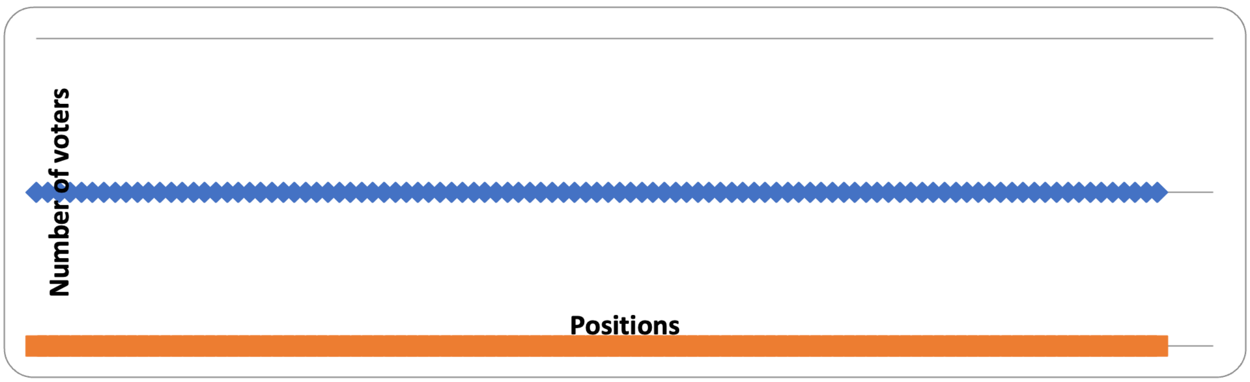
You can only apply for your ideal position and you will not be able to apply for any other position.

Once all participants have made their decisions on whether or not to run for their positions, the winning candidate in each election will be determined according to the voting process described below.

Runoff Treatment

- Election Procedure for the Winning Candidate

For each election, we have a population of 101 voting citizens. Voters are distributed along the line from 0 to 100 as follows: One voter for each whole number represented on the line.



The 101 voting citizens (simulated by the computer) will choose the winning candidate, according to the following voting procedure:

1. In a first round of voting, each citizen will vote for the candidate closest to their position. When there is more than one candidate with the same closeness, the citizen's vote will be randomly assigned among the closest candidates.

2. After the first round of voting, the two candidates who have accumulated the highest number of votes will be chosen to participate in a second round of voting.

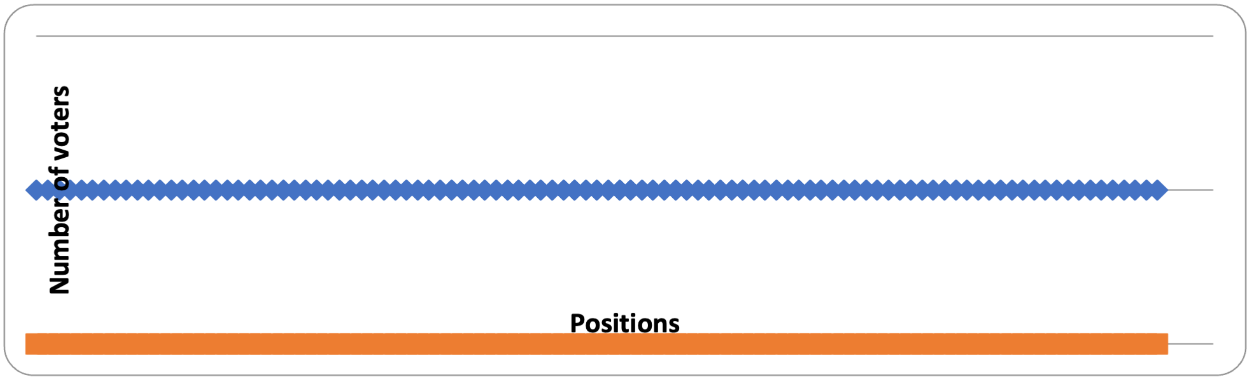
3. In this second round of voting, each citizen will vote for the candidate closest to his position. In the event of a tie, the winner will be determined randomly from the tied candidates. Therefore, there will always be only one winner if there are applicants.

4. In the event that less than three candidates have been nominated, only the first round of voting will be held, choosing the candidate who has obtained the highest number of votes.

Plurality Treatment

- Election Procedure for the Winning Candidate

For each election, we have a population of 101 voting citizens. Voters are distributed along the line from 0 to 100 as follows: One voter for each whole number represented on the line.



The 101 voting citizens (simulated by the computer) will choose the winning candidate, according to the following voting procedure:

1. Each citizen will vote for the candidate closest to his position. When there is more than one candidate with the same closeness, the citizen's vote will be randomly assigned among the closest candidates.

2. The winning candidate will be the one who accumulates the highest number of votes. In the event of a tie, the winner will be determined randomly from the candidates tied for first place. Therefore, there will always be only one winner if there are applicants.

