Empirical Evidence of Strategic Voter Abstention*

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Abstract

Existing literature demonstrates that voter information is an important empirical determinant of both voter turnout and *roll-off* (i.e. voting in some but not all races on a given ballot). One influential explanation for this finding is that uninformed citizens strategically delegate to those with better information. This paper uses American National Election Studies data to show that, consistent with that theory, an individual's own information quality (as measured by proxies such as education and age) makes her more likely to vote, while the information of others in her state makes her less likely to vote. Conditional on a voter's position within her state's information distribution, the importance of her own absolute information level is insignificant.

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1 Introduction

In every democracy, a large fraction of eligible citizens abstain from voting in public elections. Those who do vote often skip over certain races on a ballot—a phenomenon known as *roll-off*. Low or declining voter participation are commonly viewed as serious threats to democracy. Empirically, many of the most important determinants of voter participation are variables related to information. Controlling extensively for covariates, for example, Wolfinger and Rosenstone (1980) find education to be the single best predictor of voter turnout. Voting also increases with age or experience (Wolfinger and Rosenstone, 1980; Strate et al., 1989). Palfrey and Poole (1987), Bartels (1996), Degan and Merlo (2007a), and Larcinese (2006) find turnout to be correlated with political knowledge, which Wattenberg, McAllister, and Salvanto (2000) find to be the most significant factor in explaining roll-off. Dee (2004) and Milligan, Moretti, and Oreopoulos (2004) report further evidence that education actually causes higher turnout, and Lassen (2005) finds that political information causes higher turnout as well.[1] Ashenfelter and Kelley (1975) also note that voter turnout is high among individuals recently contacted by campaign workers and low among individuals who have recently moved.

A simple explanation for voter abstention is that traveling to the polls, waiting in line, and so forth, require time, which is costly. Downs (1957) points out that even small costs can dissuade citizens from voting because in large elections an individual vote is *pivotal*, reversing the election outcome, with only miniscule probability. To explain the correlation between voting and information, Matsusaka (1995) points out that the expected benefit of voting is low for a citizen who is uncertain which candidate or alternative she prefers.[2] A well-informed citizen may therefore be willing to pay a cost that a poorly informed citizen is unwilling to pay. In an influential paper, Feddersen and Pesendorfer (1996) provide an alternative explanation of abstention, which is that individuals who lack information or expertise regarding candidates or policy issues abstain strategically, in an effort to delegate to those with better information about the decision at hand. Put differently, an uninformed citizen abstains to avoid the "swing voter's curse" of overturning an informed decision.

Both strategic and non-strategic models of voter participation invite a certain degree of skepticism. On one hand, delegation arguably requires a high level of strategic sophistication. More importantly, its logic relies on the strong assumption that voter disagreements are ultimately informational—that is, if informational differences could be resolved then

[1] Coupé and Noury (2004) find that information also influences roll-off by survey participants.

Without evidence that information leads to voting, it would be reasonable to assume reverse causation, since citizens who do not intend to vote have less need to acquire political information.

[2] Throughout this paper, feminine pronouns refer to voters, and masculine pronouns refer to candidates.

underlying preferences would ultimately be identical, or at least correlated; otherwise, one citizen has no reason to defer to another's expertise. On the other hand, Feddersen and Pesendorfer (1996) point out that a decision-theoretic model cannot explain roll-off, since voting is costless to a citizen who has already entered the voting booth. Furthermore, in costly environments, the decision-theoretic prediction that information influences voter participation may actually fail in large electorates. Downs' (1957) observation implies that voting costs should dissuade all but a small number of citizens from voting[3]; to avoid this standard paradox, Matsusaka (1995) follows Riker and Ordeshook (1968) in assuming that voting provides a sense of fulfillment, effectively making some voters' costs negative. Citizens with negative costs should all vote, however, while those with positive costs should still abstain when the number of voters gets large. As an electorate grows large, therefore, the fraction of the electorate for whom information matters should become vanishingly small.

The purpose of this paper is to investigate empirically whether voter participation decisions are strategic or not. Existing empirical research has focused almost entirely on establishing a causal relationship (or at least a correlation) between information and voting, as described above, but has not addressed the differences between strategic and decision-theoretic explanations for this relationship. Battaglini, Morton, and Palfrey (2006, 2008) find that participants do respond to the swing voter's curse in laboratory experiments, but whether or not they behave similarly in actual public election settings is an open question. A broader literature has examined evidence of other aspects of strategic voting behavior, but has failed to reach consensus.[4]

The logic for identification in this paper's analysis comes from a model by McMurray (2009), which generalizes the information structure of the original Feddersen-Pesendorfer model to allow an entire spectrum of possible levels of individual expertise.[5] In that model, equilibrium is characterized by an expertise threshold, above which citizens vote and below which they abstain. The key observation is that the location of the threshold depends on the underlying information distribution, which means that an individual citizen's expertise may fall between the participation thresholds of two electorates, so that she prefers to vote in one electorate but abstain in the other. Specifically, a citizen is more likely to vote when only a small fraction of her peers have better information than her own, and is more likely to abstain when the fraction of better-informed peers is high.

[3]See Ledyard (1984) and Palfrey and Rosenthal (1983, 1985) for examples of this.

[4]For example, Coate, Conlin, and Moro (2006) conclude that a naive model of expressive voting predicts election closeness more accurately than a pivotal-voting model. See Feddersen (2004) for a helpful review of this controversy.

[5]The original Feddersen-Pesendorfer framework includes only two information types: informed and uninformed. In that case, absolute and relative information quality, as defined below, are indistinguishable.

To test this prediction, individuals within each electorate are first ranked according to education, age, income, and political knowledge. Whether an individual voted or not is then allowed to depend both on her level of information (as measured by the information proxy variables above) and her rank within her electorate's information distribution. According to a decision-theoretic model of voting, a citizen's propensity to vote may be increasing in her own level of information, but there is no reason to expect rank variables to exert any influence; according to the strategic model, a citizen's tendency to vote should increase with her rank within the information distribution. The same analysis is performed first for voter participation in general elections and then for participation in presidential primary elections. Finally, it is repeated for participation in state gubernatorial or senate races, among citizens who had already voted in the presidential race.

The result of this analysis is that an individual's rank within the education distribution has a positive and statistically significant influence on her propensity to vote, even controlling for her level of education. The same is true of her rank within the distributions of age, income, and political knowledge. Consistent with the strategic theory of voting, then, a citizen's voting behavior appears to be influenced by the quality of her information *relative* to others in her electorate, not just in absolute terms. In fact, controlling for her rank within the information distribution, the absolute quality of an individual's information impacts her voting behavior only insignificantly, contrary to the decision-theoretic prediction that a citizen's own information should be what determines her election participation. If voting were predicted using only a single measure of information quality, the relative measure would have better predictive power than the absolute measure.

