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"A Structural Model of Turnout and Voting in Multiple Elections"
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A Structural Model of Turnout and Voting in Multiple Elections*

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ABSTRACT

This paper develops a unified approach to study participation and voting in multiple elections. The theoretical setting combines an "uncertain-voter" model of turnout with a spatial model of voting behavior. We apply our framework to the study of turnout and voting in U.S. presidential and congressional elections. We structurally estimate the model using individual-level data for the 2000 elections, and quantify the relationships between observed individual characteristics and unobserved citizens' ideological preferences, information, and civic duty. We then use the estimated model, which replicates the patterns of abstention, selective abstention, split-ticket voting, and straight-ticket voting observed in the data, to assess the effects of policies that may increase citizens' information and sense of civic duty on their turnout and voting behavior.

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1 Introduction

Who votes and for whom people vote determine the outcome of elections. Hence, citizens' participation and voting decisions in elections are fundamental inputs in the political process that shapes the policies adopted by democratic societies. It is therefore not surprising that political scientists and political economists have long been concerned with understanding observed patterns of electoral turnout and voting.

In the United States, there is considerable variation in voter turnout both within and across types of elections (e.g., Blais (2000)). Also, participation and abstention rates are in general not uniform in the population of eligible voters, but are correlated with several demographic characteristics such as age, education, gender, and race (e.g., Matsusaka and Palda (1999)). When multiple elections are held simultaneously, many different patterns of abstention and voting behavior are observed in individual-level data. In particular, often people vote in some elections but abstain in others (*selective abstention*), or vote for candidates of different parties in different elections (*split-ticket voting*). In national elections, for example, it is typically the case that more people vote for President than for Congress, and a sizeable fraction of voters vote for the Republican presidential candidate and the Democratic congressional candidate or the other way around (e.g., Burden and Kimball (2002)).[1]

These observations have motivated a large body of theoretical and empirical research in political economy aimed at interpreting the evidence. For the most part, however, the literature has addressed the issues of voter turnout and voting behavior separately. In this paper, we propose a unified approach to study participation and voting in multiple elections. The theoretical framework we propose combines an "uncertain-voter" model of turnout (which shares some insights with the models of Feddersen and Pesendorfer (1996, 1999) and Matsusaka (1995)), with a spatial (Downsian) model of voting behavior. We apply our framework to study turnout and voting in U.S. national elections, and we structurally estimate our model using individual-level data for the 2000 elections.

We consider a spatial environment with a continuum of citizens facing multiple simultaneous two-candidate elections, where citizens and candidates are characterized by positions

[1] Many of these phenomena are also common in several other countries (e.g., Blais (2000)).

in a common ideological space, and citizens derive a direct benefit from fulfilling their civic duty of voting.[2] Citizens may be uncertain about candidates' positions and may have different information about the candidates running in the elections they face. Because of this uncertainty (or lack of information), citizens may make mistakes, that is vote for the "wrong" candidate. The possibility of mistakes makes voting potentially costly, and may induce citizens to abstain. If a citizen chooses to participate in an election, she votes for the candidate associated with the smallest cost of voting.

Given citizens' ideological preferences, information, and sense of civic duty, we characterize their optimal participation and voting decisions in the elections they face. We show that the extent to which voting is costly for different citizens, which affects their propensity to participate in each election, is systematically related to their ideological preferences, the distribution of the possible alternatives they may be facing, as well as their degree of uncertainty. Also, the optimal voting behavior implied by our model is consistent with expected utility maximization in a spatial setting, and may generate all possible voting profiles (that is, voting for each possible combination of candidates in the elections citizens face).

Turning attention to the empirical study of participation and voting in U.S. national elections, our main findings can be summarized as follows. First, the estimated structural model fits individual-level data for the 2000 presidential and congressional elections remarkably well. In particular, it replicates the patterns of abstention, selective abstention, split-ticket voting, and straight-ticket voting observed in the data, both for the overall sample and by individual demographic characteristics. The model also implies a positive relationship between information and turnout: since uninformed citizens are more likely to make "voting mistakes" and hence have larger costs of voting, *ceteris paribus*, they abstain more than informed citizens. With respect to the issue of selective abstention, our estimates imply that, since in general there is more information (and hence less uncertainty) about presidential candidates than congressional candidates, on average the cost of voting in the presidential election is smaller than in a congressional election. This provides an explanation for the fact that we observe more abstention in congressional elections than in the presidential election.

