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PROTEST VOTING IN THE LABORATORY

February 2020

Marco Fanno Working Papers - 247

Protest voting in the laboratory

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February 4, 2020

Abstract

Formal analysis predicts that the likelihood of an electoral accident depends on the preference intensity for a successful protest, but not on the protest's popularity: an increase in protest's popularity is fully offset by a reduction in the individual probability of casting a protest vote. By conducting the first laboratory experiment on protest voting, we find strong evidence in favor of the first prediction and qualified support for the latter. While the offset effect is present, it is not as strong as the theory predicts: protest candidates gain both by fanaticising existing protesters and by expanding the protest's popular base.

Keywords: protest voting; electoral accident; coordination; laboratory experiment.

JEL classification: D72

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1 Introduction

"'To be quite frank, I did not believe [Brexit] would happen,' [the interviewee says], 'I thought I'd put in a protest vote.' [...] As soon as [she] saw the result the following morning, her heart sank. 'I was in shock,' she remembers." (Lynskey 2017)

Protest voting has been on the rise in recent years and takes different forms (Alvarez et al. 2018). It is often fuelled by populism and may result to radical policy changes. The vote on Brexit, the Trump era in the US, or the rise of extreme and anti-establishment parties across Western democracies are just prominent examples. Research however remains premature and social scientists still try to understand both its causes and consequences. In this paper, we follow Myatt (2017) and Kselman and Niou (2011) thinking of protest voting as a strategic action signalling voters' disaffection towards their otherwise preferred candidate or party. We then explore via a theory-driven laboratory investigation how the protest's *popularity* and *salience* may affect voters' behaviour and the probability of an *electoral accident* (i.e. an undesired –by the majority– electoral outcome).

As a motivating example, consider the 2016 Brexit referendum on whether the UK should remain a member of the EU. Experts, academics, and (most) politicians argued that remaining in the EU was a superior outcome than leaving. The initial polls, and, probably, even David Cameron when calling the referendum, were indeed predicting a victory of remain (Ipsos Mori 2016). These predictions were invalidated by the actual vote that favoured the leave option by a narrow win. This was to many a surprise as EU membership was not among the citizens' major concerns. At the time, voters definitely worried more about the national health service and the state of the economy rather than EU membership (Ipsos Mori 2015). And given the narrow win to leave the EU, one will never know whether a majority of the British electorate truly believed that leaving the EU was the right outcome. Even post referendum polls indicate quite the opposite. Most voters were still of the view that Brexit will deteriorate their living standards (Ipsos Mori 2018). Indeed, support for the leave vote was concentrated among left-behind voters, and leaving the EU is not in their economic interest (Sampson 2017). So *if* Brexit was "accidental", what may lie behind its success? Our results suggest that the radical, nevertheless very successful, leave campaign orchestrated by Nigel Farage and Boris Johnson may have played an important role. A successful campaign aiming not only at expanding the pool of protesters, but also at fanaticising protest voters –who thought that this would be victory for remain– may have given populist movements a great story of success.[1]

[1]Obviously, this work does not aim to explain the Brexit referendum outcome. This referendum serves as a relevant example. For academic work on Brexit see a recent survey by Sampson (2017) and

Building on our example, we closely follow Myatt (2017) and consider a society that has to decide between a *"mainstream"* and a *"protest"* alternative via simple majority rule. Voters are of two types: *"protesters"* or *"non-protesters"*. In the simplest version of such model, both types of voters agree that the mainstream alternative is preferred over the protest one. But while non-protesters just rank the two alternatives, protesters' most preferred outcome is a *"successful protest"*. A protest is viewed successful when the mainstream alternative wins, *but the margin of victory is below a certain threshold.* Same as for non-protesters, protesters' least preferred outcome is a win by the protest alternative. Why protest voters care about the margin of victory and prefer to see such margin below a given threshold may be simply down to preferences of voters to avoid a landslide win by the mainstream candidate. This motivation could fit our Brexit example. Some protest voters may voted to leave, thinking that remain would win, and rather wanted to engage in a protest vote avoiding a large winning margin for the remain side and the "establishment". In other instances, the winning margin may also determine the winner's power. For example, in some countries, constitutional reforms and important law changes require a super majority in parliament, versus regular policy implementation that can be typically executed with a simple majority.

In the above setting, formal analysis dictates that non-protesters always vote for the mainstream alternative. Protesters instead randomize between voting for the mainstream alternative and protesting and, hence, electoral accidents cannot be ruled out. As our results show, the frequency of protest depends on: i) the *protest's popularity* (i.e., the expected share of protest voters), and ii) the *protest's salience* (i.e., the extra utility that protesters enjoy when the protest succeeds compared to a landslide win for the mainstream alternative).

Consider first that the protest's popularity is relatively low. A protester knows that her vote for the protest alternative has very few chances to generate an electoral accident where the mainstream alternative loses, and hence frequently protests. As the protest becomes more popular, the probability of such an accident naturally increases if protesters do not adjust their protest probability. This incentivizes each protester to actually protest less and less frequently as the popularity of protest increases, and, intriguingly, the probability of an electoral accident (i.e., a defeat of the mainstream candidate) in equilibrium is not affected by the protests popularity: An increase in the expected share of protesters, is fully offset by the decrease in the probability each individual protester chooses to protest.

The frequency of electoral accidents instead is found to depend crucially on the protest's salience. As protester types obtain a higher utility differential from a successful protest, the individual frequency of protesting increases. This clearly affects the

references therein.

frequency of different electoral outcomes. As the protest's salience increases and individuals protest more often, there is an increase in the frequency of electoral accidents and a decrease in the frequency of failed protests.

But is this equilibrium analysis pertinent to settings of empirical interest? To give a first answer, we take the above theoretical predictions to the laboratory and consider the simplest possible experimental setup to test them: Two voters choose simultaneously whether to vote for the mainstream or the protest alternative. If both subjects vote for the mainstream alternative, the mainstream alternative wins and the protest fails. If there is one vote for each alternative then the mainstream alternative wins and the protest is successful. An electoral accident occurs when both subjects vote for the protest alternative and therefore the mainstream alternative loses. In this setting, we use a 2x2 factorial design where we vary either the protest's popularity or the protest's salience, our two main variables in the theoretical setting as far as comparative statics are concerned.

In line with the theory, fixing the protest's popularity, an increase in the protest's salience increases the individual frequency of protest voting and hence the frequency of electoral accidents and of successful protests. Fixing the protest's salience instead, an increase in the protest's popularity decreases the individual frequency of protest voting. Nevertheless, this offsetting effect of the protest's popularity on the individual probability to protest is substantially smaller than predicted by the theory. Therefore, the frequency of electoral accidents *is also increasing in the protest's popularity*. This finding was not predicted by the theoretical analysis and highlights the added value of the experimental investigation. Protest campaigns may gain not only by fanaticizing existing protesters, but also by expanding their base. Finally, our laboratory exercise uncovers a tendency for *role-playing*: subjects seem to coordinate in the long-run by gradually employing asymmetric strategies (i.e., some subjects over-protest and others under-protest). This suggests that in frameworks of repeated interaction, the set of the protest-oriented population that actually protests may end up pretty stable over time.[2]

Our contribution to the literature is twofold: First, we adjust the model of Myatt (2017) in a way that permits us to highlight the differences between the protest's salience and popularity. Indeed, while our approach is a derivative of Myatt (2017) the two models are not nested: Myatt (2017) considers richer environments regarding types of voters and information (i.e. aggregate uncertainty), but he focuses on bell-shaped distributions, which make it hard to disentangle the protest's popularity and the protest's salience. The simplified version of the Myatt (2017) model that we employ (i.e. with only two types of voters) allows us to do that and dictates a clean experimental design. More importantly,

[2]This is in line with other experimental studies of voting behaviour (e.g. Bouton et al. 2016) who also find gradual convergence to asymmetric behaviour.

we present experimental evidence supporting the above theoretical predictions. This is important since a) empirical validation of the theory of strategic protesting is scarce and indirect (e.g., Franklin et al. 1994; Blais 2004; Burden 2005; Kselman and Niou 2011; Campante et al. 2018), and b) it seems impossible to empirically test the independent effects of the protest's popularity and salience on electoral outcomes as predicted by the theory.

