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Esteban F Klor and Eyal Winter

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Esteban F Klor, Hebrew University of Jerusalem and CEPR
Eyal Winter, Hebrew University of Jerusalem

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Centre for Economic Policy Research
90–98 Goswell Rd, London EC1V 7RR, UK
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999
Email: cepr@cepr.org, Website: www.cepr.org

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ABSTRACT

On Public Opinion Polls and Voters' Turnout*

This paper studies the effects that the revelation of information on the electorate's preferences has on voters' turnout decisions. The experimental data show that closeness in the division of preferences induces a significant increase in turnout. Moreover, for closely divided electorates (and only for these electorates) the provision of information significantly raises the participation of subjects supporting the slightly larger team relative to the smaller team. This behaviour contradicts the qualitative predictions of the unique quasi-symmetric Nash equilibrium of the theoretical model. We show that the heterogeneous effect of information on the participation of subjects in different teams is driven by the subjects' (incorrect) beliefs of casting a pivotal vote. Simply put, subjects overestimate the probability of casting a pivotal vote when they belong to the team with a slight majority, and choose the strategy that maximizes their utility based on their inflated probability assessment. Empirical evidence on gubernatorial elections in the U.S. between 1990 and 2005 is consistent with our main experimental result. Namely, we observe that the difference in the actual vote tally between the party leading according to the polls and the other party is larger than the one predicted by the polls only in closely divided electorates. We provide a behavioural model that explains the main findings of our experimental and empirical analyses.

JEL Classification: C72, C92, D72 and H41
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Esteban F Klor
Assistant Professor
Department of Economics
Hebrew University of Jerusalem
Mount Scopus
Jerusalem 91905
ISRAEL
Tel: (972 2) 588 3143
Fax: (972 2) 581 6071
Email: eklor@mscc.huji.ac.il

Eyal Winter
Department of Economics
The Hebrew University of Jerusalem
Mount Scopus
Jerusalem 91905
ISRAEL
Email: mseyal@mscc.huji.ac.il

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1. Introduction

In large electorates the probability of casting a pivotal vote is close to zero regardless of the actual distribution of preferences. A poll pointing to an evenly split electorate, however, may affect the voters' beliefs on the probability of casting a pivotal vote and, therefore, the voters' turnout decisions.[1] Indeed, a lively debate is being carried in several countries on whether or not polls affect electoral results. A fundamental difficulty when trying to empirically assess the causal effect of public opinion polls on the individuals' turnout decisions is that of omitted variables. Several factors, like valence characteristics of candidates and their chosen platforms, affect not only individuals' turnout but also the public opinion polls.

This paper analyses experimentally and empirically the impact that the provision of information on the electorate's distribution of preferences has on the voters' participation decisions. Our experiment, based on the seminal theoretical contribution of Palfrey and Rosenthal (1983), compares the subjects' participation decisions in an election when they know the exact distribution of preferences of the electorate to their decisions when they only know their own preferences. Additionally, we collected, through a survey administered at the beginning and at the end of our experiment, the subjects' estimated probabilities of casting a pivotal vote for all the different distributions of preferences. This allow us to

[1] In the last presidential elections in the U.S., for example, individual voters that supported Ralph Nader and resided in states where the election was predicted to be close traded their votes with John Kerry's supporters that lived in states where the election was expected to be lopsided in favor of one candidate. People that traded votes felt that now their vote "really counted." As related in votepair.org/stories: "I live in Utah. The most republican state in the nation. I happen to be a democrat who voted for Gore. My vote did not count because of the stupid electoral college. By swapping my vote, I can finally have my vote count for a democrat."

assess whether the subjects' behavior is a consequence of their beliefs or despite thereof.

Our approach provides several contributions to the vast literature that analyzes voters' turnout from a rational choice perspective.[2] First, the experimental approach provides us with a controlled environment that nevertheless resembles a turnout situation. As a result, we generate data on the subjects' actual behavior without any of the biases existent in empirical studies based on post election survey data. Second, in the laboratory we are able to track the behavior of every single voter in different scenarios, allowing us to conduct comparative static exercises using the individual voter as our unit of analysis. By only changing the electorate's distribution of preferences from one round to the other we identify the effect that those changes have on the participation decision of each individual voter.[3]

Finally, the laboratory grants us the unique possibility to learn the voters' beliefs. Most of the rational choice studies of voter turnout assume that voters are fully rational –that is, voters have the correct beliefs for every possible configuration of the electorate's preferences. In equilibrium a voter's strategy maximizes her payoffs given the voter's beliefs, which should be consistent with the actual strategies of the rest of the voters. Unable to obtain data on voters' beliefs, the related empirical literature maintains the rationality assumption throughout. Voters' beliefs, however, are a fundamental ingredient of voters' behavior. Hence the importance of eliciting the beliefs that voters hold separately from their actions.

[2] Blais (2000) and Feddersen (2004) provide thoroughs literature reviews.

[3] Note the impossibility of conducting a similar analysis using actual elections. This would entail not only gathering a panel data set with each individual voter as the unit of observation for several elections, but also controlling for the information that each individual is exposed to before every election.

The experimental results show that closeness in the division of preferences induces a significant increase in turnout. Perhaps more surprisingly, in closely divided electorates (and only for these electorates) the provision of information significantly raises the participation of subjects supporting the slightly larger team relative to the smaller team –we refer to this behavior as the bandwagon effect of polls. This behavior contradicts the qualitative predictions of the unique quasi-symmetric equilibrium of the baseline theoretical model underlying the experiments. Moreover, the observed bandwagon effect of information provision is qualitatively opposed to the equilibrium behavior of models of information revelation through public opinion polls. The theoretical analyses by Goeree and Großer (2005) and Taylor and Yildirim (2005) predict that the provision of information on the electorate's preferences induces voters in the majority to participate less frequently because they free ride on the voting of other individuals supporting the same alternative. At the same time polls stimulate the participation of voters in the minority to offset the advantage of the other alternative. The observed behavior in the laboratory contradicts these predictions for electorates that are closely split. When preferences are lopsided in favor of one alternative some free riding does occur in the behavior of subjects supporting the large team, but subjects supporting the small team decrease their frequency of participation in similar proportions.

The observed bandwagon effect of polls is consistent with previous experimental studies. While studying the incidence of reform in the presence of individual-specific uncertainty, Cason and Miu (2005) find that the participation rates of the majority are higher than the participation rates of the minority. In an independent study, Großer et al. (2005)

examine the welfare implications of endogenous voter participation using a different experimental design that includes floating voters. They also find that the majority participates more than the minority but this difference is not statistically significant. Their experimental design allows them to test this hypothesis only using the electorate as the unit of observation. Our experiment, like Cason and Miu's (2005), is especially designed to use the subjects as our unit of observation, granting us the possibility to differentiate between distributions with enough observations for each one to be able to perform statistically meaningful tests.