[2]Since in the environment we consider there is a continuum of citizens, no individual voter can decide the outcome of any election.

With respect to the issue of split-ticket voting, our analysis suggests that heterogeneity in candidates' and citizens' ideological positions and in citizens' information is sufficient to account for the amount of split-ticket voting observed in the data.

Second, our estimates allow us to quantify the relationships between observed individual characteristics and unobserved citizens' ideological preferences, information, and civic duty. For example, our estimates imply that *ceteris paribus*: the more educated citizens are, the more liberal and the better informed they tend to be, and the higher their sense of civic duty; and individuals who are either catholic or protestant tend to be more conservative, more informed, and have a higher sense of civic duty than those who are not christians.

Third, we use our estimated model to assess the effects of policies that may increase citizens' information and sense of civic duty on their turnout and voting behavior. We find that increasing the sense of civic duty in the population or making citizens more informed about electoral candidates decreases abstention. However, while an increase in civic duty also reduces selective abstention and has a negligible effect on split-ticket voting, the effect of more information is to increase selective abstention as well as the relative fraction of voters who split their ticket.

Finally, we find that a considerable part of the incumbency advantage in congressional elections (i.e., the observation that incumbents on average obtain a larger vote share than challengers), can be explained by the fact that more information is typically available on incumbents than challengers. However, this informational advantage plays an important role only for Democratic incumbents but not for Republican incumbents. This result is due to the fact that there is less variation among the ideological positions of Republican candidates than Democratic candidates, which implies that the Republican "brand name" conveys more information to citizens than the Democratic one.

The remainder of the paper is organized as follows. In Section 2, we discuss the related literature. In Section 3, we present a model of participation and voting in multiple elections. In Section 4, we describe the parameterization of the model for the empirical study of citizens' behavior in U.S. national elections. Section 5 contains a description of the data we use in estimation, and Section 6 the results of our empirical analysis. The results of the policy experiments are described in Section 7. Concluding remarks are in Section 8.

2 Related Literature

As mentioned in the Introduction, our paper is related to several distinct literatures on voting. Here, we describe the relationship of our work to each of these literatures in turn. The starting point of theoretical research on voter turnout is represented by the "calculus of voting" framework, originally formulated by Downs (1957) and later developed by Tullock (1967) and Riker and Ordeshook (1968). According to this framework, given a citizenry of size N facing an election e where there are two alternatives (e.g., two candidates or two policy proposals), citizen $i \in N$ votes in the election if $p_i^e b_i^e + d_i^e \geq c_i^e$ and abstains otherwise. Here, p_i^e is the probability that citizen i's vote decides the election (i.e., her vote is pivotal), b_i^e is the (indirect) benefit to citizen i associated with inducing her desired electoral outcome, d_i^e is the (direct) benefit of voting in election e, which includes any benefit citizen i may derive from fulfilling her civic duty of voting, and c_i^e is citizen i's cost of voting in election e.

The terms $p_i^e b_i^e$ and d_i^e are often referred to as capturing the instrumental (or investment) and expressive (or consumption) value of voting, respectively. Most of the recent theoretical research on voter turnout has focused on modeling these two components of the benefit from voting. *Pivotal-voter models* (e.g., Borgers (2004), Ledyard (1984) and Palfrey and Rosenthal (1983, 1985)), endogenize the probability that a citizen's vote is decisive. However, since p_i^e converges to zero as N increases, the term $p_i^e b_i^e$, and hence pivotal calculations, become negligible in large elections. *Ethical-voter models* (e.g., Coate and Conlin (2004), Feddersen and Sandroni (2006) and Harsanyi (1980)), endogenize the concept of civic duty. These models consider a continuum of citizens and therefore abstract from the probability of being pivotal. They are based on the behavioral assumption that a citizen's action is chosen in order to maximize the welfare of the population (Feddersen and Sandroni (2006)), or of the group she belongs to (Coate and Conlin (2004)). All these models, however, focus on whether people vote or abstain in a single election, and assume away the issue of how people vote by postulating that each individual has an alternative she supports and would vote for if she chooses to participate in the election.