The remainder of this paper proceeds as follows. Section 2 first summarizes the model analyzed in McMurray (2009), which provides the theoretical framework for the subsequent analysis. Section 3 explains the data that are used. Section 4 describes in more detail the formal empirical test of the importance of relative information, and Section 5 presents the test results. Section 6 examines the robustness of these results, and Section 7 concludes.

2 Theory

The logic of the swing voter's curse is that poorly informed citizens prefer to abstain from voting, rather than vote for either candidate, delegating the collective decision to those with better information. In this section, I formalize this intuition by summarizing the theoretical model analyzed in McMurray (2009), and derive the central comparative static to be tested in section 4.

2.1 The Model

A group of citizens must choose between two alternatives, A and B. With equal probability, nature designates one of these $Z \in \{A, B\}$ as superior and the other (say $\tilde{Z}$) as inferior. Citizens have *common values*, meaning that they unanimously prefer to implement the superior alternative; however, Z is unobservable, so that citizens disagree over which alternative is in fact superior. On the issue at hand, there is a spectrum of expertise: independently, each individual draws her information quality $Q_i \in \left[\frac{1}{2}, 1\right]$ from a commonly-known distribution F, and then receives a private signal $S_i \in \left\{Z, \tilde{Z}\right\}$ that correctly identifies Z with probability Q_i. That is,

$$\Pr\left(S_i = A | Z = A\right) = \Pr\left(S_i = B | Z = B\right) = Q_i).$$

To the most expert voter (i.e. $Q_i = 1$), then, S_i reveals Z precisely; to the least expert voter (i.e. $Q_i = \frac{1}{2}$), S_i provides no information. Conditional on Z, signals are mutually independent.

Simultaneously, individuals each vote for candidate A or B, or else abstain from voting. Whichever candidate $X \in \{A, B\}$ receives more votes wins the election. Each citizen then receives utility

$$u\left(X, Z\right) = \begin{cases} 1 \text{ if } X = Z \\ 0 \text{ if } X \neq Z \end{cases}.$$

Attention is restricted to symmetric strategy profiles

$$\sigma : \left[\frac{1}{2}, 1\right] \times \{A, B\} \longrightarrow \Delta\left(\{A, B, 0\}\right),$$

which specify the same (possibly mixed) voting strategy for all citizens with the same information quality $q \in \left[\frac{1}{2}, 1\right]$ and private opinion $s \in \{A, B\}$. For such a profile, expected utility is merely probability of electing the better candidate or alternative:

$$Eu\left(X, Z\right) = \Pr\left(X = Z; \sigma\right).$$

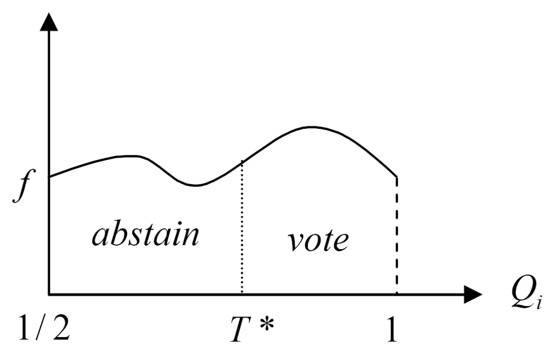
The relevant equilibrium concept is symmetric Bayesian equilibrium.

2.2 Equilibrium

McMurray (2009) shows that equilibrium voting must be both *informative*, revealing the private signal, and also *signal-symmetric*, meaning that citizens with the same level of expertise but opposite signals behave symmetrically. For an informative and signal-symmetric strategy profile σ, $P\left(\sigma\right)$ and $\tilde{P}\left(\sigma\right)$ denote the probabilities with which a single additional vote for Z or $\tilde{Z}$ would be *pivotal*, changing the election outcome in that candidate's favor. By voting for the candidate that she perceives to be superior, therefore, a citizen changes the election outcome in favor of candidate Z with probability $Q_i P(\sigma)$. On the other hand, with probability $(1 - Q_i)\tilde{P}(\sigma)$ she mistakenly changes the election outcome in favor of candidate $\tilde{Z}$, instead. In response to σ, therefore, the expected benefit of voting is

$$\Delta EU(Q_i; \sigma) = Q_i P(\sigma) - (1 - Q_i)\tilde{P}(\sigma). \tag{1}$$

The right hand side of (1) is positive if and only if an individual is sufficiently well-informed, so that Q_i exceeds a quality threshold $T(\sigma) \equiv \frac{\tilde{P}(\sigma)}{P(\sigma)+\tilde{P}(\sigma)}$. In equilibrium, therefore, individuals above and below some quality threshold T^* vote informatively and abstain, respectively, as illustrated in Figure 2.2.



An equilibrium voting threshold

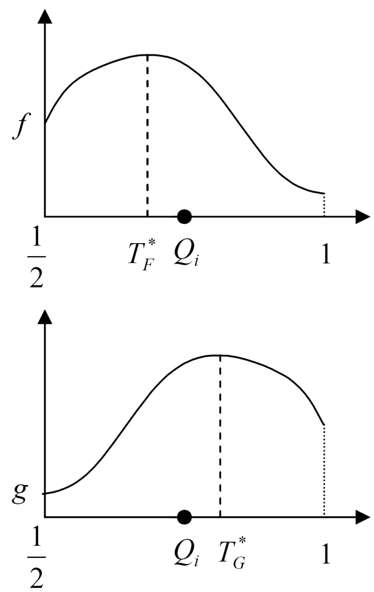
The best response to a threshold strategy like that depicted in Figure 2.2 is, of course, another threshold strategy. Using a straightforward fixed point argument, McMurray (2009) shows the existence of an equilibrium threshold strategy that is its own best response. The limit, as an electorate grows large, of any sequence of equilibrium thresholds must solve

$$E(Q|Q \geq T) = \frac{T^2}{T^2 + (1-T)^2}. \tag{2}$$

Under mild distributional assumptions, such a solution is unique. In a large electorate, therefore, the unique solution T^* to (2) completely characterizes equilibrium voting behavior.

The left hand side of (2), and therefore the limiting equilibrium threshold T^*, depend on the underlying distribution F of expertise. Fixing this distribution , a citizen's decision of whether to vote or not depends only on her own information quality: she votes if $Q_i \geq T^*$

and abstains otherwise. Across electorates with different information distributions, however, the location of T^* varies; an individual of type Q_i might therefore find herself above the participation threshold in one electorate but below the participation threshold in another. This is illustrated in Figure 2.2: in an electorate with generally poor information, such as distribution F, an individual of type Q_i will vote (since $Q_i > T_F^*$); in a generally well-informed electorate, such as distribution G, she abstains (since $Q_i < T_G^*$).