To the best of our knowledge, this is the first experiment on protest voting. Nevertheless, the setting at hand links with previous theoretical work on political economy, and hence subsequent laboratory experiments. First, protest voting bears some similarities with classical models of strategic voting in multi-candidate elections. In these models there is need for coordination among subjects belonging in the majority, to avoid an "electoral accident" where the Condorcet loser wins the election (Palfrey 1989; Myerson and Weber 1993; Fey 1997; Bouton and Castanheira 2012). Such models were subsequently tested in the laboratory (Forsythe et al. 1993; Bouton et al. 2017). In contrast to these models, protest voters do not have monotonic preferences over their favourite candidate's vote share. Second, our work links with theoretical models of costly voting and strategic turnout (Krishna and Morgan 2012; Myatt 2015; Faravelli and Sanchez-Pages 2015) and experimental evidence (Herrera et al. 2014; Kartal 2015; Palfrey and Pogorelskiy 2019; Herrera et al. 2019). In these models, voters want either their preferred alternative to win (in private value settings), or the society to take the right decision (in common value settings), but would rather save the cost of participating in the election. In our model instead, there is no preference for abstention (i.e. when the protest succeeds, all protesters –both those who voted the mainstream alternative and those who did not– enjoy the same utility) and whether protesters decide to protest or vote for the mainstream candidate depends solely on the expectation of the protest being successful. In a recent paper, Ginzburg et al. (2019) develop and experimentally test a model in which voters receive expressive utility from voting for an ethical alternative, although they prefer it not to win. Although one could view protest as such an ethical alternative, there is an important difference in the two setups. Voters receive utility from a successful protest irrespective of whether they voted for the protest alternative themselves. Finally, there is a series of papers that focuses on strategic voting combined with different types of signalling from voters to candidates via the electoral outcome, but those do not feature the coordination or anti-coordination features put forward in the previously mentioned literature (Castanheira 2003; Shotts 2006; Razin 2003; Meirowitz and Shotts 2009).

In what follows we first derive our hypotheses by studying a simple formal model of protest voting (Section 2), we then present our experimental design (Section 3) and results (Section 4), and, finally, we conclude (Section 5).

2 Theoretical arguments

Consider a society of n individuals, $N = \{1, 2, ..., n\}$, with $n \geq 2$ and even, which has to make a choice between two alternatives $\{M, P\}$, referred to as the *mainstream* and the *protest* alternative, respectively. The decision is taken by a simple majority vote, abstention is not allowed, and in case of a tie alternative M is chosen.[3]

Individuals are of two types: "protesters" or "non-protesters". All individuals prefer a win of alternative M to a win of alternative P, but "protesters" do not have monotonic preferences over the number of votes for M, in the spirit of Myatt (2017).[4] Formally, "non-protesters" enjoy utility one when M wins and utility zero when P wins. "Protesters" instead, enjoy utility $1 + s > 1$ when M wins and the protest succeeds, utility one when M wins and the protest fails, and utility zero when P wins. The protest succeeds if M wins and its votes are at most equal to some fixed threshold $t \in \{\frac{n}{2}, \frac{n}{2} + 1, ..., n - 1\}$. Parameter $s > 0$ captures the protest's salience. The above preferences for protesters are summarized in Figure 1.

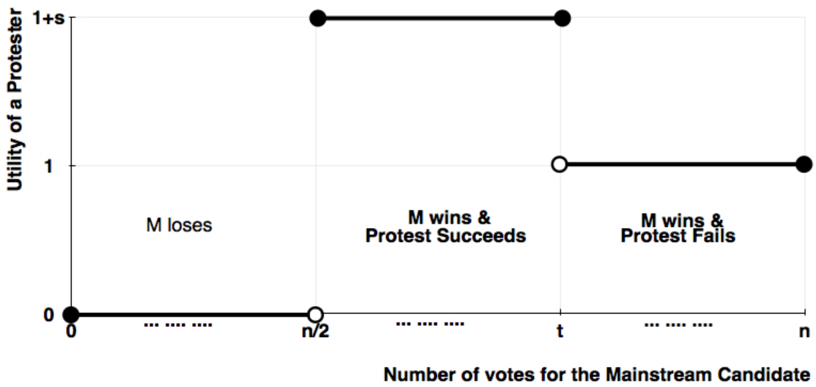


Figure 1: Outcome and utility of the "protester" type.

The timing is as follows: At stage zero, nature draws the types of the individuals with *i.i.d.* draws from a binomial distribution with parameter $q \in (0, 1)$, which is common information and represents the probability that a random individual is a "protester". Each individual observes her own type, but does not observe the type of her fellow citizens. At stage one, players simultaneously decide whether to vote for M or P. At stage two, the outcome of the election is announced and the payoffs of all players are

[3]The assumptions of an even number of voters instead of an odd number of voters, and whether M or P win in case of a tie do not affect the qualitative features of our main result.

[4]Allowing for voters who prefer a win of alternative P does not add to the analysis of strategic voting behaviour. For the sake of simplicity we therefore do not consider this possibility, though it could be easily accommodated in our model.

computed. Given that strategic decisions are made simultaneously only in the first stage of the game, the natural solution approach is to seek for Bayesian Nash Equilibria (BNE).

We take the size of the society and the protest success threshold as given, and we focus on the comparative effects of the protest's popularity, q, and of the protest's salience, s, on voters' equilibrium behaviour and the electoral outcome. We start by arguing that efficient pure strategy equilibria –i.e. outcomes that maximize the ex-post sum of individual utilities– always exist.

Proposition 1. *There are pure strategy BNE such that M wins and the protest succeeds with certainty, but none of them is in undominated strategies.*

Indeed, consider the following strategy profile: the first t players vote for M and the remaining vote for P independently of their type. If players adopt this profile then the mainstream alternative, M, wins with certainty, and the protest is successful. Notice, though that these equilibria involve dominated strategies: voting for P when you are a "non-protester" is never better than voting for M, for any strategy profile of the rest of the players (and for some of them it is strictly worse). It is easy to see, that all efficient equilibria suffer from such a drawback. Hence, while there are BNE that support a socially optimal outcome, they are not really reliable predictions.

Given that in such games the set of BNE can be really large and/or diverse, we use dominance, symmetry and responsiveness as equilibrium selection tools. "*Dominance*" means that the BNE should only involve undominated strategies. "*Symmetry*" requires that all players of the same type employ the same strategy (in absence of a coordination device, this seems quite reasonable). "*Responsiveness*" demands players to employ different behaviour depending on their assigned type. Similar equilibrium selection tools are employed in several experimental studies of electoral behaviour (e.g., Bouton et al. 2016, 2017)

Dominance essentially dictates that every player votes for M when she is a "non-protester". Symmetry rules out equilibria in which different players behave differently when they are assigned the same type. Given what dominance implies, responsiveness merely rules out the trivial equilibrium in which all players vote for M independently of their type. The following proposition characterizes the unique BNE in our setting.

Proposition 2. *Let*

$$\tilde{q}(s) = \frac{1}{1 + 4^{\frac{1}{-n+2t+2}} \left(\frac{(s+1)(t+1)!(n-t)!}{sn\left(\frac{n}{2}!\right)^2} \right)^{\frac{2}{-n+2t+2}}}$$

There exists a unique BNE satisfying dominance, symmetry, and reponsivness.

When $q \in (0, \tilde{q}(s)]$, this equilibrium is in pure strategies: all "non-protesters" vote for M and all "protesters" vote for P.

When $q \in (\tilde{q}(s), 1)$, this equilibrium is such that: a) all "non-protesters" vote for M, b) each "protester" votes for P with probability $p(s, q) = \tilde{q}(s)/q$ and for M with the remaining probability.

The threshold value $\tilde{q}(s)$ determines whether protesters follow a pure strategy and always vote for P or randomize their vote. If the probability that a random voter is a protester is below the threshold (i.e. $q \leq \tilde{q}(s)$), protesters always protest. Given that q is low, most likely there are not enough protesters to produce an electoral accident, and hence there are incentives to always protest. On the contrary, if $q > \tilde{q}(s)$, protesters follow a mixed strategy where they vote P with some positive probability $p(s, q)$. This probability is computed so that protesters are indifferent between voting for the mainstream or protest alternative.

For low values of the protest's popularity (i.e., $q \in (0, \tilde{q}(s)]$) the comparative statics are obvious. In this region, both types follow pure strategies, "protesters" vote P and "non-protesters" vote M. The probability that a random voter protests, equals the probability an individual is a "protester" (i.e., q). The following proposition instead describes the relevant comparative statics in the interesting region where the protest is popular enough (i.e., $q \in (\tilde{q}(s), 1)$). These results pave the ground for our main empirical hypotheses; the ones that we subsequently test in the laboratory.