A third group of models focuses instead on the cost of voting, c_i^e. *Uncertain-voter models* (e.g., Feddersen and Pesendorfer (1996, 1999) and Matsusaka (1995)), endogenize a component of the cost of voting related to the limited information available to citizens in an election. In the environments studied by Feddersen and Pesendorfer (1996, 1999), the cost of voting derives from the fact that each vote may be pivotal, and a vote cast out of ignorance may induce the wrong candidate to get elected. Hence, less informed citizens may choose to abstain in an election in order to let more informed citizens determine the outcome of the election. This effect, however, also vanishes in large electorates. Matsusaka (1995), on the other hand, proposes a model where individuals derive higher benefits from voting the more confident they are of their voting choices, independent of whether their vote can decide an election. Hence, the more informed individuals are about the candidates in an election, the more confident they are about making the right voting decisions, and the more likely they are to participate in the election. The framework we consider embeds an uncertain-voter model similar to the one of Matsusaka (1995) into a spatial model of voting in multiple elections, and relates the cost of voting for each citizen to her ideological position relative to those of the candidates.

The model we propose is also related to the minmax regret theory of turnout of Ferejohn and Fiorina (1974), which postulates that citizens may vote in order to avoid the regret they would experience if they were to abstain in a situation where their vote would have been decisive. As explained in Section 3.2, however, our framework differs from standard economic theories of regret, and incorporates important insights from the psychological literature.[3]

Turning to the empirical literature, our paper is related to the recent literature on the structural estimation of models of *voter turnout*. Coate, Conlin and Moro (2005) estimate a pivotal-voter model using data on local liquor referenda in Texas.[4] Their analysis shows that while the estimated model is capable of predicting observed levels of turnout quite well, at the same time it predicts closer electoral outcomes than they are in the data. In other words, the only way the theory behind pivotal-voter models can explain actual turnout, is

[3]Another interesting approach to the study of voter turnout postulates that citizens are averse to ambiguity (Ghirardato and Katz (2002)). Hence, citizens may abstain in an election if the policy positions of both candidates are ambiguous and "ambiguity complements" (that is, one candidate looks better than the other under some scenario, while the opposite is true under another scenario). For recent surveys of the vast theoretical literature on voter turnout see, e.g., Dhillon and Peralta (2002) and Merlo (2006).

[4]For another interesting empirical analysis of pivotal-voter models using data from local school budget referenda in Oregon, see Hansen, Palfrey and Rosenthal (1987).

if elections are very close, which makes their outcome very uncertain and hence individual votes more likely to be pivotal. These circumstances, however, are not consistent with what is observed in reality, thus leading to a rejection of this class of models. On the other hand, using the same data, Coate and Conlin (2004) structurally estimate a group rule-utilitarian model of voter turnout, and show that ethical-voter models are capable of reproducing all of the important features of the data.[5] The results of our empirical analysis suggest that uncertain-voter models may offer a valid alternative to ethical-voter models as useful tools for interpreting the empirical evidence on voter turnout.[6] In addition, our structural model of turnout and voting can also account for observed patterns of abstention and voting in multiple elections (e.g., selective abstention and split-ticket voting).

Finally, our paper relates to the literature on the structural estimation of models of *voting behavior* in U.S. national elections. Using data on how individuals vote in two consecutive presidential elections, Degan (2004) and Shachar (2003) estimate two different models aimed at explaining the various patterns of voting observed in the data (where some voters vote for the same presidential candidate or the candidate of the same party in the two consecutive elections, while others switch their vote between elections). While Degan's model emphasizes the role of incomplete information about candidates' valence, Shachar's model focuses on habit formation. Mebane (2000), on the other hand, estimates a structural model of voting in presidential and congressional elections based on the theoretical work of Fiorina (1992) and Alesina and Rosenthal (1996). His analysis provides some empirical support for the idea that moderate voters may split their ticket in order to balance the House with the President.[7] Unlike our paper, however, all these studies ignore the issue of abstention and focus exclusively on the behavior of voters.

[5] Shachar and Nalebuff (1999) reach a similar conclusion by estimating a structural model that shares some of the features of the Coate and Conlin model, using state-level voting data for U.S. presidential elections.

[6] For other empirical analyses of the role of information in elections see, e.g., Alvarez (1998), and Palfrey and Poole (1987).