Voting and abstaining in
various electorates

Whether this citizen of type Q_i votes or not, therefore, depends entirely on the distribution of information among her peers. If she is the best-informed citizen, for example, she will surely vote; if she is the least-informed citizen, she will surely abstain. Across electorates, she is more likely to vote, the higher she ranks among her peers.

3 Description of Data

The data analyzed below are from the American National Election Studies (NES). Participants in these studies were interviewed in person, both shortly before and shortly after November elections in each presidential election year. The central variable of interest is whether an individual voted or not. The first set of results deal with roll-off voting in state gubernatorial and senate races by citizens who had already voted in the presidential race (listed on the same ballots). Then similar analyses are performed of voting in the general presidential election in November and in the presidential primary election, held the previous spring. The average turnout rates for these elections are listed in Table 1: across years, about one-third of survey respondents voted in the spring primary; three-fourths voted for president; and, in states with gubernatorial or senate races, three-fourths of those who voted for president also voted in the state races.[6]

The explanatory variables of this analysis, in addition to controls for gender and race, are proxies of individuals' information quality. The first of these is education, measured in seven categories of completed years of schooling. As mentioned in the Introduction, Wolfinger and Rosenstone (1980) find education to be the single best predictor of voter turnout and Dee (2004) and Milligan, Moretti, and Oreopoulos (2004) find this relationship to be causal. Specific candidate information is unlikely, of course, to have been part of any formal schooling curriculum. Nevertheless, formal education is likely to provide a general awareness and understanding of public issues, government and social processes, and relevant historical contexts, and to enhance analytical and research skills, thereby enabling individuals to find and process political information confidently. Thus, education is likely to have a strong impact on voter information, broadly conceived.[7]

The second proxy of information quality is age, ranging from 17 to 99 years. As with formal education, the hypothesis at work here is that a framework for understanding and distinguishing between complicated policy alternatives develops gradually as life experience accumulates. After considering other possible mechanisms by which age might influence voting, Strate et al (1989) concludes that experience appears to be the most important. The third information proxy is a categorical variable indicating the range of a respondent's income.[8] Like education and age, this may reflect some general knowledge, intelligence, or ability to make complex decisions—skills that are both useful for processing political information, and also rewarded by labor and capital markets.[9]

The final information proxy used below is a five-point scale of a "respondent's general level of information about politics and public affairs", as evaluated by the NES interviewer.[10]

[6] A notorious problem in voting data (including the ANES—see Belli, Traugott, and Beckmann, 2001) is that nonvoting survey respondants often report having voted, an issue that I address in Section 6.

[7] This connection between education and voting has been offered (e.g. by Dee, 2004, and Milligan, Moretti, and Oreopoulos, 2004) as a primary justification for public provision of education.

[8] The five categories correspond to percentiles within the national income distribution. Dollar values for income brackets change over time.

[9] Another reason why income might improve voter information is a simple income effect: if political information is a normal good, wealthier individuals will consume more of it.

[10] See ANES cumulative 1948-2004 study codebook

As a measure of information quality, interviewer impressions are admittedly subjective, but are also more comprehensive than other information variables, which evaluate knowledge of very specific political facts. In fact, Zaller (1986) finds this variable to be the single most useful information item in the NES.[11] In any case, subjectivity may be less of a problem here than in other settings, since the logic of strategic delegation requires that voters assess one another's information quality, just as NES interviewers evaluate survey participants.

Summary Statistics

Individuals	Min	Max	Mean	Std. Dev.	# of obs.
Education	1	7	3.86	1.76	15,232
Age	17	99	45.3	17.3	15,232
Income	1	5	2.89	1.14	15,232
Information	1	5	3.22	1.09	15,232
Voted (general)	0	1	0.7402	0.4385	15,232
Voted (primary)	0	1	0.3296	0.4701	6,645
Voted (roll-off)	0	1	0.7247	0.4467	4,069

Electorates	Min	Max	Mean	Std. Dev.	# of elections
# of individuals	15	262	61.4	42.0	313
Mean education	1.79	5.69	3.78	0.66	313
Mean age	35.5	61.2	46.0	4.1	313
Mean income	1.75	3.86	2.85	0.37	313
Mean information	2.04	4.18	3.15	0.33	313
Turnout (general)	0.3654	0.9615	0.7464	0.1120	313
Turnout (primary)	0.0175	0.7692	0.3308	0.1593	190
Turnout (roll-off)	0.2000	0.9643	0.7122	0.1919	96

Table 1

Table 1 illustrates how widely average education, age, income, and information levels vary across states and years. In the opinions of NES interviewers, for example, the average information level of survey respondents in Louisiana in 1980 was just over 2.0 (on a five-point scale), while average information ratings were over 4.0 in New Hampshire in 1984 and in Iowa in 2004—states in which presidential politics receive extra attention because of the early timing of primary elections. Similarly, average education levels range from 2 to 6 (on a 7-point scale), and average ages range from 35 to 60.

It is quite possible, of course, that demographic variables such as education, age, and income influence voter turnout for reasons unrelated to information. The direction of such influence, however, is unclear. As voters age, for example, the cost of voting may either

(http://sda.berkeley.edu/D3/NES2004C/Doc/hcbk.htm). Assessments were made after pre-election interviews; similar assessments made after post-election interviews yield similar results.

[11] Interviewer impressions are also utilized by Bartels (1996).

increase (e.g. as health deteriorates) or decrease (e.g. as workers retire), and the benefit may likewise increase (e.g. because of a growing interest in health care, social security, etc.) or decrease (e.g. as time horizons shorten with remaining life expectancy). Similarly, high-wage earners–who tend to be both older and better educated–can better afford the luxury of political participation but also have a higher opportunity cost of time than those with low incomes. In any case, these alternative channels of influence may apply to voters' turnout decisions, but should not influence roll-off, or other costless participation decisions. The result in Section 5 that these variables influence roll-off in addition to turnout, therefore, suggests an information channel, as hypothesized above.

4 Test

To test the prediction that voter participation depends on the distribution of expertise within an electorate, survey respondents are first grouped by state and year (and party, for the analysis of presidential primary elections)—the level at which elections take place.[12] Within each electorate, citizens are then ranked according to education, age, income, and information. For elections with at least 15 survey respondents, I use the information proxies Ed_i, Age_i, Inc_i, and $Info_i$ described in section 3 to construct percentile variables, ranking each individual against survey respondents from the same election. Specifically, $Ed\%_i$, $Age\%_i$, $Inc\%_i$, and $Info\%_i$ denote the fractions of survey respondents from the same state and year as individual i whose education, income, and information levels are less than or equal to i's own.[13] Thus $Ed\%_i$ tends to be high, for example, either when i's own education level Ed_i is high or when education levels are generally low throughout her state.