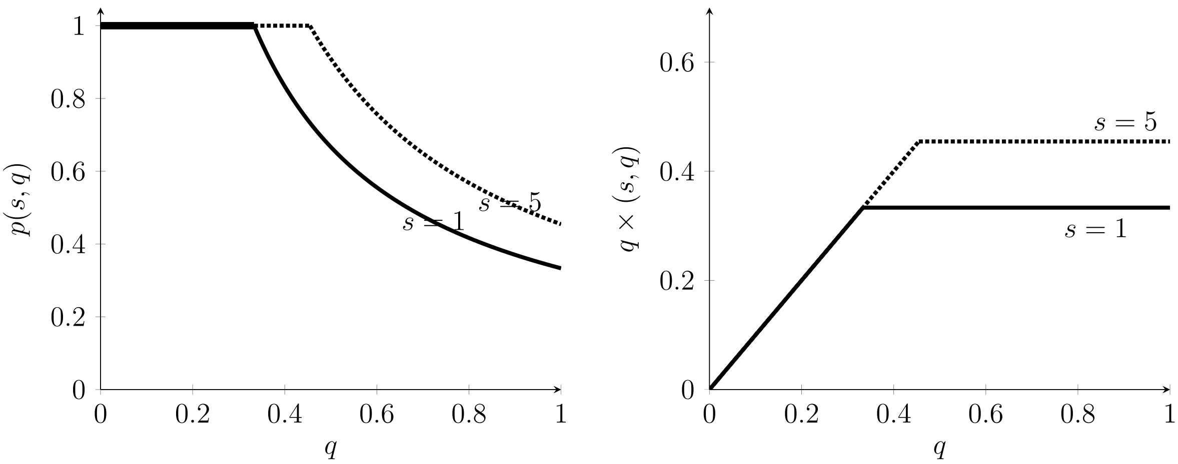
Proposition 3 (Comparative Statics)**.** *For any $q \in (\tilde{q}(s), 1]$:*

a) the probability that a protester votes for P (i.e., $p(s, q)$) is decreasing in q and increasing in s,

b) the probability that a random voter votes for P (i.e., $q \times p(s, q)$) does not vary in q and is increasing in s.

For any value of $q \in (\tilde{q}(s), 1)$ the probability that an individual protester protests is decreasing in the protest's popularity q. This is the main offsetting effect that the protest's popularity has on the individual probability that a protester actually protests. As the protest becomes more popular, protesters protest less often to avoid an electoral accident. The exact shape of $p(s, q)$ for an example with two voters is depicted in Figure 2a.

Figure 2b instead illustrates that the probability that a random voter protests does not depend on the protest's popularity q, when $q > \tilde{q}(s)$. The mixed strategy played by protesters ensures exactly that: In expectation, protesters choose how often to protest so that there is the "right" share of voters protesting. This share equals $\tilde{q}(s)$ and does not depend on q. That is, any change in the protest's popularity, is accompanied by an



(a) Probability a “protester” votes P.

(b) Probability a random voter votes P.

Figure 2: An example where $n = 2$, $t = 1$. Solid line for $s = 1$, dashed line for $s = 5$. Value of $\tilde{q}(s)$ is 1/3 for $s = 1$ and 5/11 for $s = 5$.

appropriate adjustment in the individual frequency that protesters protest. In aggregate terms, this implies that the expected vote share for P is not affected by changes in q, suggesting that the electoral outcome is not affected by the protest's popularity.

Changes in the protest's salience s instead affect the probability that a randomly chosen voter protests and hence the likelihood of each electoral outcome. As the protest's salience increases, the utility difference for a protester between a successful and an unsuccessful protest increases, providing incentives to protesters to protest more often (see Figure 2a). Given that q is fixed, an increase in s hence implies an increase in the probability that a random voter is protesting. Going back to our example with two voters, when the salience is “low” (i.e., $s = 1$) the mixed strategy equilibrium dictates that the probability a random voter is protesting is 1/3 while when the salience is “high” (i.e., $s = 5$) this probability is 5/11.

Changes in s hence surely affect the likelihood of each electoral outcome. An increase in s —and hence an increase in the probability a random voter protests— surely increases the frequency of electoral accidents and decreases the frequency of unsuccessful protests. The relationship between this probability and the frequency of successful protests instead is non-monotonic.

Figure 3 illustrates the relationship between the probability of a random voter protesting and the frequency of electoral outcomes for our example with $n = 2$ and $t = 1$. On the left, we illustrate the monotonicity of electoral accidents and failed protests and the non-monotonicity of successful protests. On the right, we represent the same frequencies of electoral outcomes on the simplex. The dashed line on the simplex represents the expected frequencies of the three outcomes assuming that a randomly chosen voter votes for P with *any* probability in the $[0,1]$ interval. If this probability is zero the protest fails with certainty and we are at the northern corner of the simplex. As the protesting probability increases we move along the dashed line till M surely loses when randomly selected voters always protest. Both graphs also illustrate the exact frequencies of the three outcomes in our two voter example when $s = 1$ and $s = 5$.

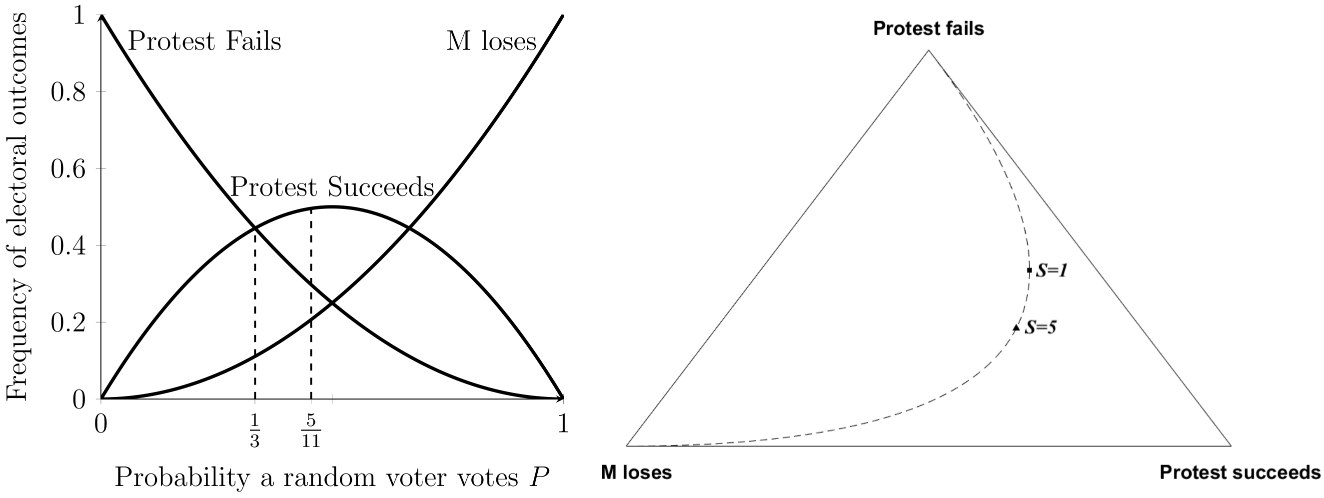


Figure 3: On the left, frequencies of electoral outcomes in the example where $n = 2$, $t = 1$ assuming that a randomly selected voter protests with a given probability $[0,1]$. On the right, representation of such frequencies on the simplex. For $s = 1$ the probability a random voter protests is 1/3. For $s = 5$ this probability is 5/11. Both representations highlight that an increase in s from 1 to 5 increases the probability of electoral accidents and successful protests and decreases the probability of failing protests.

These findings naturally lead to a number of empirically relevant hypotheses. In the section that follows we describe our experimental design, which aspires to test the implications of the above theoretical analysis.

3 The Experiment

3.1 Design

The experiment took place at the Laboratory for Experimental Economics at the University of Cyprus (UCY LExEcon). A total of 128 subjects were recruited in 8 sessions, with 16 subjects in each session.[5] The experiment consisted of 100 rounds, prior to which there were 2 practice rounds that aimed at helping the subjects familiarize with the environment. Average total payment was approximately 17.4 euros, including 5 euros as a

[5]Recruitment was done via ORSEE (Greiner et al. 2004).