[7] Note, however, that Burden and Kimball (2002) provide empirical evidence that contradicts balancing arguments, and find that voters are not intentionally splitting tickets to induce divided governments and moderate policies.

3 Model

We consider the typical situation in U.S. national elections in a presidential election year, where citizens face two simultaneous two-candidate elections: a presidential election and a congressional election.[8] While the presidential election is nation-wide (that is, all citizens face the same set of candidates regardless of where they reside), congressional elections are held at the district level (that is, citizens residing in different congressional districts face different sets of candidates). For each election, citizens have to decide whether to vote or abstain, and if they vote, which candidate to support.

Let $h \in \{1, ..., 435\}$ denote a generic congressional district, P the presidential election, H the congressional election in district h, and $e \in \{P, H\}$ a generic election faced by a citizen residing in district h.[9] In each election, there are two candidates running for office: a Republican candidate, R_e, and a Democratic candidate, D_e, and we let $j \in \{R_P, D_P, R_H, D_H\}$ denote a generic candidate.[10] Each candidate j is characterized by a position y^j in the unidimensional, liberal-conservative ideological space $Y = [-1, 1]$.[11] Consistent with the empirical evidence (e.g., Ansolabehere, Snyder and Stewart (2001)), throughout the analysis we assume that in each electoral race the democratic candidate is more liberal than the republican candidate (i.e., in each election e, $y^{D_e} < y^{R_e}$). In particular, presidential and congressional candidates are drawn from populations of potential candidates whose ideological positions have distribution functions $F_P\left(y^D, y^R \mid y^D < y^R\right)$ and $F_H\left(y^D, y^R \mid y^D < y^R\right)$, respectively.

[8] In the United States, citizens are called to participate in national elections to elect the President and the members of Congress. While congressional elections occur every two years, the time between presidential elections is four years. We refer to an election year where both presidential and congressional elections occur simultaneously as a presidential election year. Consistent with the existing literature on split-ticket voting, we restrict attention to House elections, which are held every election year for every district. Hence, each citizen faces both a presidential election as well as a House election. Senate elections, on the other hand, are staggered and only about a third of all states have a Senate election in any given election year.

[9] The total number of U.S. congressional districts is 435.

[10] We ignore the fact that in some elections independent candidates may also be running and we exclude from our analysis elections where only one candidate runs unopposed.

[11] The model can be easily be generalized to more than two elections and to a multi-dimensional ideological space.

Note that these distributions may be different for presidential and congressional elections, and they may also differ across districts in congressional elections.[12]

For each election $e \in \{P, H\}$, let Δ_i^e denote citizen i's information in election e, which can be represented as a joint probability distribution function over the ideological positions of the two candidates in the election, $G_i^e \left(y^D, y^R \mid y^D < y^R \right)$, conditional on the maintained assumption that $y^{D_e} < y^{R_e}$. Depending on what a citizen knows, $G_i^e (\cdot)$ may be degenerate (if, for example, citizen i knows the actual ideological positions of the two candidates in election e), or may or may not be equal to $F_e (\cdot)$. Hence, $\Delta_i^e = G_i^e (\cdot)$ captures the fact that citizens may be uncertain about the ideological positions of candidates in an election, and that citizens may differ with respect to the information they possess. Let $\Delta_i = \left\{ \Delta_i^P, \Delta_i^H \right\}$ denote the information set of citizen i residing in district h.

We assume that in each district there is a continuum of heterogeneous citizens.[13] It follows that no single vote can ever be pivotal in any election (i.e., using the terminology of the calculus of voting framework described above, $p_i^e = 0$ for all i and all $e \in \{P, H\}$). Hence, the only benefit citizen i derives from voting is the direct benefit of fulfilling her civic duty, $d_i \geq 0$, which may differ across citizens.

Each citizen i has an ideological position $y^i \in Y$, and evaluates alternative ideologies $y \in Y$ according to the payoff function

$$u_i (y) = -(y^i - y)^2 \tag{1}$$

which is single-peaked at y^i.[14]

Because citizens may be uncertain about candidates' ideological positions, they may make "voting mistakes" or, equivalently, vote for the "wrong" candidate. This is what makes

[12] In particular, note that the assumption that in each individual race the democratic candidate is more liberal than the republican does not preclude the possibility that a democratic candidate in one race is more conservative than a republican candidate in a different race.