Finally, Levine and Palfrey (2005) experimentally test the predictions of Palfrey and Rosenthal (1985) whereby participation costs are heterogeneous and privately known. They find that subjects in the small team vote with higher frequency than subjects in the large team. Unlike our experimental design, theirs doesn't directly test for the effects of the provision of information. Perhaps more importantly, their study [as well as that of Großer et al. (2005)] fixes each subject's preferences at the beginning of the session thus allowing the subjects to gain experience and learn over rounds. This was done in order to check whether the subjects' behavior converges with experience to the one predicted by the pure strategy equilibrium of the game they analyzed. On the contrary, we use a random and anonymous reassignment procedure specifically to reduce repeated game incentives and minimize the effects of learning. We believe this is the right experimental design given the objectives of our study.

To uncover the root causes behind the bandwagon effect of polls we incorporate into the analysis the subjects' responses to the surveys. This analysis shows that the heterogeneous

effect of information on the participation of subjects in different teams is driven by the subjects' (incorrect) beliefs of casting a pivotal vote. Simply put, subjects overestimate the probability of casting a pivotal vote when they belong to the team with a slight majority, and choose the strategy that maximizes their utility based on their inflated probability assessment. This conjecture was first formalized by Riker and Ordeshook (1967). To the best of our knowledge, the current paper is the first attempt to formally test this hypothesis.

We test the external validity of our main experimental result using a newly culled data set on gubernatorial elections in the U.S. since 1990. For these purposes we use as our proxy to closeness in the distribution of preferences the results of pre-election polls published by newspapers within one week before the elections. The observed evidence is consistent with the experimental results. Namely, in elections where the polls pointed to a narrow margin between the two parties the difference in the elections' vote share of the two parties is greater than the difference predicted by the polls. The effect above is not present in electoral contests that were expected to be lopsided according to the polls' predictions.

The individuals' behavioral pattern has significant implications in two different contexts. The immediate one is in the context of voting, where our results point to an interesting behavioral phenomenon that has been overlooked by the related literature. This behavior has important implications on the widespread policy debate on the desirability of publishing polls close to an election date. On the one hand, supporters of the ban claim that the observed inclination of people to vote for candidates leading in the surveys may

lead to the manipulation of polls before elections by parties with vested interests. On the other hand, opponents to the measure claim that a ban on polls before elections suppresses the freedom of expression.[4] Experimentally, we show that the bandwagon effect is a direct consequence of higher voter participation and not necessarily of voters changing their preferences. This suggests that a policy geared to increase voters' participation can substantially offset the effects of polls.

The observed phenomenon has also broader implications regarding the empirical relevance of mixed strategy equilibria in more general setups. When a player can choose between two alternatives she may use a mixed strategy only when she is indifferent between the two. In an asymmetric environment as the one proposed here, players in the small team would be indifferent between voting and abstaining only if players in the large team vote with a relatively lower frequency than players of the small team. Moreover, each player should have the correct beliefs regarding the mixed strategies used by the rest of the players. The equilibrium strategies (and beliefs) are not necessarily intuitive, especially in setups with only slight differences between the players. Thus, for these conditions to hold behaviorally probably requires that the game is played with a considerable amount of repetition to facilitate experience and learning.

We propose an alternative theoretical explanation that relaxes Nash equilibrium but is consistent with the voters' beliefs and behavior observed in the laboratory. In particular, we show that if individuals believe that in a close election the probability of voting is

[4] According to the Foundation for Information/ESOMAR a ban on the publication of opinion polls exists in 30 out of 66 countries surveyed in their study published in 2003. Nowadays, a lively debate is being conducted in several countries, like Canada, France, Ireland, The Philippines and Russia.

sufficiently high and similar for every voter regardless of team sizes, then optimal behavior with respect to these beliefs gives rise to voting patterns consistent with the ones observed in the current study. While these beliefs cannot be part of equilibrium with groups of unequal sizes, they are consistent with the documented departures from quasi-symmetric equilibrium strategies in other contexts as well.[5]

The paper is organized as follows. The next section presents the theoretical framework underlying our experiment. A detailed description of our experimental design appears in Section 3. Section 4 shows the main experimental results of the paper. Section 5 test the external validity of our experimental results. We present an alternative theoretical explanation for the subjects behavior in Section 6. The last section of the paper concludes. The proof of our theoretical result appears in the appendix.

2. Theoretical Framework

The theoretical framework we consider is based on the seminal contribution of Palfrey and Rosenthal (1983). There are n risk neutral individuals ($n \geq 3$). Individuals have to decide between two alternatives. The alternative is chosen via simple plurality rule; that is, the alternative with the greater number of votes is chosen. In the event of a tie each alternative is selected with equal probability. This is a collective choice problem: the chosen alternative applies to all the individuals.

Each individual has preferences over the two alternatives. Let B denote the utility

[5] The alternative beliefs proposed herein can account, for example, for the departures of quasi-symmetric mixed strategies documented by Rapoport et al. (2002) in an experimental study of market entry with asymmetric players.

difference to an individual between the event that her favored alternative is elected and the event that the other alternative wins the election. Each individual has to decide whether to vote or abstain.[6] Let us denote by s_i the strategy of individual i (let $s_i = 1$ when individual i votes and $s_i = 0$ otherwise). All the individuals make their strategy choices simultaneously. There is a positive cost $C > 0$ associated with the act of voting. B and C are common knowledge and identical to all the individuals. We assume that $B > 2C$.

In this setup, a rational individual votes if and only if

$$B \times P(1, s_{j \neq i}) - C \geq B \times P(0, s_{j \neq i}),$$

where P denotes the probability that individual i's preferred alternative is chosen and $s_{j \neq i}$ is a profile that describes the strategy of all the individuals excluding individual i.

Clearly, a rational individual participates in the election only if, given the other individuals' strategies, her participation affects the probability that her preferred alternative is chosen. In other words, an individual may turn out to vote only when she is pivotal.

We analyze the game above under two different frameworks regarding the individuals' information about the distribution of preferences. The first scenario focuses on a symmetric private value model of voting. Accordingly, each voter knows the alternative that she favors, and that the probability that any other individual prefers any given alternative is

[6] In the present framework voting against one's preferred alternative is strictly dominated by not voting. Therefore, we rule out this possibility and, whenever we say that an individual votes, we imply that she is voting in support of her preferred alternative.

the same for both alternatives. The individuals' probability distributions are stochastically independent. We find the unique Bayesian Nash Equilibrium (BNE) of this game. According to the unique BNE all the individuals randomize between voting for their preferred alternative and abstaining with the same probability. This is a direct consequence of the symmetric common prior over the individuals' distribution of preferences.

In the second scenario the number of voters favoring each alternative is commonly known. This is exactly the framework analyzed by Palfrey and Rosenthal (1983). This complete information game has multiple Nash equilibria. The solution concept that generates unique predictions for the game is that of totally quasi-symmetric mixed strategy Nash equilibrium (QSNE). According to this equilibrium concept all the individuals supporting the same alternative are using the same strategy. Moreover, this strategy involves voting with a probability strictly between zero and one. Note that individuals supporting different alternatives are not necessarily mixing with the same probability.

For the purposes of our experimental study we focus on electorates of seven individuals and set $B = 10$ and $C = 4$. We choose an odd number of participants in each electorate to rule out equilibrium in pure strategies (except for the case where all the participants share the same preferences). When the subjects know the distribution of preferences symmetric equilibria do not exist for this configuration either. In fact, with seven players and two alternatives there exists a unique totally mixed quasi-symmetric Nash equilibrium. Table 1 provides the point predictions for the unique BNE and QSNE.