The hypothesis that relative information matters for voting, even conditional on absolute information, can be tested by including both levels and percentiles for the above information proxies in a standard Probit regression, with a dependent variable V_i indicating whether an individual voted or not in the relevant election. For a vector X_i of absolute and relative information proxies and a vector Y_i of control variables (including gender and race, and

[12] The presidential election, of course, is a national race, but electoral college votes are determined within each state. It seems plausible that, in addition to incentives within her home state, a citizen takes into account the probability with which her state's electoral votes will be pivotal at the national level; if so, these incentives are identical for all voters within a state, and so will be included below in the state fixed-effect.

[13] As defined here, individuals in education category 7 have rank $Ed\%_i = 100$, regardless of the state and year (i.e. denoting that their education levels are greater than or equal to 100% of the citizens in their electorate). Alternatively, a citizen's rank could have been defined as the fraction of her peers with strictly worse information than her own, so that $Ed\%_i = 0$ for all citizens in education category 1, regardless of the state and year. Doing so yields results similar to those presented below.

dummy variables for each election), the conditional mean of V_i is given as follows:

$$E(V_i|X_i, Y_i) = \Phi(\beta_0 + \beta_1 Ed_i + \beta_2 Ed\%_i + \beta_3 Age_i + \beta_4 Age\%_i + \beta_5 Inc_i + \beta_6 Inc\%_i + \beta_7 Info_i + \beta_8 Info\%_i + \beta_9 Y_i), \tag{3}$$

where Φ is the standard normal cdf.

The strategic theory described in Section 2 predicts that the even-numbered coefficients in (3) should be positive. If information instead matters for non-strategic reasons, then the odd-numbered coefficients should be positive, but there is no reason to expect even-numbered coefficients to be different from zero. Thus, the null hypothesis is as follows,

$$H_0 : \beta_2 = \beta_4 = \beta_6 = \beta_8 = 0, \tag{4}$$

and rejecting H_0 in favor of positive coefficients constitutes evidence that voters indeed respond strategically to one another's information.[14] While odd-numbered coefficients are not of interest for their own sakes, they must be included as controls, to avoid omitted variables bias: absolute and relative information variables are highly correlated (since, for example, a citizen whose absolute level of education is high likely finds herself toward the top of her state's education distribution, and vice versa), and so a regression on relative information proxies alone would likely generate positive coefficient estimates, even if strategic considerations were unimportant. In this test, even-numbered coefficients are identified by comparing individuals with the same absolute level of information but living in different states, so that their positions within their respective information distributions differ. Identification for odd-numbered coefficients comes from comparing individuals whose absolute levels of information differ but whose rank within their respective information distributions is the same.

In addition to the information variables described above, the regressions below include controls for gender and race, as well as dummy variables for each state-year pair (or state-year-party triple, in the case of primary elections). The purpose of these election controls is to account for any factors, unrelated to voters' information, that may influence voter turnout. For example, turnout in a particular state or year may depend on the presence of an incumbent candidate, on the perceived closeness of an election, on the number and nature of other races listed on the same ballot, on state-specific voting requirements or ballot

[14] According to the strategic theory of voter participation, the relevant alternative hypothesis to H_0 is that even-numbered coefficients are positive. Accordingly, significance levels listed in Tables 2 through 5 correspond to one-sided hypothesis tests.

technologies, as well as on non-political factors such as weather conditions on the day of an election.[15]

5 Results

The results of the regression analysis described above are presented in Tables 2 through 5. Column 1 of Table 2 begins with results for voter participation in state senate and governor races by citizens who had already voted for president. Because interviewer evaluations of information quality are available only in certain years, only education, age, and income are included in this analysis. As predicted by the strategic turnout theory, coefficients on each of the rank variables are positive and statistically significant. A test of the hypothesis in (4) that these coefficients are jointly equal to zero yields an F-statistic of 16.04, which is rejected at the 1% level of

[15] In presidential primary elections, voter participation may also depend on the timing of the state's primary relative to other states, and on state rules for determining electoral college votes.

Information and Roll-off			
Probit: 1 = voted for senate/governor, given voted for president			
	1	2	3
Education (level)	-0.0008	0.0311***	-
	(-0.06)	(8.46)	-
Education (%)	0.0022***	-	0.0021***
	(2.62)	-	(8.99)
Age (level)	-0.0010	0.0024***	-
	(-0.66)	(6.58)	-
Age (%)	0.0021***	-	0.0015***
	(2.38)	-	(7.41)
Income (level)	-0.0099	0.0224***	-
	(-0.53)	(4.11)	-
Income (%)	0.0012**	-	0.0008***
	(1.67)	-	(4.18)
F-test (relative)	16.04***	-	-
F-test (absolute)	0.71	-	-
Non-nested fit test	-	-	3,369***
# of Observations	6,168	6,168	6,168
Pseudo R-squared	0.097	0.094	0.097

Notes: Table lists marginal effects (and z-statistics). Source is NES (1952-1980). Controls for gender, race, and electorate effects for 153 year-state pairs are included but not shown. *, **, ***, indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 2: Information and Roll-off 1

The significance of relative information variables is more than a mere statistical phenomenon. Estimates of the marginal effects of these variables on the probability of voting (i.e. $\frac{d\Pr(V=1|X_i,Y_i)}{dX_i}$, evaluated at the sample means of explanatory variables) are substantively large, as well. For example, moving ahead by one percentile in the education distribution would increase a citizen's probability of voting by 0.0022. Hypothetically, if this effect were constant across the education distribution, moving from the bottom of the distribution to the top of the distribution would make a citizen approximately $0.0022 \times 100\% = 22\%$ more likely to vote. Similar moves from the bottom to the top of the age or income distributions would make a citizen 21% or 12% more likely to vote, respectively.

A stark result in Table 2 is that odd-numbered coefficient estimates are statistically no different from zero—in fact, point estimates are actually negative! This is a dramatic departure from existing empirical work, which has consistently found such the effects of such variables to be positive and large. For the sake of comparison, column 2 of Table 2 regresses voter participation on absolute information proxies alone, this time excluding relative information variables. Without exception, this more standard analysis yields the standard result: marginal effects are positive, statistically significant, and large. One education category, for example, makes a citizen 3.1% more likely to vote. Each year of age makes her 0.24% more likely to vote. Hypothetical moves from the lowest to the highest education category or age level, therefore, would make a citizen $6 \times 3.1\% = 18.6\%$ or $82 \times 0.24\% = 19.7\%$ more likely to vote, respectively. As explained above, the strategic theory of voter participation makes no prediction about absolute information variables; in the test described in Section 4, absolute information variables are included merely as controls.[16] Non-strategic models such as Matsusaka's (1995), which predict an unambiguously positive role for absolute information quality, on the other hand, are seriously undermined by the result that absolute information effects disappear with the addition of relative information variables.