[13] By law, in order to satisfy the basic democratic principle of "one person one vote," congressional districts are drawn (and periodically redrawn) so that each district contains approximately the same number of citizens. Hence, all districts have the same size. Since the number of eligible voters in each district is large, we approximate it with a continuum.

[14] For a justification of the use of a quadratic specification of the payoff function $u_i (y)$ in an electoral environment with uncertain candidates' positions see, e.g., Alvarez (1998).

voting potentially costly in this framework. In particular, given her information regarding the candidates in election e, $\Delta_i^e = G_i^e\left(y^D, y^R \mid y^D < y^R\right)$, and her ideological position y^i, citizen i's cost of voting for candidate D_e is equal to

$$c_i\left(D_e; y^i, \Delta_i^e\right) = \int_{\{(y^D,y^R)\, \in\, Y\times Y:\; u_i(y^D)\, <\, u_i(y^R)\}} \left[u_i\left(y^R\right) - u_i\left(y^D\right)\right] dG_i^e\left(y^D, y^R \mid y^D < y^R\right), \tag{2}$$

and her cost of voting for candidate R_e is equal to

$$c_i\left(R_e; y^i, \Delta_i^e\right) = \int_{\{(y^D,y^R)\, \in\, Y\times Y:\; u_i(y^D)\, >\, u_i(y^R)\}} \left[u_i\left(y^D\right) - u_i\left(y^R\right)\right] dG_i^e\left(y^D, y^R \mid y^D < y^R\right). \tag{3}$$

Each cost corresponds to the expected payoff loss for citizen i of voting for one candidate when the candidates' ideological positions are such that she would prefer the position of the other candidate. This cost is a psychological disutility incurred upon voting, and is based on the information possessed by the voter at the time of the election. In particular, although it depends on the perceived probabilities of the candidates' positions, it is experienced upon making a possibly wrong choice and not ex-post.[15]

Let $t_i^e \in \{0,1\}$ and $v_i^e \in \{D_e, R_e\}$ denote citizen i's turnout and voting decisions in election $e \in \{P, H\}$, respectively, where $t_i^e = 1$ ($t_i^e = 0$) if she participates (abstains) in election e, and $v_i^e = D_e$ ($v_i^e = R_e$) if she votes for candidate D_e (R_e). For each election $e \in \{P, H\}$, citizen i solves the following optimization problem:[16]

$$\max_{t_i^e\in\{0,1\},\; v_i^e\in\{D_e,R_e\}} t_i^e\left[d_i - c_i\left(v_i^e; y^i, \Delta_i^e\right)\right]. \tag{4}$$

Without loss of generality, the decision problem in (4) can be reformulated as a two-stage optimization problem, where in the first stage the citizen decides whether or not to participate in the election and, in the second stage, she decides whom to vote for (conditional

[15] This cost of voting is different from expected ex-post regret, which implies that all potential outcomes are eventually observed. Our setting does not require that citizens eventually learn the true ideological positions of all candidates.

[16] One could easily add a payoff component which depends on the outcome of the election. However, because a citizen's vote is never pivotal, this would not affect her participation and voting decisions.

on voting). To solve this problem we work backwards, starting from the last stage. In the second stage, citizen i's optimal voting rule is:

$$v_i^{e*}\left(y^i,\Delta_i^e\right)=\begin{cases} D_e & \text{if} \quad c_i\left(R_e;y^i,\Delta_i^e\right)>c_i\left(D_e;y^i,\Delta_i^e\right), \\ R_e & \text{if} \quad c_i\left(R_e;y^i,\Delta_i^e\right)<c_i\left(D_e;y^i,\Delta_i^e\right), \end{cases} \tag{5}$$

and in the event that $c_i\left(R_e;y^i,\Delta_i^e\right)=c_i\left(D_e;y^i,\Delta_i^e\right)$ citizen i randomizes between the two alternatives with equal probability.

This leads to the following proposition which states that if a citizen participates in an election it is optimal for her to vote for the candidate associated with the highest expected payoff.