[Table 1 around here]

Note that in the QSNE for every distribution of preferences individuals in the minority vote with higher probability than individuals in the majority. This result is a direct consequence of the mixed strategies equilibrium's requirement that individuals' should be indifferent between voting and abstaining. Since individuals would be willing to vote only if the probability of casting a pivotal vote is positive, they have to expect that with a high enough probability the number of votes in support for each team would be equal, or differ by only one vote. To satisfy that requirement individuals supporting the large team should vote with lower probability than individuals supporting the small team.

3. Experimental Design

The experiment was run at the RatioLab - The Center for Rationality and Interactive Decision Theory at The Hebrew University of Jerusalem. The 84 subjects in this experiment were recruited from the pool of undergraduate and graduate students from The Hebrew University and had no previous experience in experiments related to voters' participation.

In each session 21 subjects participated as voters. The experiments were conducted via computers. Before the experiment started an experimental administrator read the instructions aloud. We also asked several hypothetical questions at the end of the instructions to check subjects' comprehension of the procedure (the instructions and the questionnaire are available from the authors upon request). The experiment began after all subjects had solved all questions successfully. The experiment lasted for about ninety minutes. Each subject received 80 tokens as a participation fee and subsequent earnings according

to the payoffs specified in the experiment. Average earnings were equal to 244 tokens. We converted each token to NIS 0.25 and paid the subjects in cash in private at the end of the session.[7] Throughout the experiment we ensured anonymity and effectively isolated each subject in a cubicle to minimize any interpersonal influence that could stimulate uniformity of behavior. Communication among subjects was not allowed throughout the session.

Each experimental session entailed 20 independent rounds. In each round we randomly divided 21 subjects into three electorates of seven participants each. At the beginning of each round an equal probability rule randomly assigned each subject to one of two teams: Green or Blue. A subject earns 10 tokens if the team she prefers is selected by majority voting in an election. Voting entails a cost of 4 tokens.

The sequence of events is as follows. In the first stage of each round each subject knows only her preferred color. She decides whether to vote or abstain. After all the participants make their decisions we proceed to the second stage of the round. In this stage subjects are told the electorate's distribution of preferences. Note that subjects don't receive any information on the subjects' participation decisions in the round's first stage. Subjects have to decide again whether or not to vote. After all the subjects choose an action, they learn the selected teams of the first and second elections, their corresponding payoffs for the round, and their cumulative payoffs – no information is provided on the number of subjects that voted for a given team. Ties are always broken by an equal probability rule.

[7] That is, subjects on average earned NIS 61 for roughly 90 minutes of their time. The hourly minimum wage in Israel is slightly below NIS 20. The current exchange rate is NIS 4.65 per US dollar.

At the end of each round subjects are randomly reshuffled between electorates and each subject's preferred color is again randomly decided.

In addition to playing this game each subject completed a survey that asked her to assess the probability of casting a pivotal vote for each possible team size. Every subject completed the same survey twice – before the beginning of the first round and after finishing the last round.

4. Experimental Results

This section presents the effects of revealing information about the electorate's distribution of preferences on the subjects' turnout decisions. To clarify the exposition we divide this section into two subsections. The first subsection presents the basic results on the impact of information provision on subjects' participation decisions. The second subsection reports the results taking into account not only subjects' actions but also their beliefs.

For all the tests reported below the unit of observation is the subject. For the nonparametric tests we consider, for each subject, the average across all the different rounds. This eliminates possible correlations across repeated observations of a given subject. Therefore, the statistics reported are averages of the subjects' averages. In the regression analysis, however, we use all the available data, adopting a random effects specification with the subject as the random factor.

4.1. The Effect of Information on Subjects' Turnout Decisions

Figure 1 depicts the average turnout rate before the provision of information and the average turnout rate after information is revealed, as a function of the different distribution of preferences. The figure also includes the equilibrium's predicted turnout rate.

[Figure 1 around here]

The figure clearly indicates that closeness in the division of preferences induces a significant increase in turnout. Whereas the average turnout rate before the provision of information is slightly below 25 percent, the average turnout rate for a distribution of teams of sizes three and four is 40 percent (the difference between the two is statistically significant with $z = 3.125$, $p < 0.001$, two-sided sign test using the normal approximation to the binomial distribution).

The provision of information for other divisions of the electorates doesn't have a significant impact on the subjects' turnout relative to their turnout rates before the provision of information ($p > 0.8$ when the division of teams is five versus two; $p > 0.65$ when the division is six versus one; and $p > 0.8$ when the division is seven versus zero, all according to a two-sided sign test). Moreover, the observed rates aren't substantially different from the equilibrium's prediction. The turnout rate is higher than the equilibrium's prediction for distributions of seven versus zero and five versus two, whereas turnout is lower than the equilibrium's prediction for a distribution of six versus one. For closely divided preferences, on the contrary, we observe important quantitative differences between the

subjects' turnout and the predictions of the theoretical model underlying the experiment.[8]

Although Figure 1 reveals a clear and significant effect of closeness on participation, the figure masks important and unexpected differences between teams for a given distribution of preferences. The heterogeneous effect of closeness between teams is presented in Figure 2, which decomposes turnout as a function of the size of the teams. Note that a team of size j implies that the distribution of the electorate's preferences is $(j, 7-j)$.

This figure shows the most startling effect that emerges from our experiment: For closely divided electorates the effect of information on voter participation is not homogenous across teams of different sizes. In particular, the provision of information significantly raises the participation of voters supporting the slightly larger team relative to the participation of voters supporting the smaller team, thus affecting the election's results.

[Figure 2 around here]

In other words, for closely divided electorates revealing information on subjects' preferences causes an important increase on the participation of all the subjects: Subjects that belong to teams of size three and four vote more often after learning the distribution of preferences. The effect, however, is stronger for subjects that belong to the slightly larger team. The turnout rate for subjects that belong to a team with four supporters is more than twenty percent higher than the turnout rate of subjects that belong to a

[8] The correlation between closeness and turnout observed in the laboratory is consistent with results in the related empirical literature [see, for example, Shachar and Nalebuff (1999)]. Feddersen and Sandroni (2006) show that this correlation can be explained using a model where voters have ethical preferences. Coate and Conlin (2004) provide empirical evidence supporting the ethical voters approach.

team of three. This behavior contradicts the quantitative and qualitative predictions of the theoretical model. Accordingly, members of the minority should vote with a higher probability than the members of the majority to offset the advantage of the majority. Moreover, the provision of information should induce a decrease in the turnout rate of the majority because of free riding of its members.

We don't observe a similar effect for electorates with a more lopsided division of preferences. For electorates that aren't closely divided, revealing the distribution of preferences doesn't affect the turnout rate of subjects supporting the small team but lowers the turnout of subjects supporting the large team. For example, we see an important decrease in the participation of subjects after learning that they belong to a team of size seven. A similar phenomenon occurs for subjects that belong to a team of six subjects. Note that these subjects turn out in a frequency lower than the frequency of a subject that is the sole supporter of an alternative. An analogous situation occurs when the subjects' preferences are divided between teams of five and two members. This behavior, which seems to be a consequence of free riding, is in accordance with the equilibrium's predictions.