Treatment	Salience (S)	Popularity (q)	Subjects	Sessions	Subgroups
$(300, 0.5)$	300	0.5	32	2	8
$(300, 0.8)$	300	0.8	32	2	8
$(700, 0.5)$	700	0.5	32	2	8
$(700, 0.8)$	700	0.8	32	2	8
		Total:	128	8	32

Table 1: The four treatments.

participation fee, and the experiment lasted about 90 minutes.[6]

The experiment employs the simplest version of the protest voting game described in the previous section. For each election, we fix the number of voters to two ($n = 2$), and set the threshold for a successful protest to one ($t = 1$). We use a 2×2 factorial design with two sessions per treatment. The two treatment variables are: (i) the protest's salience, S, and (ii) the protest's popularity, q. Salience refers to the payoff (in tokens) that protester types enjoy in the event of a successful protest, and may take one of two values in each treatment: $S \in \{300, 700\}$. Popularity, q, is the probability of being and a protester and is also selected from two possible values in each treatment: $q \in \{0.5, 0.8\}$. A summary of the experimental design is shown in Table 1.

In each round, subjects were randomly matched in pairs and played a one–shot game with their assigned pair. We use a stranger matching protocol to avoid any repeated game effects. In order to maintain a sufficient number of independent observations, pairs are drawn from subgroups of four subjects. Subject are told that matching is random and that in each round it is more likely to not be matched with the same subject as in the previous round, while the existence of these subgroups is not detailed to subjects.[7] This design choice is not behaviourally neutral and we come back to that in Section 4.3.

The two subjects of each pair are asked to vote for either one of the two alternatives: either in favor of the mainstream alternative M, or to protest and vote for P. If both protest, the mainstream alternative M loses and both players receive 100 tokens. If both vote for M, the mainstream alternative M wins, but the protest fails. In this case both players receive 200 tokens. If one subject votes for M and the other for P, then the main alternative wins and the protest succeeds. Non-protest type players receive 200 tokens, while protesters receive S tokens. The value of S varies in different treatments. Notice that the payoffs depend solely on the outcome and a subject's type in the specific round,

[6]The experiment was designed and run on z-Tree (Fischbacher 2007).

[7]See instructions in the appendix.

votes: outcome:	PP M loses	MP or PM Protest succeeds	MM Protest fails
Protester	100	$S \in \{300, 700\}$	200
Non-Protester	100	200	200

Table 2: Round payoffs in tokens, for each type, depending on outcomes.

but not on the subject's vote. Table 2 summarizes the possible outcomes and payoffs. In the experiment we use a neutral frame without any mention of elections or voting.[8]

Types are assigned randomly and independently for each subject in each round. Subjects know their own type but not that of their partner. They know the distribution of types. The process is represented to them as draws (with replacement) from a single urn with red and blue balls. In the treatments were $q = 0.5$ the urn contains 5 balls of each colour. When $q = 0.8$ the urn contains two red balls and eight blue balls. Drawing a blue ball means that a subject is a protester type in that round. Both subjects know the composition of the urn. They see the ball that is drawn for them, but not the one drawn for their partner. The composition of the urn remains the same throughout a session.

At the end of each round, subjects were informed about the choice of their partner and their payoff from that round. Final earnings were determined by the sum of the subject's payoffs in 10 randomly selected rounds out of the 100.[9] The conversion rate used in the experiment was 1 euro for every 250 tokens.

3.2 Testable Hypotheses

Similar to our theoretical setting, non–protesters have a straightforward payoff-maximizing option (i.e. vote for M). Hypothesis 0 summarizes this behaviour. Hypotheses 1 and 2 instead summarize protesters' behaviour as predicted by Proposition 3. Recall that as summarized in Figure 2a, for a given protest popularity, protesters protest more often as the protest's salience increases. Similarly, for a given salience, protesters protest less often as the protest's popularity increases. The exact values for the mixed strategy equilibrium probabilities that a protester votes P in our experimental setup are given in Table 3.[10]

[8] Votes for M and P are presented as "choosing **X** or **O**". Again, see the instructions in the appendix for details.

[9] Subjects are paid based on a random subset of rounds to avoid any wealth effects. Given the large number of rounds in the experiment, we do not pay for a single randomly picked round to keep monetary incentives salient, as some subjects may underweight the very small likelihood of a particular round being picked (Hertwig et al. 2004).

[10] Those values can be directly obtained from Proposition 2 by substituting the relevant parameters of our experimental treatments (i.e., $n = 2$, $t = 1$, and $q \in \{0.5, 0.8\}$, $s \in \{1, 5\}$). Actually, those values are the ones that are used in our example of Figures 2 and 3.

Hypothesis 0. *Non–protesters vote for M almost always in all treatments.*

Hypothesis 1. *For a given protest popularity $q \in \{0.5, 0.8\}$, protesters vote for P more often in the high salience treatment $(700, q)$ than in the low salience treatment $(300, q)$.*

Hypothesis 2. *For a given salience $S \in \{300, 700\}$, protesters vote for P less often in the high popularity treatment $(S, 0.8)$ than in the low popularity treatment $(S, 0.5)$.*

Hypotheses 3 and 4 and Table 4 summarize the predictions of our model regarding the likelihood of electoral outcomes across treatments (see Figure 3 for the corresponding theoretical predictions). Recall that there are three possible outcomes from a pair's vote. If none of the two subjects votes for M, then M loses and each voter gets the lowest possible payoff, irrespective of her being a protester or not. If only one voter votes for M we observe a successful protest: M wins, and any voter that is a protester gets the maximum payoff. If both voters vote for M the protest fails. M wins and both voters get the intermediate payoff, regardless of their type.

Hypothesis 3 fixes the protest's popularity and permits its salience to vary. One of our main comparative statics shows that "electoral accidents" occur more often as the protest's salience increases. This increase in electoral accidents goes hand in hand with an increase in the frequency of successful protests and a decrease in failing protests.

Hypothesis 3. *For a given popularity $q \in \{0.5, 0.8\}$, M loses more often, the protest succeeds more often, and the protest fails less often in the high salience treatment $(700, q)$ than in the low salience treatment $(300, q)$.*

Hypothesis 4 instead fixes the protest's salience and varies the protest's popularity. As we have shown, changes in the protest's popularity do not affect the frequency of different electoral outcomes. This is because the mixed strategy equilibrium strategies adjust to changes in the popularity (Hypothesis 2), letting the frequency of outcomes invariant to changes in the protest's popularity.

Hypothesis 4. *For a given salience $S \in \{300, 700\}$, M loses equally often, the protest succeeds equally often, and the protest fails equally often in the high and low popularity treatments $(S, 0.8)$ and $(S, 0.5)$.*

4 Results

We first present results regarding individual behaviour and then we argue how such behaviour translates to electoral outcomes.

4.1 Voting behaviour (Hypotheses 0-2)

Table 3 shows the Nash equilibrium predictions for each type of voter in each treatment, as well as the corresponding mean frequency of protesting observed in the data. Figure 4 summarizes the behaviour of protesters across treatments, compares that with the Nash predictions and summarizes relevant tests across treatments.

Focusing on the lower part of Table 3, it is reassuring to note that in line with **Hypothesis 0**, non-protesters seem to realize that voting for M is payoff-maximizing and almost always follow this strategy.

We can now focus on the behaviour of protesters. In general we find significant treatment effects, as subjects respond to the changes in the treatment variables. When comparing behaviour to that predicted by theory we find that in three out of four treatments, protesters vote for P less often than the Nash equilibrium prediction. The exception is the treatment where $q = 0.8$ and $S = 300$, where the frequency observed in the data is not statistically different from Nash. For all other treatments, we have statistically significant under-voting for P (see Figure 4).

		$S = 300$		$S = 700$	
		$q = 0.5$	$q = 0.8$	$q = 0.5$	$q = 0.8$
Protester	Nash	0.667	0.417	0.909	0.568
	Data	0.591	0.44	0.692	0.517
Non protester	Nash	0	0	0	0
	Data	0.012	0.029	0.041	0.024

Table 3: Equilibrium and actual frequency of protesting (i.e., voting for P).

Regarding **Hypotheses 1 and 2**, although the voting frequency is mostly different from the Nash point predictions, comparative statics move in the predicted directions. Performing Wilcoxon rank sum tests comparing the data in two treatments aggregated at the subgroup level (8 observations per treatment) our results indicate that treatment effects on average protesting frequency are all statistically significant. First, for a given popularity, protest voting among protesters is increasing in the salience (p-values$<$0.01).