Proposition: *If a generic citizen i participates in election $e\in\{P,H\}$ where candidates D_e and R_e are running, her optimal voting rule is given by:*

$$v_i^{e*}\left(y^i,\Delta_i^e\right)=\begin{cases} D_e & if \quad E[u_i\left(y^D\right)-u_i\left(y^R\right)\mid\Delta_i^e]>0, \\ R_e & if \quad E[u_i\left(y^D\right)-u_i\left(y^R\right)\mid\Delta_i^e]<0. \end{cases}$$

If $E[u_i\left(y^D\right)-u_i\left(y^R\right)\mid\Delta_i^e]=0$, citizen i votes for either candidate with equal probability.

Proof: To prove the result it is sufficient to show that, for any citizen i and any election e, $c_i\left(D_e\right)<c_i\left(R_e\right)$ if and only if $E[u_i\left(y^D\right)-u_i\left(y^R\right)\mid\Delta_i^e]>0$. Since $u_i\left(y^D\right)-u_i\left(y^R\right)=-\left(u_i\left(y^R\right)-u_i\left(y^D\right)\right)$, using the definitions of $c_i\left(D_e\right)$ and $c_i\left(R_e\right)$ contained in equations (2) and (3), we have that

$$\begin{aligned} & c_i\left(D_e;y^i,\Delta_i^e\right)-c_i\left(R_e;y^i,\Delta_i^e\right) \\ = & \int\limits_{\{(y^D,y^R)\,\in\,Y\times Y:\,u_i(y^D)\,<\,u_i(y^R)\}}\left[u_i\left(y^R\right)-u_i\left(y^D\right)\right]dG_i^e\left(y^D,y^R\mid y^D<y^R\right)+ \\ & \int\limits_{\{(y^D,y^R)\,\in\,Y\times Y:\,u_i(y^D)\,>\,u_i(y^R)\}}\left[u_i\left(y^R\right)-u_i\left(y^D\right)\right]dG_i^e\left(y^D,y^R\mid y^D<y^R\right) \\ = & \int\left[u_i\left(y^R\right)-u_i\left(y^D\right)\right]dG_i^e\left(y^D,y^R\mid y^D<y^R\right) \\ \equiv & E[u_i\left(y^R\right)-u_i\left(y^D\right)\mid\Delta_i^e]. \qquad\blacksquare \end{aligned}$$

As it is clear from the proof of the Proposition, the result that the optimal voting behavior implied by minimizing the cost of voting is the same as the one implied by maximizing the expected payoff does not depend on the functional form of $u_i(y)$. Given the quadratic payoff function specified in (1), the Proposition implies the following corollary, stating that a citizen's optimal voting rule is a "cutoff" rule on the citizen's ideological position conditional on her information.

Corollary: *If a generic citizen i with information set Δ_i^e participates in election $e \in \{P, H\}$ where candidates D_e and R_e are running, there exists an ideological cutoff*

$$\tau^e\left(\Delta_i^e\right) = \frac{E\left[\left(y^{R_e}\right)^2 - \left(y^{D_e}\right)^2 \mid \Delta_i^e\right]}{2E\left[y^{R_e} - y^{D_e} \mid \Delta_i^e\right]},$$

such that her optimal voting rule is given by:

$$v_i^{e*}\left(y^i, \Delta_i^e\right) = \begin{cases} D_e & if \quad y^i < \tau^e\left(\Delta_i^e\right), \\ R_e & if \quad y^i > \tau^e\left(\Delta_i^e\right). \end{cases}$$

If $y^i = \tau^e\left(\Delta_i^e\right)$, citizen i votes for either candidate with equal probability.

The optimal voting rule implies a cost for citizen i of voting in election e

$$c_i^e\left(y^i, \Delta_i^e\right) \equiv c_i\left(v_i^{e*}\left(y^i, \Delta_i^e\right)\right). \tag{6}$$

Hence, citizen i's optimal turnout rule in election e is:

$$t_i^{e*}\left(y^i, \Delta_i^e\right) = \begin{cases} 1 & \text{if} \quad c_i^e\left(y^i, \Delta_i^e\right) \leq d_i, \\ 0 & \text{if} \quad c_i^e\left(y^i, \Delta_i^e\right) > d_i. \end{cases} \tag{7}$$