The different effect of closeness on subjects conditional on the size of the team they support is evident from the estimation of the following participation equation:

$$Vote\_Inf_{i,t} = 1\left\{\beta_0 + \beta_1 Vote\_NoInf_{i,t} + \beta_2 Majority_{i,t} + \beta_3 round_t + \alpha_i \geqq 0\right\} \quad (4.1)$$

where $1\{\cdot\}$ is an indicator function that takes the value 1 if the left hand side of the inequality inside the brackets is greater than or equal to zero, and 0 otherwise; $Vote\_Inf_{i,t}$

reflects subject i's participation decision in the second stage of round t after the provision of information on the distribution of preferences. The covariates account for the subject's decision in the first stage of round t before the provision of information ($Vote\_NoInf_{i,t}$), and whether or not the subject belongs to the large team in an electoral contest ($Majority_{i,t}$). We also include in the analysis a time trend ($round_t$) to capture the fact that subjects may systematically change their strategy as a consequence of learning from round to round; and a subject specific constant effect (α_i), that captures random disturbances (constant through time) that characterize subject i.

We estimate equation (4.1) separately for each different distribution of subjects' preferences using a random effects probit estimation.[9] Table 2 presents the estimated coefficients.

[Table 2 around here]

The table quantifies the most striking of our results: When the electorate is closely divided, the provision of information on subjects' preferences significantly raises the participation of subjects in the majority relative to the minority. The team size effect when the electorate is divided into teams of three versus four subjects is positive, large in value relative to the other coefficients and statistically significant. It increases the probability of voting by slightly over 10 percent for the average subject. We also observe a significant negative effect of rounds, pointing to a learning process that induces subjects to reduce

[9] A similar estimation strategy was used in an experimental context by Frechette et al. (2005). That study's main focus is the analysis of the impact of open versus closed amendment rules in models of bargaining.

their participation in elections.[10] Interestingly, subjects' participation decision in the first stage of each round doesn't explain their actions after the provision of information.

The subjects' behavior is qualitatively different when the difference in the number of supporters for each team is relatively large. When the difference in the number of supporters is of three or five subjects the provision of information doesn't affect the participation of subjects in the majority any differently than it affects the participation of subjects in the minority. For these groups compositions, moreover, the number of rounds elapsed doesn't affect participation.

Contrary to closely divided groups, when the difference in the number of supporters for each team is relatively large the best predictor for subjects' participation decisions after the provision of information is the subjects' actions in the first stage of each round. That is, there are subjects that reveal a preference for participation in the first stage, and therefore these subjects are the ones turning out to vote in the second stage when the electorate's preferences are not closely divided. This seems to be particularly the case in very lopsided contests (6 versus 1) where the coefficient of the first stage decision is not only highly statistically significant, but also large in value relative to the other coefficients. The probability of voting in the second stage is 30 percent higher for the average subject that belongs to a team of size one and voted in the first stage relative to the average subject that didn't vote in the first stage. The marginal effect of voting in the first stage on the probability of voting in the second stage is 24 percent for subjects in teams of size

[10] We test the same model including the interaction between majority and number of rounds as an additional covariate. The coefficient for this covariate is not significant; thus, the significant differences between majority and minority don't disappear over rounds.

6.

These results not only contradict the theoretical predictions of Palfrey and Rosenthal (1983), Goeree and Großer (2005) and Taylor and Yildirim (2005), all based on Nash equilibria. They cannot be accounted by the alternative quantal response equilibrium concept applied to the study of participation games by Goeree and Holt (2005).

4.2. The Effect of Subjects' Beliefs on Their Turnout Decisions

This subsection incorporates the surveys' answers to the analysis to better account for the subjects' strategies. As already pointed out, these surveys, conducted at the beginning and at the end of the experiment, asked every subject to quantify the probability of casting a pivotal vote for every possible distribution of preferences. Theoretically, the equilibrium probability of casting a pivotal vote depends only on $2C/B$ –the voting cost divided by half the benefits of a victory of the subject's preferred alternative. Given that we hold both constant, the equilibrium's predicted probability of casting a pivotal vote is constant as well regardless of the distribution of preferences. (In our application with a benefit of 10 tokens and a cost of 4 tokens this probability is equal to 0.8).

Figure 3 depicts the average subjects' beliefs of casting a pivotal vote as a function of the size of the team. The figure includes the results of the survey taken at the beginning (labeled survey 1 in the figure) and at the end of the experiment (survey 2). This figure also includes the frequencies of elections in which at least one subject was pivotal based

on the other subjects actual behavior.

[Figure 3 around here]

Figure 3 shows that subjects grossly miscalculate the probability of casting a pivotal vote. Quantitatively, the subjects state a probability much lower than the theoretical and actual probabilities. Qualitatively, subjects' beliefs seem to be strongly affected by the distribution of preferences across teams. A low probability is attributed to situations with a large difference in the number of supporters between the two teams, whereas the probability shows an important increase for closely divided teams. On average, the subjects stated a probability of 36.14% (with a standard deviation of 21.41%) of casting a pivotal vote when the difference between the teams is one. The stated probability decreases to 25.54% and 20.48% as the differences in team sizes increases to three and five respectively (the corresponding standard deviations are 17.53% and 18.01%). For teams of size seven the reported probability is 23.04% (the standard deviation is 27.08%). The subjects' estimates for a close distribution of preferences is significantly different than their estimates for the rest of the distributions ($p < 0.001$).[11]

It follows from the previous subsection (see Figure 2) that not only subjects' beliefs of casting a pivotal vote are relatively higher for closely divided electorates, but also their propensity to vote increases for these electorates. As a consequence, the actual probability

[11] The probability stated for distributions with a division of two versus five is significantly different than that reported for distributions of one versus six ($p < 0.001$). Neither series, however, is significantly different from the probabilities reported for teams of size seven ($p = 0.28$ and 0.18, respectively).

of casting a pivotal vote decreases in closely divided electorates. Hence, an increase in the subjects' beliefs of casting a pivotal vote brings about a decrease in the actual probability of being pivotal.

For a given distribution of preferences subjects, for the most part, attach a higher probability of casting a pivotal vote when they belong to the majority relative to the probability attached when subjects belong to the minority.[12] Contrary to our results from the previous section the differences are statistically significant for every distribution of preferences. The p-value that subjects in the majority state a higher probability of casting a pivotal vote than subjects in the minority is below 0.04 for a distribution of four versus three subjects. This value decreases to 0.03 and to 0.003 as the difference between the teams increases to three and five, respectively.[13]

A comparison of the subjects' beliefs and their participation decisions leads us to conjecture that the subjects' behavior is at least partially accounted by their beliefs. Simply put, subjects may overestimate the likelihood of casting a pivotal vote and act rationally based on their inflated probability assessment. To test this hypothesis we estimate equation (4.1) replacing $Majority_{i,t}$, the explanatory variable that captured the relative effect of belonging to the majority, by each subject's beliefs of casting a pivotal vote conditional on the size of the subject's team.