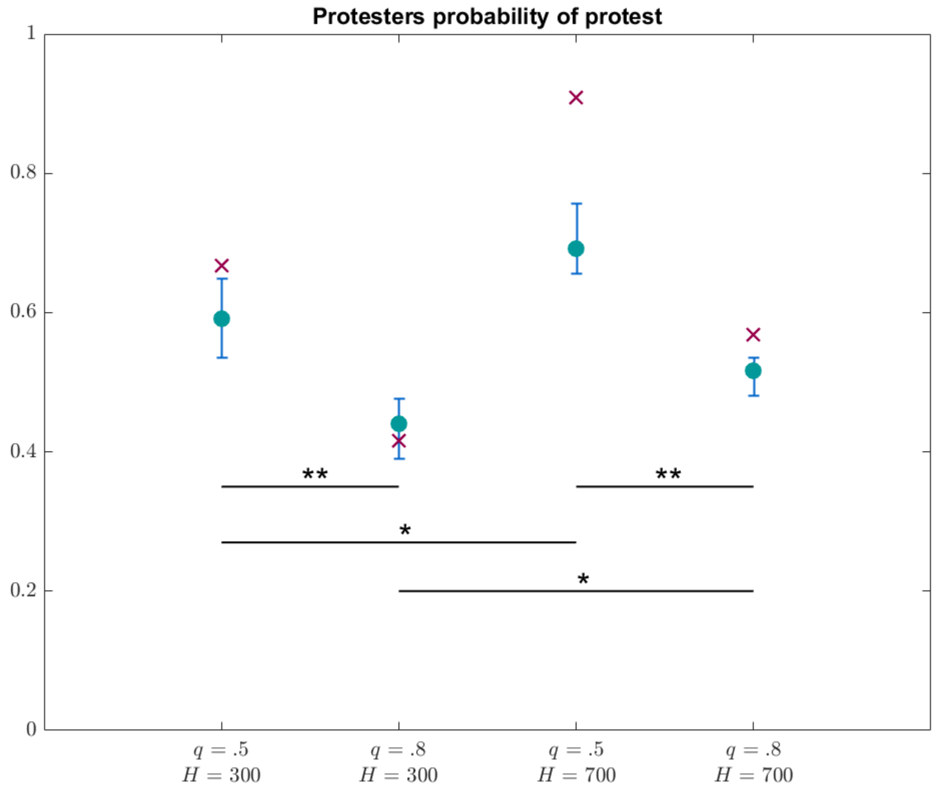


Figure 4: The cyan dots indicate the average frequency of protesters voting for P in each treatment. Error bars indicate 95% confidence intervals for the mean, constructed using 5000 bootstrap samples from the data clustered at the subgroup level. The red X's mark the Nash prediction for each treatment. The horizontal bars and stars indicate the result of a Wilcoxon rank sum test comparing the data in two treatments aggregated at the subgroup level (8 observations per treatment), with *: p-value<0.05 and **: p-value<0.01.

Second, for a given salience, protest voting among protesters is decreasing in the popularity (p-values<0.05).

		$S = 300$		$S = 700$	
		$q = .5$	$q = .8$	$q = .5$	$q = .8$
M loses (*"electoral accident"*)	Nash	.111	.111	.207	.207
	Data	.087	.100	.120	.148
M wins, Protest succeeds	Nash	.444	.444	.496	.496
	Data	.422	.512	.484	.538
M wins, Protest fails	Nash	.444	.444	.297	.297
	Data	.491	.388	.396	.314

Table 4: Frequencies of the three possible electoral outcomes

4.2 Voting outcomes (Hypotheses 3 & 4)

Table 4 shows the outcome distribution in the experimental treatments and the corresponding Nash equilibrium distribution. Figure 5 summarizes those outcome distributions on the simplex. The arrows on Figure 5 report the p-values for a bootstrapped Hotelling test for compositional data (Tsagris et al. 2017). All observed treatment effects are statistically significant (highest p-value is equal to 0.0566).

The prediction of **Hypothesis 3** is supported in our data. As we see in Table 4, for a given popularity, we observe more successful protests and electoral accidents as the protest's salience increases, while the frequency of failing protests decreases. As we see in Figure 5, the corresponding p-values are 0.0566 for the high popularity treatment (i.e., $q = 0.8$), and 0.0528 for the low popularity treatment (i.e., $q = 0.5$). The intuition is clear: For a given q, as the protest's salience S increases, protesters realize the potential gain from a successful protest and protest more often (Hypothesis 1), therefore increasing the frequency of electoral accidents and successful protests.

Support for the comparative statics regarding changes in the protest's popularity and **Hypothesis 4** instead is less evident. Recall that for a given S, changes in q should not affect the frequency of the three outcomes. Table 4 instead indicates that for either level of salience, as the protest becomes more popular, the frequency of outcomes varies.

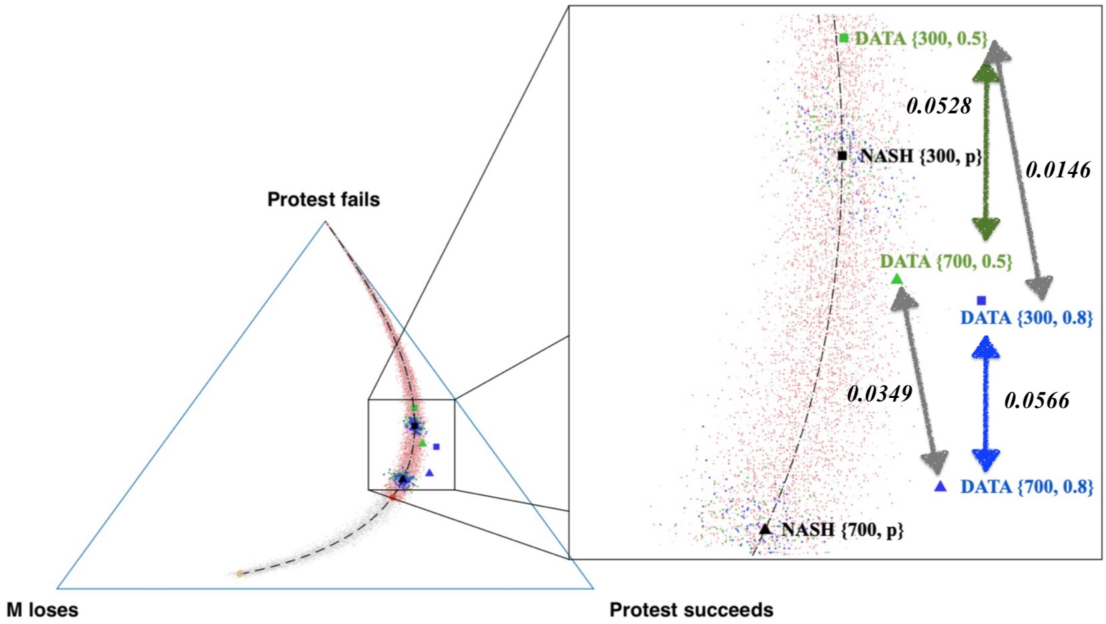


Figure 5: Outcome frequencies for our experimental data across the four treatments and Nash predictions on the simplex. Arrows report p-values for a bootstrapped Hotelling test for compositional data (Tsagris et al. 2017). The dashed line and dots illustrate the results of a simulation exercise where we assume a symmetric voting behaviour for all protesters as detailed in Section 4.3.

As the protest becomes more popular, the protest succeeds more often, there are more electoral accidents but also fewer failing protests. These results are also visualized in Figure 5. For a given level of salience S, an increase in q moves the distribution point south-east, and those movements are statistically significant (p-values are 0.0349 for the high salience treatment (i.e., $S = 700$), and 0.0146 for the low salience treatment (i.e., $S = 300$)).

4.3 Asymmetric behaviour

To better understand the discrepancies between our experimental results and the theoretical predictions we take a closer look at the data. We first focus on the distribution of outcomes and try to understand how far it is from the one predicted.

Figure 5 depicts expected and actual distributions of outcomes on the simplex. The dashed line represents the expected frequencies of the three outcomes assuming *symmetric behaviour*, where all non-protesters vote M and all protesters vote for P with *any* given probability in the $[0, 1]$ interval. If protesters never protest, the protest fails with certainty and we are at the northern corner of the simplex. As the (symmetric) protesting probability increases we move along the dashed line. The ending point of that curve illustrates the frequency of outcomes when protesters always protest. The illustrated dashed line in Figure 5 is plotted for $q = 0.8$. While varying the level of q does not affect the shape of the curve, it affects its ending point. That is, for lower levels of q this curve would be "shorter", and for higher levels of q "longer". Finally, note that the dashed line, passes through the equilibrium predictions of our model if protesters were following the characterized symmetric mixed strategy.