Although we have implicitly assumed that if a citizen is indifferent between voting and abstaining the tie is broken in favor of participation, this assumption is inconsequential. Under the maintained assumption that $y^{D_e} < y^{R_e}$, for any information set Δ_i^e, the cost of voting $c_i^e\left(y^i, \Delta_i^e\right)$ is weakly increasing (decreasing) to the left (right) of the ideological cutoff $\tau^e\left(\Delta_i^e\right)$ (see also Degan (2006)). This result holds for any payoff function $u_i(y)$ that is strictly decreasing in $|y^i - y|$ and concave.[17]

[17] To see that this is the case, note that when citizen i optimally votes for candidate D_e (which occurs if $y^i < \tau^e$), she makes a voting mistake for any candidates' positions pair $\left(y^{D_e}, y^{R_e}\right)$ such that $y^i > \left(y^{D_e} + y^{R_e}\right)/2$. Clearly, the closer y^i is to the cutoff point τ^e, the larger the set of possible candidates' positions pairs for which the citizen makes voting mistakes. Also, for any two citizens j and k with the same information, and

When we consider the two elections faced by a citizen i together, it should be clear that differences in Δ_i^e across elections may make it optimal for the citizen to participate in one elections and abstain in the other.[18] Also, depending on the configuration of the ideological positions of candidates in the different elections relative to the positions of citizens, the citizens' optimal voting rules may imply different combinations of voting decisions in the two elections. To illustrate these results and the main properties of the model we present a simple example.

3.1 An Example

Consider a situation where there is a single district, and the democratic and republican presidential and congressional candidates have positions $(y^{D_P}, y^{R_P}) = (0, 1/2)$ and $(y^{D_H}, y^{R_H}) = (0, 1)$, respectively. Suppose that the benefit of voting is the same for all citizens and is equal to $d_i = 1/4$ for all i's. Each citizen is informed in election P, and can either be informed or uninformed in election H. If a citizen is informed in an election, she knows the positions of the candidates running in that election. If a citizen is uninformed in election H, she knows that $y^{D_H} \in Y^{D_H} = \{-1, -1/2, 0, 1/2\}$, $y^{R_H} \in Y^{R_H} = \{-1/2, 0, 1/2, 1\}$, $y^{D_H} < y^{R_H}$, and $\Pr\left\{\left(y^{D_H}, y^{R_H}\right) \in Y^{D_H} \times Y^{R_H} : y^{D_H} < y^{R_H}\right\} = 1/10$. We refer to a citizen who is informed (uninformed) in election H as an informed (partially informed) citizen, and let Δ_I^P and Δ_U^H, Δ_I^H denote the information of an informed citizen in election P, and of an uninformed and informed citizen in election H, respectively.

Using the Corollary above, we can calculate the ideological cutoffs characterizing the citizens' optimal voting rules. Since in this example all citizens are informed in election P, $\tau^P\left(\Delta_I^P\right) = 1/4$ for all citizens. On the other hand, if citizen i is informed in election H, $\tau^H\left(\Delta_I^H\right) = 1/2$, and if she is uninformed in election H, $\tau^H\left(\Delta_U^H\right) = 0$. It follows that,

ideological positions $y^j < y^k < \tau^e$, for any candidates' positions pair (y^{D_e}, y^{R_e}) for which both citizens make a voting mistake by voting for candidate D_e, the associated payoff loss is higher for citizen k than for citizen j as long as the payoff function is strictly concave. Similar considerations apply when citizens optimally vote for R^e.

[18] The same would be true if we were to allow d_i to differ across elections. However, since we want to assess the extent to which selective abstention can be explained by information considerations, we assume here that a citizen's sense of civic duty does not depend on the election.

conditional on participating in both elections, informed citizens would vote for candidates D_P and D_H if their ideological position is less than 1/4, for R_P and D_H if their ideological position is between 1/4 and 1/2, and for R_P and R_H if their ideological position is greater than 1/2. Similarly, conditional on participating in both elections, partially informed citizens would vote for candidates D_P and D_H if their ideological position is less than 0, for D_P and R_H if their ideological position is between 0 and 1/4, and for R_P and R_H if their ideological position is greater than 1/4.[19]