The estimated coefficients appear on Column (2) of Table 2. The results are qual-

[12] In the only exception, subjects in the second survey assigned a higher probability of casting a pivotal vote to a team of size one (25.02%) than to a team of size six (21.48%).

[13] All the conclusions above are reached using each subject's average of both surveys for a given team size. Interestingly, the subjects' responses to the surveys are not significantly different for any team size. Our results don't change if we use either survey instead of the subjects' average of the two surveys.

itatively similar to the ones observed in Column (1); that is, subjects' beliefs explain their behavior only when the distribution of preferences is closely divided between the two teams. Intuitively, in close elections subjects believe that there is a higher probability of casting a pivotal vote when they belong to the majority; these beliefs lead subjects to increase their relative frequency of voting when they indeed belong to the large group. Quantitatively, however, the coefficient for the subjects' beliefs is smaller than the coefficient estimated in Column (1). In particular, a ten percentage point increase in the belief of casting a pivotal vote when belonging to a team of size four causes a five percent increase in the probability of voting of the average subject.

When the sizes of the teams aren't closely divided the subjects' beliefs don't play a significant role in their participation decision. In these situations, as was concluded before, the best predictor for a subject's participation in the second stage of a round is the subject's action in the first stage of the round.

The next section tests the external validity of our main experimental observation using data from gubernatorial elections in the U.S.

5. Evidence from Gubernatorial Elections in the US

This section's exercise is mainly intended to assess the external validity of our main experimental result. Using a newly culled data set on gubernatorial elections in the U.S. we test whether, in close elections, the difference in the actual vote tally between the party slightly leading according to the polls and the other party is larger than the one predicted

by the polls. This hypothesis emanates directly from our experimental results and, to the best of our knowledge, has never been addressed in the vast extant empirical literature on voter turnout.

For the purposes of our empirical exercise we use as our proxy for closeness in the distribution of preferences the results of pre-election polls on gubernatorial races in the U.S., between 1990 and 2005. These polls, conducted by an independent polling firm (Mason-Dixon Polling and Research Inc.), were published by newspaper media within one week before the elections.[14] The polls are supposed to be extremely accurate. They are published right before the elections and report results based only on likely voters. Therefore, the polls already incorporate other factors that affect participation (e.g. candidates' spending and mobilizations' effects). Hence, any systematic difference between the polls and the electoral results may be attributed, at least partially, to effects that the poll has on the electorate – effects that were not taken into account by the polling company.

Our data set consists of 143 gubernatorial elections in 47 states. These are all the elections between 1990 and 2005 where Mason-Dixon Polling and Research Inc. conducted a public opinion poll within one week before the elections and where a third party didn't receive more than 30 percent of the election's votes.

The main two variables of interest are the differences in the vote share for the leading party minus the vote share for the trailing party according to the polls, and the electoral

[14] According to Matsusaka and Palda (1993, p. 861) "the ideal measure would be survey predictions from opinion polls taken the day before the election." Our data come as close as possible to that ideal.

results. Let us denote by

$$DP = L_p - T_p$$

the difference in the vote share of the leading and trailing parties according to the polls, and denote by

$$DE = L_e - T_e$$

the corresponding difference between the two parties according to the electoral results.[15] Our exercise focuses on deviations of the electoral results from the polls predictions, $DE - DP$, and how these deviations correlate with the size of DP.

Table 3 presents summary statistics of the variables of interest. The table differentiates between elections where the difference in the support between the two parties according to the polls was less than 10 percentage points and the rest of the elections.[16]

[Table 3 around here]

The table clearly illustrates the main difference between closely divided electorates and the rest. The mean difference between DE and DP is positive for elections expected to be close and negative for the rest of the elections. Moreover, the mean deviation between the electoral results and the polls' predictions is higher, in absolute value, for closely divided

[15] For a given election the classification of the parties as leading or trailing is fixed. Therefore, DP is always positive whereas DE may be negative if the winner of the election is the party trailing in the published public opinion poll. This occurs for 11 observations in our sample.

[16] The chosen cutoff of 10 percent is the level of closeness that emerges endogenously from the analysis below.

electorates than for the rest of the electorates (0.0154 and -0.0071 percentage points, respectively) even though the latter group of elections has a higher variance.

Figure 4 depicts $DE - DP$ on the vertical axis and DP on the horizontal axis. The figure includes the resulting curve according to the predicted value of $DE - DP$ based on the estimation of a fractional polynomial of DP, along with the confidence interval of the mean (calculated using robust standard errors).

[Figure 4 around here]

The observed pattern in Figure 4 is consistent with our experimental results. Accordingly, for polls pointing to a narrow margin between the candidates we observe a bandwagon effect, whereby supporters of the leading candidate increase their participation relative to supporters of the trailing candidate.[17] This is the case for polls predicting a difference smaller than 22 percentage points between the two parties. The bandwagon effect is particularly strong for DP values between 0.04 and 0.1 percentage points. In this range $DE - DP$ is statistically greater than zero at the 2.5% significance level.[18]

In electoral contests that are expected to be one-sided the above effect isn't present. For these contests the predicted value of $DE - DP$ is decreasing as the difference in the support for the two parties according to the polls increases. As predicted by the theoretical models, free riding of supporters of the large party seems to be behind the negative slope

[17] One may think that the publication of the poll may not only affect the voters' participation decision but their preferences as well. Since we restrict our attention to polls published within one week of the actual elections we believe that this effect isn't of an important magnitude.

[18] If we restrict the estimation to be linear $DE - DP$ is statistically greater than zero at the 2.5% significance level for every DP value lower than 0.1.

of $DE - DP$ in lopsided divided electorates.

Summing up, the evidence presented above is consistent with our experimental results. We need to stress that the empirical analysis is correlational in nature – it can't by itself establish causality. Combined with our experimental results, however, the empirical evidence strengthens the case for the existence of a bandwagon effect of public opinion polls in closely divided electorates.

6. A Behavioral Model

Our main experimental results, confirmed using data on gubernatorial elections, cannot be accounted by the traditional rational choice approach to turnout. The results therefore call for an alternative behavioral explanation.

An alternative specification of the voters' utility function may help explain part of the behavior observed in the laboratory. According to the traditional approach each voter's benefit and cost of participation aren't affected by whether the voter is in the losing or winning side of the contest. Several papers, mainly interested in models of sequential voting, modify the voters' utility function to take into account the fact that voters experience a desire to vote for the winner (on top of the costs and benefits explicit in rational choice models).[19] This approach, while able to explain bandwagons, assumes that the very behavior we need to explain is good for the voters. Moreover, the approach doesn't account for the stark difference observed in the voters' behavior between elections

[19] Borgers (2004) mentions this possibility in a simultaneous voting game similar to the one we analyze here. Callander (2004) models this possibility explicitly in a sequential voting game by adding a positive parameter to a voter's utility function when the voter supports the winning alternative.

expected to be close and the rest of the elections.

In this section we propose an alternative approach that relaxes Nash equilibrium but is consistent with the voters' beliefs and behavior observed in the laboratory. The Nash equilibrium concept requires that players optimize with respect to beliefs which are consistent with the actual strategies of players. As we have already pointed out no such combination can support the behavior we observe in our findings. Our experimental results, however, may be consistent with a weaker notion of rationality. Are there "reasonable" beliefs that we can attribute to voters under which voters' best responses will be akin to the observed behavior (without these beliefs being consistent with the actual voters' strategies)?