In defense of non-strategic models, this reduction in explanatory power might be attributed to a problem of colinearity: since absolute and relative information variables are highly correlated, adding the latter to the regression inevitably reduces the explanatory power of the former. Colinearity, however, should cut both ways. That is, the addition of absolute information proxies should reduce the explanatory power of relative information variables. To evaluate this possibility, column 3 of Table 2 regresses voter participation on relative information variables alone, this time excluding absolute variables. Not surprisingly, coefficient estimates are all positive, statistically significant, and large. Moving from column 3 back to column 1, however, does not mute these estimates; to the contrary, estimated effects are even larger in the fully specified regression.

The issue of colinearity can be avoided completely by comparing the regressions of columns 2 and 3 directly, since each includes only a single set of information variables. To compare the explanatory power of two non-nested models, Clarke (2003) proposes evaluating the likelihood function for each of the $6,168$ observations, using both models. If the models predicted behavior equally well then each would produce the higher likelihood function for about half of the observations.[17] That hypothesis can be rejected (at the 1% level), however, because column 3 outperforms the model in column 2 in $3,369$ instances,

[16] An individual's absolute information level could rise while her relative position within her electorate's information distribution remains unchanged if, for example, information were improved uniformly across the electorate. Comparative statics results in McMurray (2009) show, however, that this can have an ambiguous impact on voter turnout.

[17] Specifically, the number of times that either model produced the higher likelihood function would have binomial distribution, with parameters $n = 6,168$ and $p = \frac{1}{2}$. Some advantages of this test over the similar and more well-known Vuong (1989) test are demonstrated by Clarke (2007).

which is significantly more than $3,084$. Thus voter behavior is better explained by relative than by absolute information variables.

Information and Roll-off

Probit: 1 = voted for senate/governor, given voted for president

	1	2	3
Education (level)	0.0040	0.0171***	-
	(0.22)	(3.28)	-
Education (%)	0.0009	-	0.0012***
	(0.82)	-	(3.59)
Age (level)	-0.0002	0.0023***	-
	(-0.07)	(5.00)	-
Age (%)	0.0016*	-	0.0015***
	(1.32)	-	(5.41)
Income (level)	-0.0258	0.0102*	-
	(-0.99)	(1.39)	-
Income (%)	0.0013*	-	0.0004*
	(1.37)	-	(1.52)
Information (level)	0.0104	0.0946***	-
	(0.38)	(11.59)	-
Information (%)	0.0033***	-	0.0036***
	(3.20)	-	(12.17)
F-test (relative)	16.64***	-	-
F-test (absolute)	1.11	-	-
Non-nested fit test	-	-	2,232***
# of Observations	3,971	3,971	3,971
Pseudo R-squared	0.115	0.112	0.115

Notes: Table lists marginal effects (and z-statistics). Source is NES (1968-1980). Controls for gender, race, and electorate effects for 105 year-state pairs are included but not shown. *, **, ***, indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 3: Information and Roll-off 2

Table 3 repeats the analysis of Table 2 of voting in senate or gubernatorial elections by citizens who already voted for president, this time adding as explanatory variables the subjective assessment of information quality made by NES interviewers, together with its associated percentile variable. In comparison with Table 2, estimates in Column 1 of Table 3 of the marginal effect of relative information proxies are smaller and less significant. The estimated difference in voting propensity between the bottom and top of the education distribution, for example, is a modest 9%; similar values for the age and income distributions are only 16% and 13%. None of these differs significantly from zero at the 5% level. This reduction in explanatory power is partly due to the smaller sample size (since interviewer assessments are available only for certain years), together with the increased number of explanatory variables. More important, however, is the strong significance of the newly added information variable: relative to the bottom, a citizen at the top of her information distribution is 33% more likely to vote! Together, the relative information variables are significant even at the 1% level: the F-statistic associated with a test of (4) is 16.64.[18]

The estimated effects of education and information in Table 3 are positive, unlike those in Table 2, but neither is statistically significant at even the 10% level. In fact, (5) expresses the strong hypothesis that all of the coefficients on absolute information variables are equal to zero:

$$H_0' : \beta_1 = \beta_3 = \beta_5 = \beta_7 = 0. \tag{5}$$

With an F-statistic of only 1.11, even this joint hypothesis cannot be rejected at even the 10% level. Absolute coefficients are also small in magnitude, both relative to the much larger estimates obtained in column 2, and relative to the estimates in column 1 of the importance of relative information. Moving from the lowest to the highest education or information levels, for example, makes a citizen $6 \times 0.4\% = 2.4\%$ or $4 \times 1\% = 4\%$ more likely to vote, respectively, while moving from the bottom to the top of the education or information distributions makes her 9% or 33% more likely to vote, respectively. Once again, a Clarke (2003) test concludes that the relative information variables in column 3 predict voting significantly better than the absolute variables in column 2.

[18] The result that controlling for information reduces the explanatory power of education and other information proxies is consistent with Wattenberg, McAllister, and Salvanto (2000), and is not surprising in the context of the information model described in Section 2.

Information and Voting in Presidential Primaries

Probit: 1 = voted in presidential primary election

	1	2	3
Education (level)	0.0048	0.0283***	-
	(0.36)	(6.35)	-
Education (%)	0.0015**	-	0.0018***
	(1.89)	-	(6.73)
Age (level)	0.0020	0.0061***	-
	(1.27)	(15.48)	-
Age (%)	0.0026***	-	0.0037***
	(2.76)	-	(15.84)
Income (level)	0.0024	0.0396***	-
	(0.10)	(6.13)	-
Income (%)	0.0012*	-	0.0013***
	(1.50)	-	(5.50)
Information (level)	0.0322	0.0750***	-
	(1.35)	(10.36)	-
Information (%)	0.0015**	-	0.0026***
	(1.85)	-	(10.47)
F-test (relative)	17.61***	-	-
F-test (absolute)	3.67	-	-
Non-nested fit test	-	-	3,287
# of Observations	6,507	6,507	6,507
Pseudo R-squared	0.153	0.151	0.153

Notes: Table lists marginal effects (and z-statistics). Source is NES (1972-1992). Controls for gender, race, and electorate effects for 189 year-state-party pairs are included but not shown. *, **, ***, indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 4: Information and Voting in Presidential Primary Elections

Table 4 repeats the analysis of Table 3, this time for voting in presidential primary elections. As before, column 1 estimates of the marginal effects of relative information variables on voting are positive, statistically significant, and large. For example, a hypothetical move from the bottom to the top of the education, age, income, or information distributions would make a citizen 15%, 26%, 12%, or 15% more likely to vote, respectively. A test of the hypothesis in (4) that these variables are actually uncorrelated with voting yields an F-statistic of 17.61, which is rejected at the 1% significance level. Estimates of the marginal effects of absolute information variables are all positive, but are not as large: moving from the lowest to the highest levels of education, age, income, and information, would only make a citizen

$6 \times 0.5\% = 3\%$, $80 \times 0.2\% = 16\%$, $4 \times 0.2\% = 0.8\%$, and $4 \times 3.2\% = 12.8\%$ more likely to vote, respectively. These estimates are also less significant: a test of the hypothesis (5) that all are equal to zero yields an F-statistic of only 3.67, which cannot be rejected at even the 10% level. Once again, this is in dramatic contrast with column 2 estimates of the effects of absolute information, which are all positive and large. Though the difference is not significant in this case, Clarke's (2003) test reveals that the absolute information variables of column 2 do not explain voting as well as the relative information variables of column 3.