To have a feeling of the distance between the predicted and observed distribution of outcomes we use simulations. In each simulation a pair is drawn 100 times with $q = 0.5$ (red dots) or $q = 0.8$ (gray dots) and the two voters vote as follows: non-protesters always vote for M; for protesters we fix a level for the probability of protesting $p \in \{0, .01, .02, ..., 1\}$ and run the simulation 100 times for each given level. For the simulations where the protest probability is equal to the one predicted by the BNE we colour the dots green (when $q = 0.5$) and blue (when $q = 0.8$). The coloured "clouds" of simulated outcome distributions form pseudo-'confidence intervals' –CI clouds– for the outcome distribution expected in the experiment.

A first observation is that Figure 5 visually confirms what is indicated in Table 4, namely that observed outcomes are far from the corresponding Nash predictions. Nevertheless, in the treatments in which $q = 0.5$ it cannot be ruled out, based on our simulations, that subjects are using a symmetric protest strategy, as in both cases the distribution of outcomes is "within the CI cloud" surrounding the dashed line. The same cannot be said for the two treatments where $q = 0.8$. In these the outcome distributions are too far to the right of the dashed line.

The area on the right of the dashed line represents the expected frequencies of electoral outcomes when players adopt *asymmetric strategies*. That is, when each of them is expected to protest with different probability. Notice that if player 1 adopts a strategy that induces her protest, from an ex-ante point of view, with probability p_1, while player 2 is expected to protest with probability p_2, with $p_1 > p_2$, then the probability that a random voter protests is given by $(p_1 + p_2)/2$. Importantly, when one of the two players is observed to protest, without her identity being revealed, then, by employing standard Bayesian updating techniques, one gets that the probability of the other player protesting is strictly smaller than $(p_1 + p_2)/2$.[11] This suggests that when players adopt asymmetric strategies there is a negative correlation between their protest behaviour, and a zero correlation when the strategies are symmetric. Note, that negative correlation in this case may arise without any (anti-)coordination device employed. Indeed, positive correlation in protest behaviour –which corresponds to expected frequencies of outcomes

[11] In case $p_1 = p_2$, observing a random player protesting does not make the observer update her beliefs about the other player protesting.

to the left of the dashed line– would require such a coordination device, which is ruled out by our experimental design (stranger matching and no communication).

The above suggests that the observed outcome distributions, especially in the $q = 0.8$ treatments, may be the result of subjects employing asymmetric strategies. In Figure 6, we plot the distribution of the frequencies of protest voting per subject conditional on being a protester, across treatments. Differences are apparent and in line with those suggested by Figure 5. Observe first the histograms in the low popularity treatments ($q = 0.5$). The distribution is unimodal, with a great mass of protesters adopting a homogeneous always-protesting behaviour. In the high popularity treatments ($q = 0.8$) instead the distribution is bimodal. A mass of protesters is always protesting, and a mass of protesters is never protesting; summarizing an, arguably, more heterogeneous behaviour.

As we will next argue, these differences in the extent of "role-playing" –i.e., of behaving in an asymmetric manner– depending on the protest's popularity are compatible with the predictions of the asymmetric equilibria of the game. Recall from the experimental design that in each round subjects were randomly matched with another subject from a subgroup of four. Formally this is described as a case where there is an electorate of size $n = 4$, and $k = 2$ voters are randomly chosen to participate in the election. Our theoretical results regarding symmetric equilibria still hold in this slight variation of the model.[12] Still, in this variation used in the experimental setup asymmetric equilibria may arise.

Proposition 4. *Consider our experimental setup where four voters are matched randomly in pairs, a voter is assigned a protester type with probability q, and payoffs are given in Table 2. There exist asymmetric BNE in undominated strategies where a) voters always vote M when non-protesters, and b) voters vote P as follows:*

1. *For treatments* $(300, 0.5)$ *and* $(700, 0.5)$*: one voter never votes P when protester, and three voters always vote P when protesters.*

2. *For treatments* $(300, 0.5)$, $(300, 0.8)$, *and* $(700, 0.8)$*: two voters never vote P when protesters, and two voters always vote P when protesters.*

Moreover, there exist no other asymmetric equilibria in pure strategies.

The above characterized equilibria imply that in each group of four voters, there are either one or two voters who *never* protest –even when protesters–, while the remaining voters are protesting when protesters and are voting M when non-protesters. These findings predict a more asymmetric behaviour when the protest popularity is high than

[12] Indeed, Proposition 2 and the related comparative statics go through in the general case where $k \leq n$ randomly drawn voters from the set of n individuals participate in the election.

low and can backup the behaviour observed in Figure 6: the highlighted differences between the unimodal distribution in the low popularity treatments, and the bimodal distribution in the high popularity treatments. Protesters' behaviour in Figure 6 for the low popularity treatments is in line with the mildly asymmetric equilibrium in which most players always protest when protesters. Instead, protesters' behaviour in the high popularity treatment is in line with the highly asymmetric equilibrium in which players evenly split between never and always protesting when protesters.

Further support to the claim that subjects behave as if playing an asymmetric equilibrium comes from observing how behaviour changes across rounds. Note that the asymmetric equilibria described in Proposition 4 are in pure strategies and may arise as the result of subjects best responding to past play, following an initial period where each subject adopts a fixed, non-equilibrium, possibly mixed strategy. Recall that subjects were matched in subgroups of four to participate in 100 elections. Within each subgroup pairs were formed randomly in each election. In Figure 7 there are clear signs of changes in behaviour across rounds, with behaviour varying significantly in the first twenty rounds (on the left) compared to the last twenty rounds (on the right). Initially protesters seem to experiment more across protesting or not, and there are no clear differences between the low and high salience treatments. In the last twenty rounds, the "unimodal" and "bimodal" distributions expected in the asymmetric equilibria are clearly visible. Hence, learning does seem to take place in our experimental setting with several players eventually settling into playing an asymmetric equilibrium instead of the mixed strategy one.

5 Discussion and Conclusion

We provide experimental evidence for the main comparative statics of a simple model of protest voting in the spirit of Myatt (2017). By distinguishing the notions of the protest's popularity and protest's salience we provide new comparative statics. Experimental evidence, while broadly in line with the theoretical predictions, issues additional caveats regarding protest campaigns: fringe candidates may gain not only by fanaticising protest voters as suggested by the formal analysis, but also by expanding their popular base. As it was found, such strategy, improves not only the chances of a successful protest, but also of an electoral accident where the alternative preferred by the majority of voters loses against an inferior opponent.

As in any lab experiment, there are design choices that could be done differently. For instance, choosing the smallest possible electorate size seems counter-intuitive when studying behaviour in large elections. Our focus was not in replicating large elections in the lab –a probably impossible feat–. Instead we wished to understand the degree