Herein we present a set of reasonable beliefs which will satisfy these conditions: If voters believe that in a close election the probability of voting is similar for all the individuals and those probabilities are sufficiently high, then optimal behavior with respect to these beliefs gives rise to voting patterns consistent with the ones documented in the previous sections. Formally,

Proposition 1: *Suppose individuals believe that voters in the majority vote with probability q and voters in the minority vote with probability r, with $|q - r| < \varepsilon$, for some sufficiently small $\varepsilon > 0$. If $r \geq 1/2$ the probability of casting a pivotal vote is higher for a voter in the majority than for a voter in the minority.*

To illustrate the intuition behind the proposition let us consider the case of a closely divided electorate when individuals believe that r is close to one. In this case, an individual that supports the large team believes it is very likely that her vote may break a tie. On the

contrary, an individual that supports the small team believes that her team will loose the election regardless of her choice. Thus, under the conditions of Proposition 1 individuals believe that there is a higher probability of casting a pivotal vote when they support the large team. This result is consistent with the beliefs stated by the subjects in their answers to the surveys.[20]

The main condition behind Proposition 1 is the individuals' beliefs that all voters mix with similar probabilities. Although these beliefs cannot be part of equilibrium with groups of unequal sizes, they seem reasonable when the preferences of the electorate are almost equally split between the two alternatives. This may explain why the bandwagon effect of polls occurs only when the electorate is closely divided.

7. Conclusions

This paper studies the effect that information on the voters' distribution of preferences has on turnout. The main finding is that the observed increase in turnout when the distribution of preferences is closely divided is heterogenous across teams of different sizes. In particular, the increase in turnout is significantly larger for the alternative with a slight majority according to the poll. That is, polls have a bandwagon effect whereby the frontrunner alternative increases its relative support in the elections. This effect, observed only in close elections, is not a consequence of voters changing their preferences. Rather, it is entirely driven by individuals that already supported the leading team voting

[20] The subjects' beliefs are similar to a "level-1" individual best responding to "level-0" individuals in the theoretical framework developed by Crawford and Iriberri (2005).

with a relatively higher frequency. This behavior is a direct consequence of the subjects' beliefs. That is, for closely divided electorates we observe that subjects overestimate the probability of casting a pivotal vote and behave according to those beliefs. On the contrary, subjects' beliefs don't explain their actions in electorates that are lopsided divided. Rather, only subjects that voted with high frequencies regardless of their beliefs or the distribution of preferences are the ones that participate in lopsided elections. This paper documented the bandwagon effect not only in the laboratory but also using data from U.S. gubernatorial elections in the last fifteen years.

It is noteworthy that the bandwagon effect cannot be accounted by the prevailing theory on the effect of public opinion polls on turnout. This theory is based on rational individuals holding the correct beliefs for every distribution of preferences. Hereby we proposed an alternative explanation consistent with the voters' beliefs and behavior observed in the laboratory. In particular, we presented a set of reasonable beliefs that can be attributed to voters under which utility maximization yields a behavioral pattern consistent with the bandwagon effect of polls in closely divided electorates.

Summing up, this paper discovered an anomalous behavioral pattern in the laboratory; it corroborated the external validity of this behavior for large electorates; and it presented an alternative rationale for the prevalence of bandwagon effects in close elections. Clearly, much work remains to be done for us to be able to understand what causes this effect. Currently, we are exploring the prevalence of this effect in general environments. It seems that subjects don't fully take into account information on an ex-post asymmetric distribution in environments that are ex-ante symmetric. This conjecture, if validated in the

laboratory, has implications far beyond the context of voters' turnout.

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Appendix

Proof of Proposition 1: Let us assume that there are N voters, with $N \geqslant 3$ and odd. Let us say that K of the voters prefer alternative A and L of them prefer alternative B, with $K + L = N$ and $K < L$. Assume first that $r = q$. The probability that an individual that prefers alternative A is pivotal equals

$$\sum_{i=0}^{K-1} \binom{L}{i} \binom{K-1}{i} q^{2i}(1-q)^{N-1-2i} + \sum_{i=0}^{K-1} \binom{L}{i+1} \binom{K-1}{i} q^{2i+1}(1-q)^{N-2(i+1)} \quad \text{(A.1)}$$

where the first term is the probability of observing a tie and the second term is the probability that alternative A loses the election by one vote. Similarly, the probability that an individual that prefers alternative B is pivotal equals

$$\sum_{i=0}^{K} \binom{L-1}{i} \binom{K}{i} q^{2i}(1-q)^{N-1-2i} + \sum_{i=0}^{K-1} \binom{L-1}{i} \binom{K}{i+1} q^{2i+1}(1-q)^{N-2(i+1)}. \quad \text{(A.2)}$$

Therefore, rearranging terms we can express the probability that an individual supporting B will break a tie minus the probability that an individual supporting A will break a tie as

$$\sum_{i=0}^{K-1} \binom{L-1}{i} \binom{K-1}{i} \frac{i(L-K)}{(L-i)(K-i)} q^{2i}(1-q)^{N-1-2i} + \binom{L-1}{K} q^{2K}(1-q)^{N-1-2K}. \quad \text{(A.3)}$$

Similarly, subtracting from the second term of (A.1) the second term of (A.2) we obtain

$$\sum_{i=0}^{K-1} \binom{L-1}{i+1} \binom{K-1}{i} \frac{(L-K)}{(L-1-i)} q^{2i+1}(1-q)^{N-2(i+1)}. \quad \text{(A.4)}$$

Thus, the probability of casting a pivotal vote is greater when an individual supports the majority group B if and only if (A.3) is greater than (A.4); this is equivalent to

$$\sum_{i=0}^{K-1} \binom{L-1}{i+1} \binom{K-1}{i} \frac{(L-K)}{(L-1-i)} q^{2i+1} (1-q)^{N-1-2(i+1)} \left[q - (1-q)\right] > 0.$$

This inequality is satisfied if, and only if, $q > 1/2$. The more general result for $r \neq q$ with $|q - r| < \varepsilon$, for some $\varepsilon > 0$ follows immediately from the fact that the probability of casting a pivotal vote is continuous on q and r. ■