Information and Voting in General Elections
Probit: 1 = voted in general election

	1	2	3
Education (level)	0.0085	0.0427***	-
	(0.96)	(15.68)	-
Education (%)	0.0021***	-	0.0027***
	(4.04)	-	(16.86)
Age (level)	-0.0005	0.0050***	-
	(-0.52)	(20.09)	-
Age (%)	0.0034***	-	0.0031***
	(5.99)	-	(23.39)
Income (level)	0.0329**	0.0504***	-
	(2.32)	(13.80)	-
Income (%)	0.0005	-	0.0017***
	(0.93)	-	(12.54)
Information (level)	0.0486***	0.1094***	-
	(3.20)	(27.11)	-
Information (%)	0.0022***	-	0.0039***
	(4.11)	-	(27.62)
F-test (relative)	72.13***	-	-
F-test (absolute)	18.31**	-	-
Non-nested fit test	-	-	8,071***
# of Observations	15,133	15,133	15,133
Pseudo R-squared	0.215	0.211	0.214

Notes: Table lists marginal effects (and z-statistics). Source is NES (1972-1992). Controls for gender, race, and electorate effects for 311 year-state pairs are included but not shown. *, **, ***, indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 5: Information and Voting in General Elections

Table 5 repeats the analysis of Tables 3 and 4, this time for voting in general elections.

Once again, the estimated effects of relative information variables in column 1 are positive: moving from the bottom to the top of the education, age, income, or information distributions, for example, would make a citizen 21%, 34%, 5%, or 22% more likely to vote, respectively. A test of the hypothesis in (4) yields an F-statistic of 72.13, which is significant at any conventional significance level. A test of (5) can also be rejected this time, but the estimated marginal effects of absolute information variables are smaller than the estimated effects of relative variables: moving from the lowest to the highest education, income, and information levels, for example, makes a citizen only $6 \times 0.9\% = 5.4\%$, $4 \times 0.05\% = 0.2\%$, or $4 \times 4.9\% = 19.6\%$ more likely to vote, and the estimated marginal effect of age is actually negative. Even the largest of these—information quality—is smaller than the corresponding rank variable, and all of these estimates are once again much smaller than corresponding estimates from column 2, which is the more standard formulation.[19] The regression in column 3 also explains voting behavior significantly better than column 2, yielding higher likelihood function values for $8,071$ out of the $15,133$ observations.

Taken together, the evidence displayed in Tables 2 through 5 strongly supports a strategic theory of voter turnout, as described in Section 2, while undermining simpler, non-strategic explanations. In every setting, relative information variables have large positive effects on voting, and the hypothesis (4) is rejected. Absolute information effects appear quite large when relative variables are excluded from the analysis, but are insignificant or even negative when relative variables are included. The only setting in which absolute information variables are jointly significant is general elections, and even in that case the model with relative effects only (column 3) explains voting behavior better than the model with absolute effects only (column 2), by a statistically significant amount.

Between Tables 3 through 5, estimates of the importance of relative information variables are as follows: moving from the bottom to the top of the education distribution makes a citizen between 9% and 21% more likely to vote; moving from the bottom to the top of the age distribution makes a citizen 16% to 34% more likely to vote; moving from the bottom to the top of the income or information distributions makes a citizen from 5% to 13% or from 15% to 33% more likely to vote, respectively. By even the smallest of these estimates, the combined effect of relative information variables is quite large. By comparison, the estimated effects of moving from the lowest to the highest education, age, income, and information levels are between 2.4% and 5.4%, between -4% and 16%, between 0.2% and 2.4%, and between 4% and 19.6%, respectively.

[19] It is even plausible that, in assessing survey respondants' information quality, an NES interviewer implicitly compares citizens to others within the same state (which is presumably the state that the interviewer is most familiar with). If so, the subjective measure of information quality might already include a relative component, and its significance might partly reflect strategic considerations.

6 Robustness

The discussion in Section 5 points out that the behavioral patterns visible in Tables 2 and 3 are reproduced similarly in Tables 4 and 5, implying that the results in Section 5 are robust across election settings. In addition to that analysis, this section investigates two additional sources of possible bias. The first is the tendency for survey respondents to over-report their voting behavior, and the second is the possibility of a composition bias arising from the fact that an individual's own information level is used in estimating the distribution of information within her electorate.

6.1 Mis-reporting

The value of any survey depends on the extent to which respondents answer questions truthfully and accurately. Even more than other issues, voter participation is subject to tremendous influence from social norms and pressures. Accordingly, voters or nonvoters may have incentives to mis-report—particularly to over-report—their voter participation. For several years, NES staff used public municipal records to meticulously validate whether survey respondents had actually voted or not. Assuming public records to be correct, the result of this effort was the finding that 1% of voters had denied voting, and that 30% of nonvoters had claimed to have voted. Overall, then, a troublingly high 20% of survey responses were inaccurate.

If reporting error were purely random, it would have little effect on regression estimates. Belli, Traugott, and Beckmann (2001), however, find over-reporting to be positively correlated with education, age, and expressed political knowledge—precisely the variables of interest here. How that effects the results of this paper depends on whether over-reporting is correlated with absolute level variables, relative percentile variables, or both—a question that those authors do not address. Accordingly, columns 1 and 2 of Table 6 repeat regression 1 from Table 5, using only the years of data for which validations were made using public records. Column 1 uses respondents' reports, as in the regressions above, while column 2 uses validated voting behavior obtained from public records.