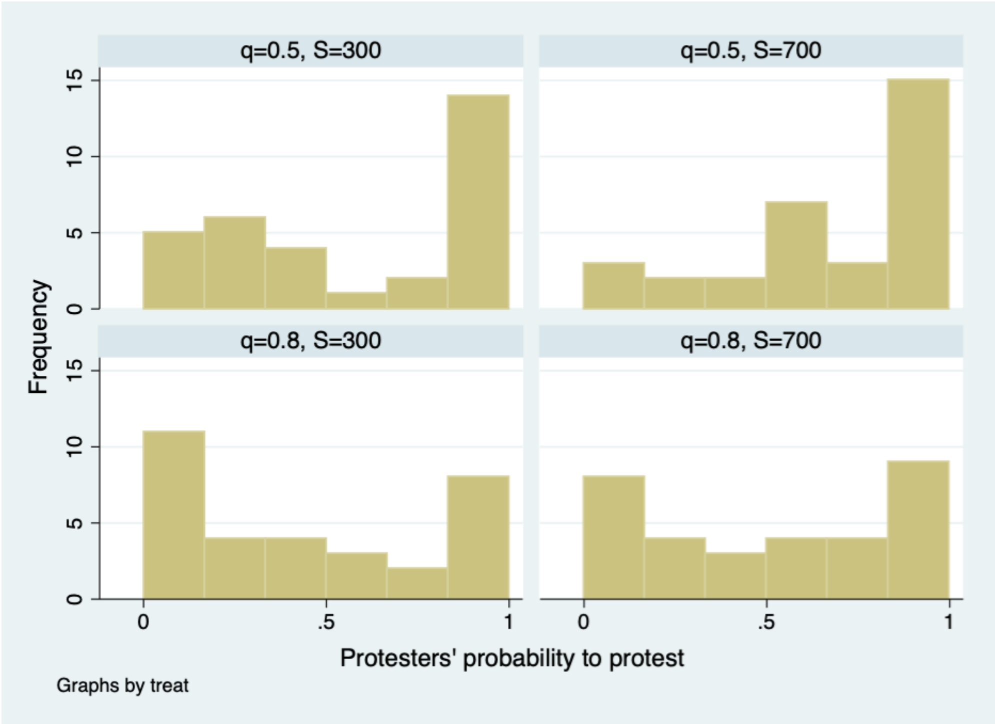
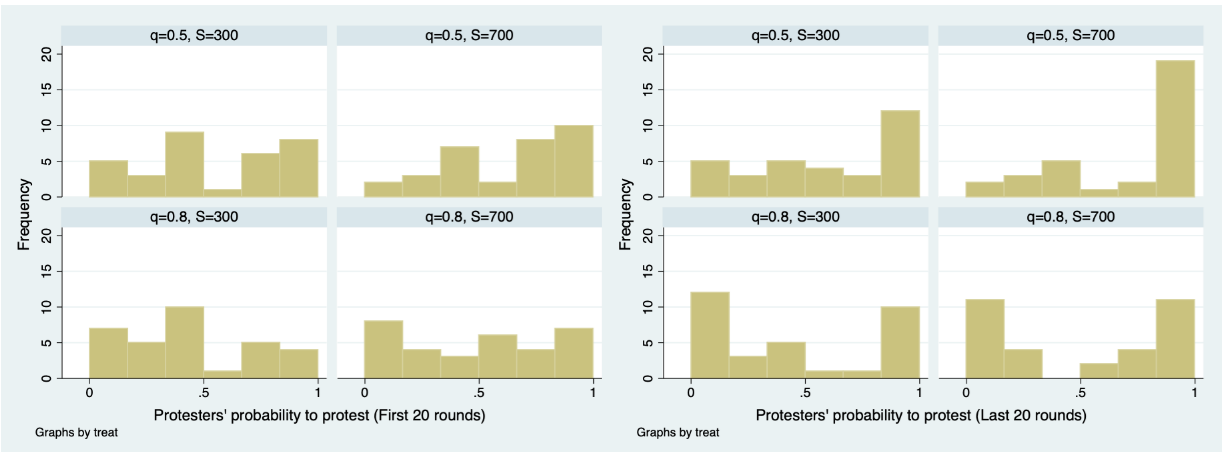


Figure 6: Histograms show the distribution of individual protester voting P frequencies by treatment. There are 32 individuals in each treatment.



(a) First twenty rounds

(b) Last twenty rounds

Figure 7: Individual behaviour in early versus late rounds.

to which it is plausible that individuals employ the strategic calculus underlying protest voting in our theoretical model. For that to be true, subjects needed to form expectations about others' behaviour given what they knew about the type distribution and previous play, and best respond to these expectations. This feature is not too different on how a voter would decide how to vote in a large election, forming expectations about others' votes using polls and historic results. Our results indicate that strategic protest voting does emerge in the lab. Having established this, it is not obvious why voters participating in large elections should reason in a significantly different way.

To be sure, our study does not settle the issue of protest voting in a definitive manner and more research is warranted in a number of important dimensions. For instance, it is important to understand how the described dynamics of protest and mainstream voting adjust in multi-party environments where, typically, additional strategic considerations co-exist. It would be particularly interesting to study the trade-off between Duvergerian considerations (i.e., coordinate behind the mainstream alternative one dislikes less) and protest desires (i.e., vote for a non-serious contender to mitigate the vote-share difference between the two mainstream candidates). Moreover, one would care to understand the effects of alternative electoral rules on protest voting decisions. Indeed, it seems that certain electoral systems allow voters to protest more safely than others. For instance, when voters vote according to a runoff system, they should face less risk of an electoral accident, as they usually have the chance to correct a possible first-round accident, in the second round.

Finally, further empirical tests in alternative settings would be useful in order to reaffirm or qualify the present findings. Despite the fact that our experimental design features certain positive elements, it is necessary that one explores different environments with a larger number of alternatives and voters, richer preference structures, and also non-artificial issues (e.g., Casella and Sanchez 2019). While analyzing such extensions is beyond the scope of the present paper, they all certainly appear as natural and interesting next steps.

Recent political events have highlighted the relevance of protest voting as an important type of behaviour in elections. Since the consequences of such behaviour may go beyond the electorate's wishes and have significant long-term effects, it is perhaps surprising how little it has been studied. Our paper can hopefully contribute towards closing this gap.

6 Appendix

Proof of Proposition 2 By dominance, it follows that, whenever a voter is assigned a non-protester type votes for M. By symmetry, we have that any equilibrium is essentially characterized by a single number, p, which denotes the probability that a voter votes for P when she is assigned a protester type. By responsiveness, it holds that this probability, p, cannot be equal to zero.

The probability, p, is larger than zero and smaller than one only if a protester is indifferent between voting M or P:

$$EU_M = EU_P$$

$$\left[\sum_{k=\frac{n}{2}-1}^{t-1} \frac{(n-1)!}{k!(n-1-k)!}[(1-q)+q(1-p)]^k[q \times p]^{n-1-k}\right] \times (1+s)+$$

$$\left[\sum_{k=t}^{n-1} \frac{(n-1)!}{k!(n-1-k)!}[(1-q)+q(1-p)]^k[q \times p]^{n-1-k}\right] \times (1) =$$

$$\left[\sum_{k=\frac{n}{2}}^{t} \frac{(n-1)!}{k!(n-1-k)!}[(1-q)+q(1-p)]^k[q \times p]^{n-1-k}\right] \times (1+s)+$$

$$\left[\sum_{k=t+1}^{n-1} \frac{(n-1)!}{k!(n-1-k)!}[(1-q)+q(1-p)]^k[q \times p]^{n-1-k}\right] \times (1)$$

The above equality holds only if p takes the following value:

$$p(s,q) = \frac{1}{q\left[1+4^{\frac{1}{-n+2t+2}}\left(\frac{(s+1)(t+1)!(n-t)!}{sn\left(\frac{n}{2}!\right)^2}\right)^{\frac{2}{-n+2t+2}}\right]}$$

We notice that $p(s,q) < 1$ if and only if

$$q > \frac{1}{1+4^{\frac{1}{-n+2t+2}}\left(\frac{(s+1)(t+1)!(n-t)!}{sn\left(\frac{n}{2}!\right)^2}\right)^{\frac{2}{-n+2t+2}}} = \tilde{q}(s)$$

and, hence, a mixed-strategy equilibrium (i.e., an equilibrium such that a protester votes for either alternative with positive probability) exists if and only if $q > \tilde{q}(s)$. When $q \leq \tilde{q}(s)$ we have that $EU_M \leq EU_P$ for every p, and, hence, the unique equilibrium that satisfies our properties is the pure one in which a protester votes for P with certainty.

Proof of Proposition 3 When $q > \tilde{q}(s)$, it is easy to see that:

$$\frac{\partial p(s,q)}{\partial q} = -\frac{1}{q^2\left[1+4^{\frac{1}{-n+2t+2}}\left(\frac{(s+1)(t+1)!(n-t)!}{sn\left(\frac{n}{2}!\right)^2}\right)^{\frac{2}{-n+2t+2}}\right]} < 0$$

$$\frac{\partial p(s,q)}{\partial s} = \frac{2^{\frac{2}{-n+2t+2}+1}\left(\frac{(s+1(t+1)!(n-t)!}{ns\left(\frac{n}{2}!\right)^2}\right)^{\frac{2}{-n+2t+2}}}{qs(s+1)[2(t+1)-n]\left[4^{\frac{1}{-n+2t+2}}\left(\frac{(s+1)(t+1)!(n-t)!}{ns\left(\frac{n}{2}!\right)^2}\right)^{\frac{2}{-n+2t+2}}+1\right]^2} > 0$$

$$\frac{\partial qp(s,q)}{\partial q} = 0$$

$$\frac{\partial qp(s,q)}{\partial s} = \frac{2^{\frac{2}{-n+2t+2}+1}\left(\frac{(s+1(t+1)!(n-t)!}{ns\left(\frac{n}{2}!\right)^2}\right)^{\frac{2}{-n+2t+2}}}{s(s+1)[2(t+1)-n]\left[4^{\frac{1}{-n+2t+2}}\left(\frac{(s+1)(t+1)!(n-t)!}{ns\left(\frac{n}{2}!\right)^2}\right)^{\frac{2}{-n+2t+2}}+1\right]^2} > 0$$

Proof of Proposition 4 We want to show that for any $q = \{0.5, 0.8\}$ and $S = \{300, 700\}$ there are type asymmetric equilibria where: a) voters always vote M when non-protesters, and b) $k = \{1, 2, 3\}$ voters always vote M when protesters and $4-k$ voters always vote P when protesters.