Figure 1: Average Turnout Rate by Distribution of Preferences

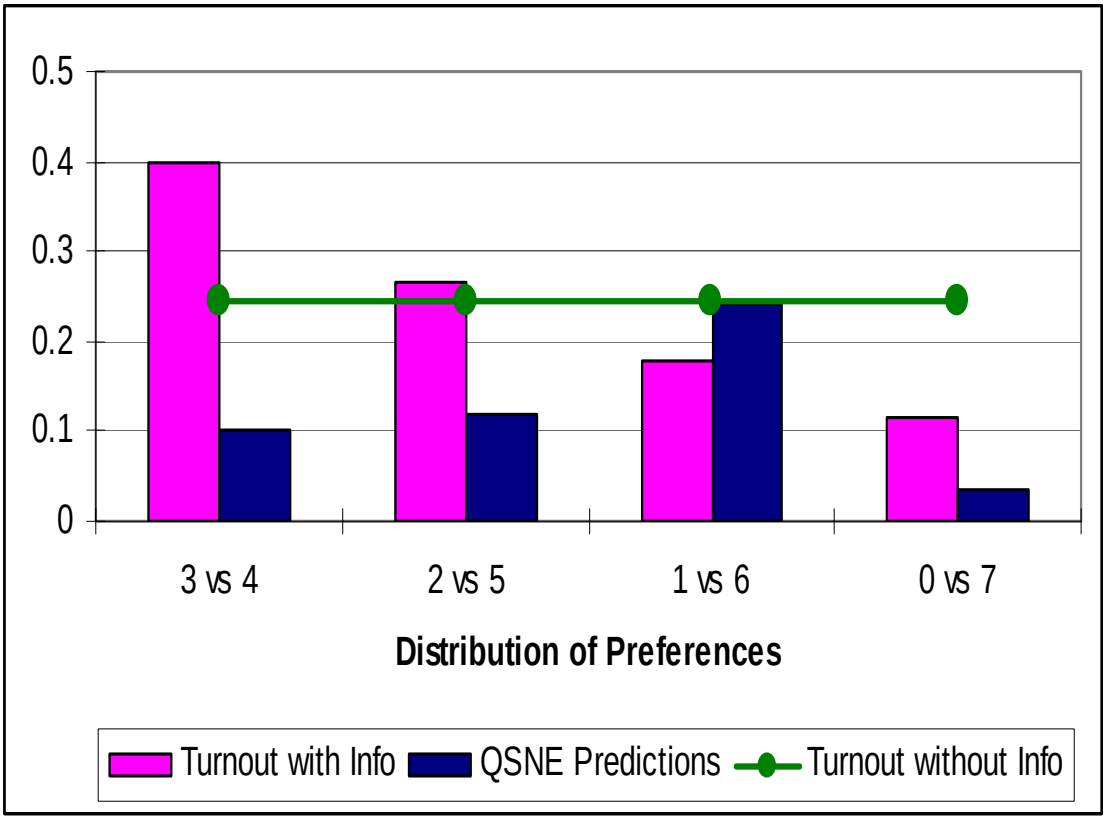

Figure 2: Average Turnout Rate by Team Size

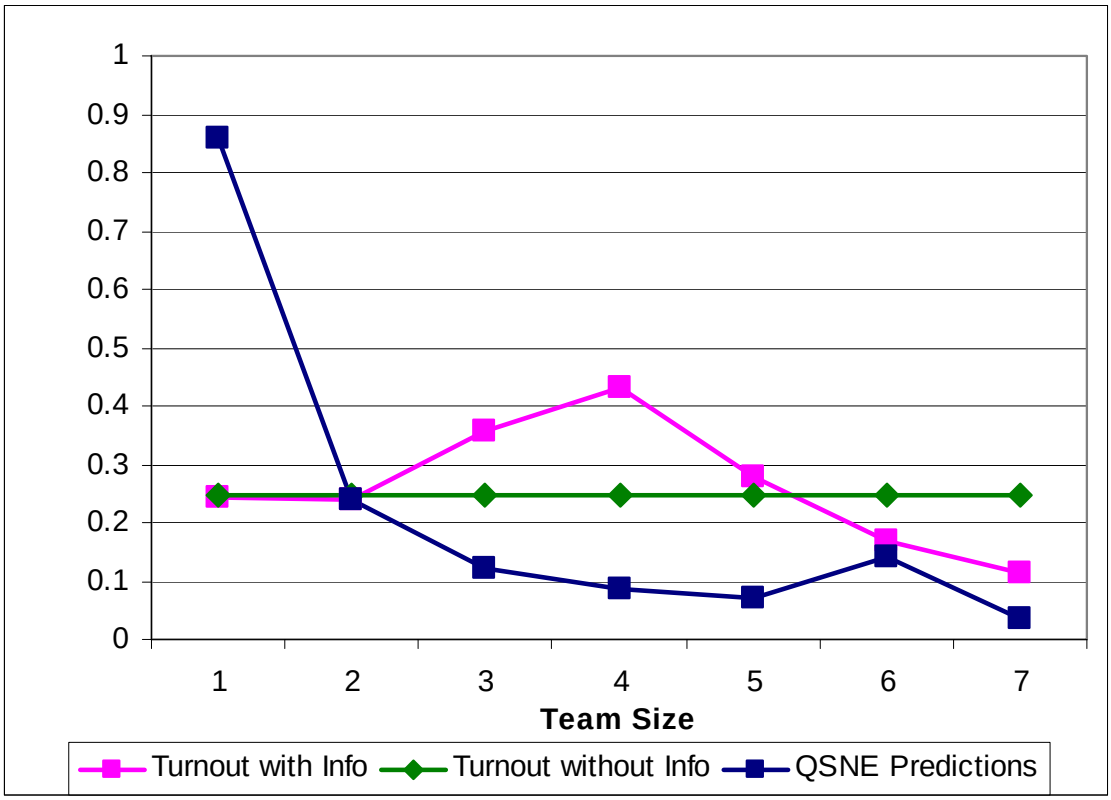

Figure 3: Subjects' Beliefs of Casting a Pivotal Vote by Team Size

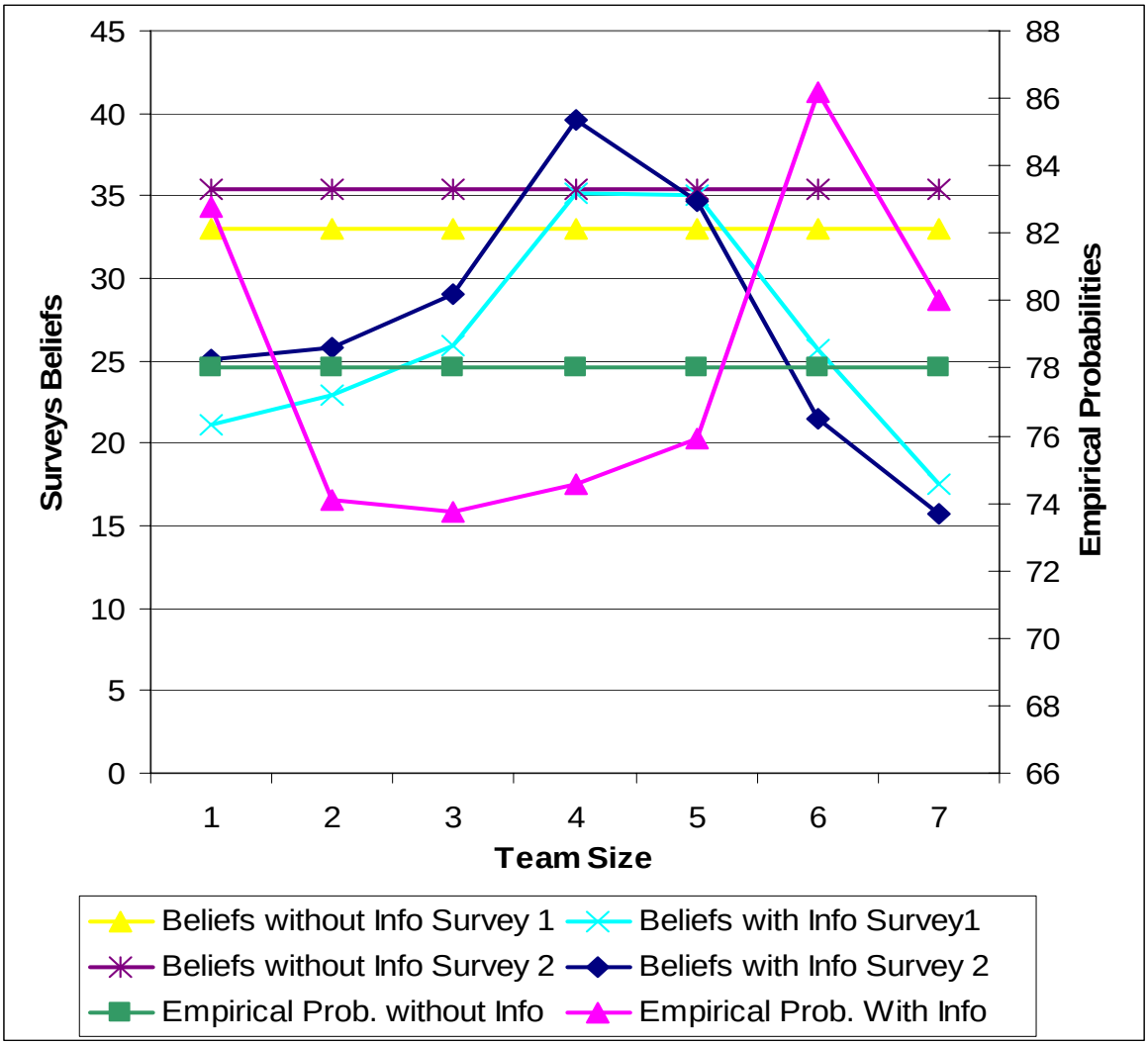

Figure 4: Deviation of Electoral Results (DE) from Polls Predictions (DP) for Gubernatorial Elections, 1990 – 2005.

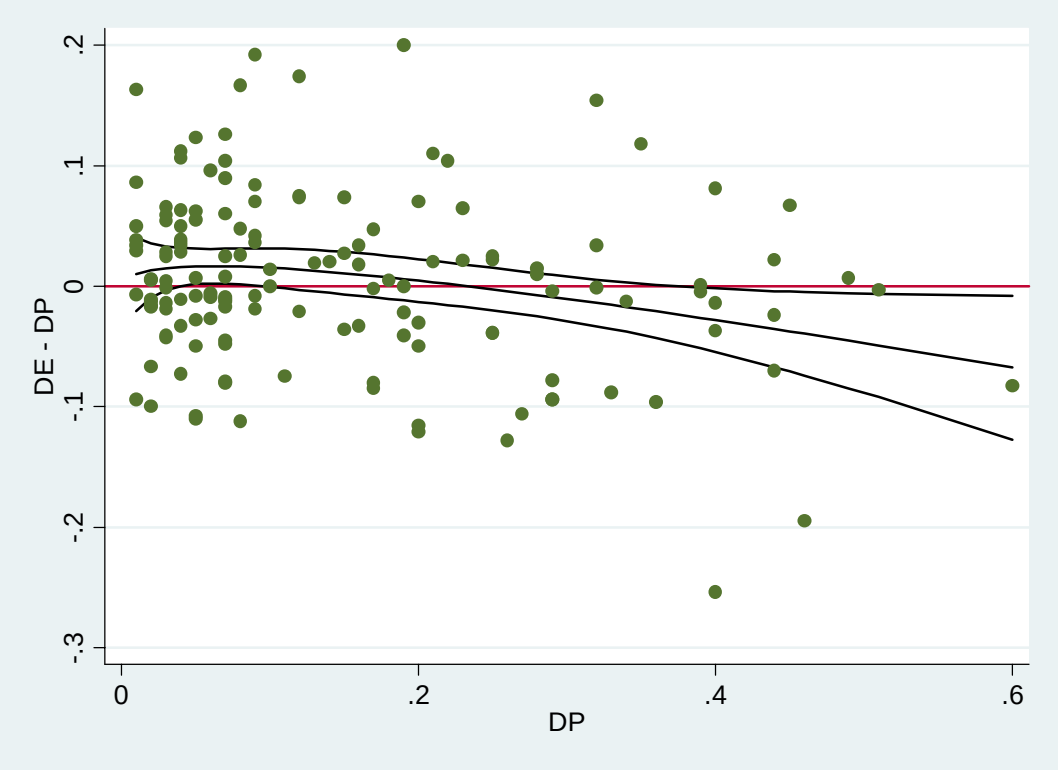

Table 1: Theoretical Predictions for the Two Different Frameworks with Benefits of Winning Equal to 10 and Costs of Voting Equal to 4.

Distribution of Preferences	3 vs. 4	2 vs. 5	1 vs. 6	0 vs. 7
Probability that a supporter of the large team votes according to the unique QSNE	0.0873	0.070805	0.13988	0.036508
Probability that a supporter of the small team votes according to the unique QSNE	0.1229	0.24001	0.86012	
Probability of voting according to the unique BNE	0.0807			

Table 2: Random Effect Probit Estimates of Voting Decisions in the Second Stage (Standard errors in Parentheses).

	(1)			(2)		
Distribution of Preferences	3 vs. 4	2 vs. 5	1 vs. 6	3 vs. 4	2 vs. 5	1 vs. 6
Constant	-0.522***	-1.039***	-1.030***	-0.740***	-0.977***	-1.446***