Information and Voting		
Probit: 1 = voted in general election	Reported 1	Validated 2
Education (level)	0.0310**	0.0117
	(2.15)	(0.73)
Education (%)	0.0009	0.0014*
	(1.04)	(1.47)
Age (level)	-0.0011	0.0011
	(-0.72)	(0.62)
Age (%)	0.0044***	0.0035***
	(4.88)	(3.33)
Income (level)	0.0579***	0.0472**
	(2.52)	(1.84)
Income (%)	-0.0004	0.0004
	(-0.46)	(0.47)
Information (level)	0.0673***	0.0388*
	(2.66)	(1.42)
Information (%)	0.0018**	0.0026***
	(1.98)	(2.69)
F-test (relative)	28.80***	21.65***
F-test (absolute)	20.59***	7.01
# of Observations	6,292	6,238
Years	1976-1988	1976-1988
Pseudo R-squared	0.221	0.163

Notes: Table lists marginal effects (and z-statistics). Source is NES (1976-1988). Controls for gender, race, and electorate effects for 127 year-state pairs are included but not shown. *, **, ***, indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 6: Information and Validated Voting

The two columns of Table 6 are generally quite similar. The basic patterns observed in Section 5 are present in both regressions; if anything, the patterns are more salient in column 2, for the validated data. In particular, the estimated effects of relative education, income, and information quality are all higher in column 2 than in column 1, and the estimated effects of absolute education, income, and information are all diminished. The test of the hypothesis (4) that relative information coefficients are zero can be rejected in both cases. The test of the hypothesis (5) that absolute information coefficients are equal to zero, however, is only rejected in column 2. It is conceivable, in light of this evidence, that reducing measurement error in the data on voter participation would make the patterns described in Section 5 even more prominent.

6.2 Small elections

One limitation of the relative information variables constructed in Section 4 is that the distribution of information in an individual's electorate is determined in part by that individual's own information quality. If she were the only individual sampled from that electorate, for example, she would be ranked mechanically at the 100th percentile, no matter how poor her information. In electorates with many observations, this is less of a concern, because a citizen's position within her electorate is estimated more precisely. The regressions described in Tables 2 through 5 in Section 5 include only electorates with at least 15 observations; for the sake of comparison, Table 7 reestimates column 1 from each of those tables, this time excluding electorates with less than 40 observations. The results are quite similar to those above—if anything, the patterns described in Section 5 are more pronounced—suggesting that any bias arising from these small-electorate composition effects is small.

Information and Voting				
Probit: 1 = voted in . . .	Sen/gov race 1	Sen/gov race 2	Primary election 3	General election 4
Education (level)	-0.0049	0.0056	0.0010	0.0097
	(-0.34)	(0.28)	(0.73)	(0.96)
Education (%)	0.0025***	0.0010	0.0012*	0.0022***
	(2.70)	(0.78)	(1.41)	(3.64)
Age (level)	-0.0025	-0.0008	0.0021*	0.0003
	(-1.43)	(-0.34)	(1.33)	(0.31)
Age (%)	0.0031***	0.0022*	0.0025***	0.0029***
	(3.06)	(1.55)	(2.60)	(4.58)
Income (level)	-0.0200	-0.0360	0.0067	0.0377**
	(-0.94)	(-1.21)	(0.29)	(2.31)
Income (%)	0.0015**	0.0018*	0.0233	0.0004
	(1.84)	(1.6)	(1.25)	(0.63)
Information (level)	-	-0.0227	0.0264	0.0381**
	-	(-0.72)	(1.08)	(2.15)
Information (%)	-	0.0043***	0.0017**	0.0025***
	-	(3.67)	(1.96)	(3.93)
F-test (relative)	20.56***	21.03***	14.88***	51.78***
F-test (absolute)	3.04	2.24	3.75	11.86**
# of Observations	5,149	3,276	6,260	12,578
# of elections	89	58	180	98
Years	1952-1980	1968-1980	1972-1992	1968-2004
Pseudo R-squared	0.090	0.105	0.151	0.209

Notes: Table lists marginal effects (and z-statistics). Source is NES (1976-1988). Controls for gender, race, and electorate fixed effects are included but not shown. *, **, ***, indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 7: Information and Voting in Large Electorates

7 Conclusion

The results of this paper strongly favor a strategic theory of voter participation over a non-strategic model. While both claim to predict that information makes a citizen more likely to vote, the former predicts further that this effect should be relative, taking into account the information levels of others within the electorate, while the latter makes no such prediction. Consistent with the strategic model, the results of Section 5 show that a citizen's rank within the distributions of education, age, income, and political knowledge within her electorate makes her more likely to vote, even controlling for her absolute level of information, as measured by these proxy variables. Furthermore, controlling for her rank in the information distributions reduces the explanatory power of absolute information variables dramatically—contrary to the predictions of a non-strategic model. That this result is more than a mere artifact of colinearity is suggested by the result that information variables alone predict voter behavior more accurately (by a statistically significant amount) than do absolute information variables alone.

An important feature of the above results is that similar patterns are observed for a variety of election settings. In particular, voter participation decisions at both the extensive and intensive margins (i.e. both turnout and roll-off) appear to involve similar strategic considerations. As discussed in the Introduction, this ability to explain turnout and roll-off simultaneously is one of the primary attractions of the strategic voting model. Merlo (2006) points out that, since voting is the most primitive element of democracy, a correct understanding of voting is a necessary prerequisite to a correct understanding of more complex democratic processes. In that light, the strong similarity of participation patterns in primary elections, general elections, and roll-off suggests progress toward establishing a single, unified theory of voting.

Along similar lines, the results above also provide insight into broader questions of fundamental voter capabilities and motivations. For example, the complexity of the pivotal voting calculations described in Section 2 appears not to prevent citizens from voting strategically. Also, that citizens appear to defer to one another's expertise suggests a much higher degree of collectivism than is often supposed. By that view, policies and candidates can be evaluated objectively, and Condorcet's (1785) basic conception of elections as information aggregators should not be dismissed as irrelevant to political settings. In that framework, McMurray (2009) shows that voter abstention can actually improve welfare, as can voting by relatively uninformed citizens; the results of this paper therefore suggest that policy efforts to prevent such behavior would be misguided. Condorcet's (1785) fundamental insight, of course, is that in such settings, majority election outcomes are likely to be good for society.

References

[1] Abramson, Paul R., John H. Aldrich, Phil Paolino, and David W. Rhode. 1992. "'Sophisticated' Voting in the 1988 Presidential Primaries." *The American Political Science Review*, 86(1): 55-69.

[2] Aldrich, John H. 1993. "Rational Choice and Turnout." *American Journal of Political Science*, 37(1): 246-278.

[3] Austen-Smith, David and Jeffrey S. Banks. 1996. "Information Aggregation, Rationality, and the Condorcet Jury Theorem." *The American Political Science Review*, 90(1): 34-45.

[4] Battaglini, Marco, Rebecca Morton, and Thomas Palfrey. 2006. "The Swing Voter's Curse in the Laboratory." CEPR Discussion Paper 5458.

[5] Battaglini, Marco, Rebecca Morton, and Thomas Palfrey. 2008. "Information Aggregation and Strategic Abstention in Large Laboratory Elections." *The American Economic Review: Papers & Proceedings*, Vol. 98(2): 194-200.