It is trivial to see that voters assigned a non-protester type never have incentives to deviate and vote P. For the voters assigned a protester type we need to show that: i) none of the k voters has incentives to deviate and vote P, and b) none of the $4-k$ voters has incentives to deviate and vote M. That is, for i) we require that:

$$EU_M \geq EU_P$$

$$\frac{k-1}{3}\times 200 + \frac{4-k}{3}\times[q\times S+(1-q)\times 200] \geq \frac{k-1}{3}\times S + \frac{4-k}{3}\times[q\times 100+(1-q)\times S]$$

and for ii) that:

$$EU_P \geq EU_M$$

$$\frac{k}{3}\times S + \frac{3-k}{3}\times[q\times 100+(1-q)\times S] \geq \frac{k}{3}\times 200 + \frac{3-k}{3}\times[q\times S+(1-q)\times 200]$$

For $q = 0.5$ and $S = 300$ the above two inequalities are satisfied only for $k = \{1, 2\}$, for

$q = 0.5$ and $S = 700$ only for $k = \{1\}$, for $q = 0.8$ and $S = 300$ only for $k = \{2\}$, and for $q = 0.8$ and $S = 700$ only for $k = \{2\}$, proving the statements in the proposition.

Sample Instructions of Treatment $(300, 0.5)$

Translated from the original version in Greek

Instructions

Thank you for participating in this session. Please remain quiet. The experiment will be conducted using a computer and all answers will be recorded on this. Please do not talk to each other and keep quiet during the session. The use of mobile phones and other electronic devices is not permitted. Please read the instructions carefully and if you have any questions, raise your hand and we will answer it.

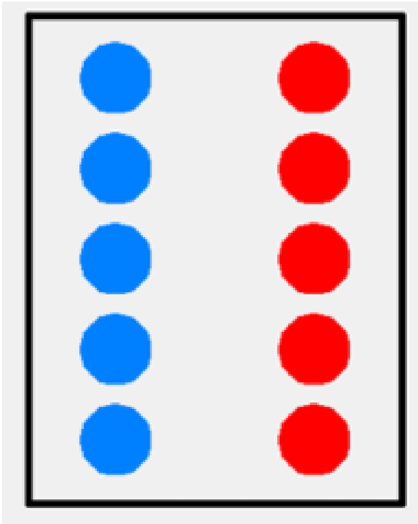
General Instructions

The experiment will include a series of decisions. Each of you will receive a financial reward. **The exact amount that you will receive will depend both on your own decisions and on the decisions of other participants**, in a way that will become clear below. In addition, you will receive 5 euros as a show-up fee. Following the completion of the experimental session, you will be paid privately in cash, by giving us the identification number of the computer you were using.

There is no time limit for making your decision. However, it is recommended that your choice should be submitted within a reasonable time frame, so that the experiment can be completed on time. If asked by the researchers, please submit your choice as soon as possible.

The Experiment

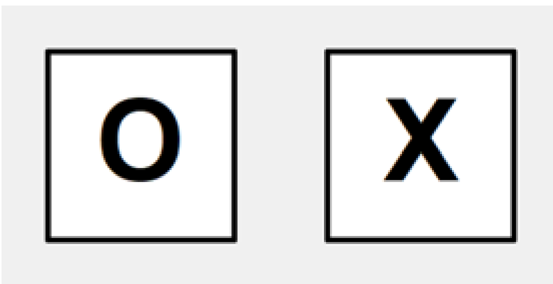
The experiment will consist of 100 rounds. Each round is completely independent of the others. In each round, you will be randomly paired with another participant and you will interact only with your partner. The pairs will be changing in each round, thus your partner in a round will most likely be different from your partner in the previous round.



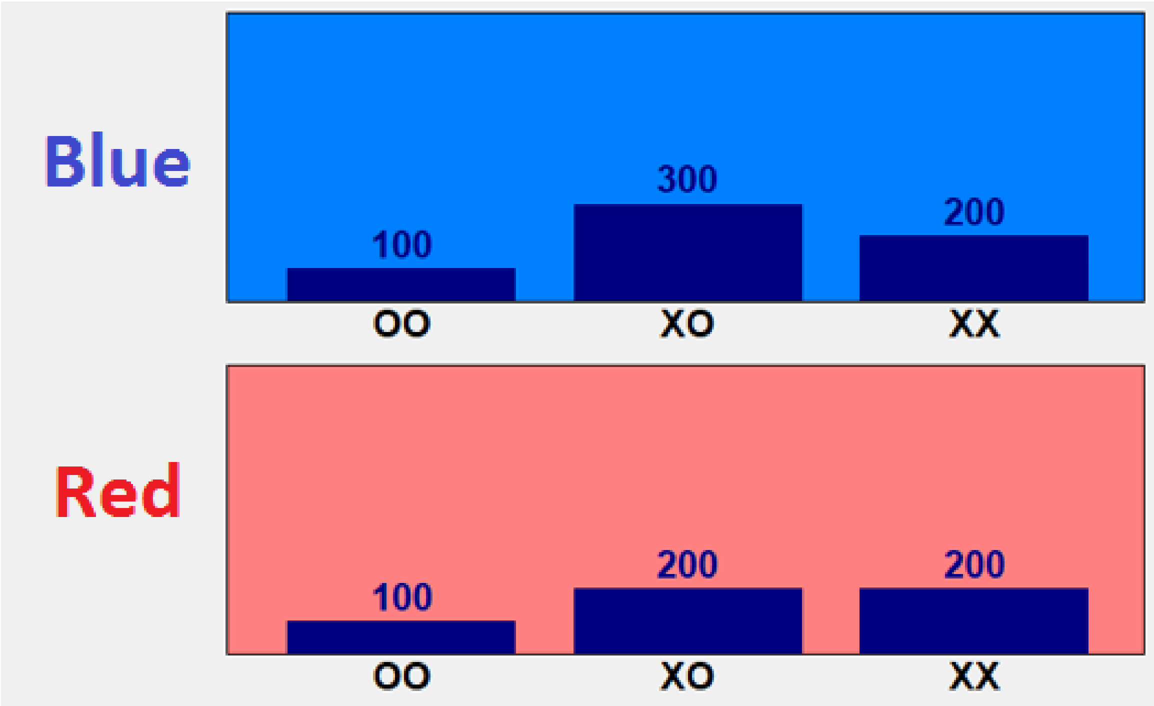
The ball. At the beginning of each round the computer will randomly draw one of the ten balls from the jar above for each member of the pair. The random draw will be made independently for each participant and each ball will be equally probable to be drawn. Therefore, each participant has a 50% chance of seeing a blue ball and a 50% chance of seeing a red ball. You will only be able to see the color of your ball.

Type. The color of each participant's ball determines the participant's type. So, in each round the type of a participant will be either **RED** or **BLUE**. The type of a participant will affect his potential profits from that round in a way that will be clarified below.

The Decisions. Once you know your type for the particular round, you will have to choose between two available options, **O or X**. At the same time with you, your partner will choose between the same two options.



Profits. Your profits in each round will depend on your type and the choices you and your partner will make, as shown below.



Namely, if your type is **Blue**, then:

- If both you and your partner choose **O** you will get **100 points**.
- If one of you chooses **O** and the other one chooses **X** you will get **300 points**.
- If both you and your partner choose **X** you will get **200 points**.

Whereas, if your type is **Red**, then:

- If both you and your partner choose **O** you will get **100 points**.
- If one of you chooses **O** and the other chooses **X** you will get **200 points**.
- If both you and your partner choose **X** you will get **200 points**.

Information at the end of each round. At the end of each round, you will be able to see your own choice, your partner's choice and your profit from that round.

Final profits. At the end of the experiment, 10 rounds will be selected randomly and you will receive the sum of your profits in those rounds, plus the show-up fee (5 euros). The conversion rate is **1 euro for every 250 points**. Each one of the 100 rounds has the same probability of being selected.

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