	(0.170)	(0.243)	(0.407)	(0.200)	(0.240)	(0.359)
First Stage Voting Decision	0.207	0.342*	0.921***	0.232	0.360*	0.954***
	(0.143)	(0.213)	(0.324)	(0.145)	(0.212)	(0.335)
Round	-0.020***	-0.002	-0.002	-0.020***	-0.002	-0.004
	(0.009)	(0.015)	(0.022)	(0.009)	(0.014)	(0.023)
Majority	0.305***	0.175	-0.339			
	(0.108)	(0.184)	(0.332)			
Pivotal Beliefs				0.012***	0.002	0.005
				(0.004)	(0.004)	(0.005)
Observations	854	378	203	854	378	203
Number of Subjects	84	84	72	84	84	72

***, **, * Indicates Statistical Significance at the 1, 5 and 10 percent level respectively.

Table 3: Average Difference in Vote Share between Leading and Trailing Party according to Polls and Elections, 1990 – 2005 (Standard errors in Parentheses)

	(1) Elections Expected to be Close DP < 0.10	(2) Elections Not Expected to be Close DP ≥ 0.10
Difference in Vote Share between Leading and Trailing Party according to Polls	0.0491 (0.0258)	0.2663 (0.1147)
Difference in Vote Share between Leading and Trailing Party according to Elections	0.0645 (0.0714)	0.2592 (0.1235)
Number of Observations	78	65

Sources: Polls' data obtained from Mason-Dixon Polling and Research Inc.