[6] Belli, Robert F., Michael W. Traugott, and Matthew N. Beckmann. 2001. "What Leads to Voting Overreports? Contrasts of Overreporters to Validated Voters and Admitted Nonvoters in the American National Election Studies." *Journal of Official Statistics*, Vol. 17:4, pp. 479-498.

[7] Borgers, Tilman. 2004. "Costly Voting." *The American Economic Review*, 94(1): 57-66.

[8] Brody, Richard A. 1978. "The Puzzle of Political Participation in America." In *The New American Political System*, ed. Anthony King. Washington DC: American Enterprise Institute.

[9] Clarke, Kevin. 2003. "Nonparametric Model Discrimination in International Relations", *The Journal of Conflict Resolution*, 47(1): 72-93.

[10] Clarke, Kevin. 2007. "A Simple Distribution-free Test for Nonnested Model Selection", *Political Analysis*, 15: 347-363.

[11] Coate, Stephen, Michael Conlin, and Andrea Moro. 2006. "The Performance of the Pivotal-Voter Model in Small-Scale Elections: Evidence from Texas Liquor Referenda." Unpublished.

[12] Condorcet, Marquis de. 1785. *Essay on the Application of Analysis to the Probability of Majority Decisions.* Paris: De l'imprimerie royale. Trans. Iain McLean and Fiona Hewitt. 1994.

[13] Crain, Mark W., Donald R. Leavens, and Lynn Abbot. 1987. "Voting and Not Voting at the Same Time." *Public Choice* 53, pp. 221-229.

[14] Dee, Thomas. 2004. "Are there Civic Returns to Education?" *Journal of Public Economics*, 88(9-10): 1697-1720.

[15] Degan, Arianna and Antonio Merlo. 2007a. "A Structural Model of Turnout and Voting in Multiple Elections." Penn Institute for Economic Research Working Paper 07-011.

[16] Degan, Arianna and Antonio Merlo. 2007b. "Do Voters Vote Sincerely?" NBER Working Paper 12922.

[17] Dowding, Keith. 2005. "Is it Rational to Vote? Five Types of Answer and a Suggestion." *Political Studies Association*, 7: 442-459.

[18] Downs, Anthony. 1957. *An Economic Theory of Democracy.* New York: Harper and Row.

[19] Edlin, Aaron, Andrew Gelman, and Noah Kaplan. 2005. "Voting as a Rational Choice: Why and How People Vote to Improve the Well-Being of Others." *Rationality and Society*, 19(2): 225-246.

[20] Feddersen, Timothy J. 2004. "Rational Choice Theory and the Paradox of Not Voting." *The Journal of Economic Perspectives*, 18(1): 2004.

[21] Feddersen, Timothy J. and Wolfgang Pesendorfer. 1996. "The Swing Voter's Curse." *The American Economic Review*, 86(3): 408-424.

[22] Feddersen, Timothy J. and Wolfgang Pesendorfer. 1999. "Abstention in Elections with Asymmetric Information and Diverse Preferences." *The American Political Science Review*, 93(2): 381-398.

[23] Geys, Benny. 2006. "'Rational' Theories of Voter Turnout: A Review." *Political Studies Review*, 4: 16-35.

[24] Goeree, Jacob K. and Jens Grosser, "Costly Voting with Correlated Preferences," mimeo, CREED, University of Amsterdam, 2003.

[25] Kiewiet, D. Roderick. 1983. *Macroeconomics and Micropolitics*, Chicago: University of Chicago Press.

[26] Knack, Stephen. 1994. "Does Rain Help the Republicans?: Theory and Evidence on Turnout and the Vote." *Public Choice*, 79: 187-209.

[27] Larcinese, Valentino. 2006. "Information Acquisition, Ideology, and Turnout: Theory and Evidence from Britain." STICERD Political Economy and Public Policy series 18.

[28] Lassen, David. 2005. "The Effect of Information on Voter Turnout: Evidence from a Natural Experiment." *American Journal of Political Science*, 49(1): 103-118.

[29] Ledyard, John O. 1984. "The Pure Theory of Large Two-Candidate Elections." *Public Choice*, 44: 7-41.

[30] Matsusaka, John. 1993. "Election Closeness and Voter Turnout: Evidence from California Ballot Propositions." *Public Choice*, 76: 313-334.

[31] Matsusaka, John. 1995. "Explaining Voter Turnout Patterns: An Information Theory." *Public Choice*, 84: 91-117.

[32] Matsusaka, John, and Filip Palda. 1999. "Voter Turnout: How Much can we Explain?" *Public Choice*, 98: 431-446.

[33] McMurray, Joseph. 2010. "Information and Voting: the Wisdom of the Experts versus the Wisdom of the Masses." Unpublished.

[34] Merlo, Antonio. 2006. "Whither Political Economy? Theories, Facts, and Issues." Unpublished.

[35] Milligan, Kevin, Enrico Moretti, and Philip Oreopoulos. 2004. "Does Education Improve Citizenship? Evidence from the United States and the United Kingdom." *Journal of Public Economics*, 88(9-10): 1667-1695.

[36] Myerson, Roger. 1998. "Population Uncertainty and Poisson Games." *International Journal of Game Theory*, 27: 375-392.

[37] Myerson, Roger. 2000. "Large Poisson Games." *Journal of Economic Theory*, 94: 7-45.

[38] Palfrey, Thomas R. and Howard Rosenthal. 1983. "A Strategic Calculus of Voting." *Public Choice*, 41(1): 7-53.

[39] Palfrey, Thomas R. and Howard Rosenthal. 1985. "Voter Participation and Strategic Uncertainty." *American Political Science Review*, 79(1): 62-78.

[40] Riker, William H. and Peter C. Ordeshook. 1968. "A Theory of The Calculus of Voting." *American Political Science Review*, 62: 25-42.

[41] Strate, John M., Charles J. Parrish, Charles D. Elder, and Coit Ford. 1989. "Life Span Civic Development and Voting Participation." *American Political Science Review*, 82(2): 443-464.

[42] Vuong, Quang. 1989. "Likelihood ratio tests for model selection and nonnested hypotheses." *Econometrica*, 57:307-33.

[43] Wattenberg, Martin, Ian McAllister, and Anthony Salvanto. 2000. "How Voting is Like Taking an SAT Test: An Analysis of American Voter Rolloff." *American Politics Research*, 28: 234-250.

[44] Wolfinger, Raymond E. and Rosenstone, Stephan J. 1980. *Who Votes?* New Haven: Yale University Press.

[45] Zaller, John. 1986. "Analysis of Information Items on the 1985 NES Pilot Study." *NES Pilot Study Report*, nes002261.