- Initial Balance, Earnings and Payments

Each participant will start with an initial balance of 140 pesos. At each election, the opening balance will be updated as follows:

In the event that at least one alternative has been postulated:

1. The amount in pesos equal to the Alpha parameter (= 0.1) multiplied by the absolute distance between their ideal position and the position of the winning candidate will be subtracted from each participant. That is, the amount of:

$$0.1\text{x}|\text{ Your Ideal Position } - \text{ Winning Candidate Position }|$$

2. The amount of 5 pesos will be subtracted from each participant who has decided to postulate their ideal position.

3. The winning candidate will be added the amount of 25 pesos.

In the event that no alternative has been postulated, the only amount of 40 pesos will be subtracted from each participant.

- Accumulated Balance and Payment Procedure

The accumulated balance at the end of each election will be the sum of your starting balance plus the payments and winnings you have obtained in each previous election. The accumulated balance at the end of the 30 periods will be paid to you in a sealed envelope. In case of obtaining a negative balance, you will not get any payment.

Summary of Instructions

In every election,

1. You will be part of a new group of 3 participants.

2. Each group member will be assigned one of the following 3 positions on the line from 0 to 100: 20, 30 and 80.

3. Each participant must decide whether or not to run as a candidate for the election.

4. The 101 voting citizens (simulated by the computer) will determine the winning candidate, voting in two rounds for the one closest to their location.

to. In a first round, the two candidates with the highest number of votes are chosen.

b. In a second round, the winning candidate is chosen from the two candidates with the highest number of votes.

c. A first round of voting will only be carried out in the event that the number of nominated candidates is less than three.

5. Updating of balances will be done as follows after each election:

a. In the event that at least one alternative has been postulated:

i. The amount in pesos equal to 0.1 x will be subtracted from each participant — Your Ideal Position - Position of the Winning Candidate —

ii. The amount of 5 pesos will be subtracted from each participant who has decided to postulate their ideal position.

iii. The winning candidate will be added the amount of 25 pesos.

b. In the event that no alternative has been postulated, the only amount of 40 pesos will be subtracted from each participant.

6. The accumulated balance at the end of each election will be the sum of your initial balance plus the payments and winnings that you have obtained in each previous election.

- Factors that influence your earnings in each election

As you can see, your earnings are influenced by three factors:

1. The distance between your chosen winning position and your ideal position.

2. Your decision and that of the other participants to apply.

3. Be chosen the winner by the voters.

Next Steps (Read by researcher after reading instructions)

Next we will show you the software that we have designed for you to make your decisions. Therefore, put the instructions on the side of the computer and take the IDENTIFICATION RECORDS sheet found next to your computer.

Server connection

Each participant must initiate their connection with the server using the following procedure: Enter the numbers written at the top of their IDENTIFICATION RECORDS in the Username and Password box. Then hit the submit box.

Completed registrations, press end of registration.

Screen Reading

Next we will review the information that for now appears on your screen. In the upper left part we will find a column where your USER NUMBER, the GROUP SIZE, the ROUND NUMBER, the ROUND TYPE (which in our case we are in the test rounds), and the ACCUMULATED BALANCE (which in our case is the initial balance of 140 pesos). In the second column on the right side, the value of the ALPHA parameter is indicated, the COST

TO APPLY, the PAYMENT AWARDED FOR WINNING, the COST IN THE EVENT THAT NO CANDIDATE IS PRESENT, and finally the NUMBER OF VOTERS.

Practice Rounds

We will now carry out 3 rounds of practice. The main objective of these rounds of practices is that you become familiar with the software that we have designed to make your decisions, and therefore they will not count towards your payments. If you have any questions during practice, please raise your hand and I will try to answer them.

Once everyone has entered their decisions, they must wait until all participants have made their decisions and the computer returns the results of the election.

In case your computer has not activated the decision box, it is because we do not have a number divisible by three, so you will have to wait until the next rounds for your screen to activate.

At the end of the practice periods, your initial balance will return to the initial amount of 140 pesos.

Generate Period 2Let's now proceed to the 2nd practice period. (Press: Start Period) Proceed to make your decisions.

Do you have questions?

Generate Period 3

Let's now proceed to the 3rd. practice period. (Press: Start Period) Proceed to make your decisions.

Do you have questions?

Actual or Played Periods for Money

Now we will proceed to carry out the 30 periods to be played for money. Your initial balance will return to the initial amount of 140 pesos.

Review all screens.

After the experiment begins, you are not allowed to speak or communicate with other participants. Otherwise, we will be forced to exclude it from the experiment. Please focus on your computer screen. If you have any questions, please raise your hand and one of us will come up to you and try to answer it.

Generate Period 1-30 (Press: Period Start) Proceed to make your decisions.

Final payment

Your payment for this second part is the one that appears in the balance on your screen.

Please stay at your posts. One of us will pass on to deliver a final questionnaire and your payment receipt to be filled out by you. Please add the balances obtained in both parts of the session.

They will then be called to come out to receive their payment. Please stop by to drop off all the material that was given to you.

Thank you very much for your participation!