Turning attention to citizens' optimal turnout decisions, notice that since citizens who are informed in an election can never make voting mistakes, their cost of voting in the election is always equal to zero (i.e., $c^P\left(y^i, \Delta_I^P\right) = c_i^H\left(y^i, \Delta_I^H\right) = 0$). It follows that informed citizens participate in both elections and partially informed citizens always participate in election P. Using the definitions in (2) and (3), the Corollary, and the ideological cutoffs calculated above, we have that the cost of voting in election H for partially informed citizens is

$$c_i^H\left(y^i, \Delta_U^H\right) = \begin{cases} 0 & \text{if } \; y^i \in \left[-1, -\frac{3}{4}\right] \cup \left[\frac{3}{4}, 1\right], \\ \frac{3-4|y_i|}{40} & \text{if } \; y^i \in \left[-\frac{3}{4}, -\frac{1}{2}\right] \cup \left[\frac{1}{2}, \frac{3}{4}\right], \\ \frac{7-12|y_i|}{40} & \text{if } \; y^i \in \left[-\frac{1}{2}, \frac{1}{4}\right] \cup \left[\frac{1}{4}, \frac{1}{2}\right], \\ \frac{11-28|y_i|}{40} & \text{if } \; y^i \in \left[-\frac{1}{4}, \frac{1}{4}\right], \end{cases} \tag{8}$$

which is (weakly) increasing in y^i for $y^i < \tau^H\left(\Delta_U^H\right) = 0$ and decreasing for $y^i > \tau^H\left(\Delta_U^H\right) = 0$. Given (8), since citizens participate in election H if $c_i^H(\cdot) \leq d_i = 1/4$ and abstain otherwise, it follows that partially informed citizens with positions $y^i \in [-1/28, 1/28]$ participate in election P and selectively abstain in election H. All other citizens participate in both elections.

By combining citizens' optimal participation and voting decisions, we obtain that for the citizenry in this example we would observe individuals voting for each possible combination of candidates in the two elections (i.e., citizens voting for D_P and D_H, D_P and R_H, R_P and D_H, and R_P and R_H, respectively), as well as individuals who selectively abstain in election H. It should also be clear that allowing for information asymmetries in both elections, as well as individual heterogeneity in civic duty, would also generate the possibility of observing

[19] For the purpose of the example we ignore the case where a citizen is indifferent between voting for either candidate and hence randomizes.

individuals abstaining in both elections and individuals who selectively abstain in election P. These conclusions extend to the general specification of the model considered above. Hence, qualitatively, the model could in principle explain the phenomena of selective abstention and split-ticket voting. However, whether or not the model can reproduce quantitatively the patterns of abstention and voting observed in the data is an empirical question, which we address in the remainder of the paper.

3.2 Justification of the Theoretical Setting

Before turning to the empirical application, some remarks about our theoretical framework are in order. The way we model an individual's utility is based on the behavioral assumption that individuals feel strong negative emotions when they are faced with the possibility of making the wrong choices—in the specific context we consider, voting for the wrong candidate. In particular, we model the (psychological) discomfort experienced upon voting as the expected payoff loss derived from possibly making voting mistakes. The assumption that only negative outcomes matter is consistent with evidence from research in psychology that studies theories of counterfactual thinking and the related theories of regret.[20]

Existing economic theories of regret focus only on anticipated *ex-post* regret (see, e.g., Luce and Raiffa (1957), Loomes and Sugden (1982), and Bell (1982)), and argue that regret arises only if the outcomes of the rejected alternatives is revealed. Psychological studies on counterfactual thinking, on the other hand, show that individuals can be tormented by the imaginary consequences of the alternatives not chosen, and regret need not to be restricted to those instances where the outcomes of unchosen alternatives become known (e.g., Gilovich and Medvec (1995)).

Connolly and Zeelenberg (2002) argue that regret, broadly defined, can be decomposed into two main components: *bad-outcome* and *self-blame.* While the former component is derived when a bad outcome is realized as a consequence of one's action, the latter is derived from making an unwise or unjustified choice independent of the outcome. In the context of collective actions, and more specifically voting behavior, when the size of the population is

[20] The website *www.psych.uiuc.edu/~roese/cf/* contains detailed information about this research, including an updated list of references on research on counterfactual thinking. We thank Ming Li and Dipjyoti Majumdar for letting us know about this website.

large and, hence, the action of one individual does not affect the outcome, the *bad-outcome* component will be absent and the regret will reduce to the *self-blame* component.

Another known finding in the research on counterfactual thinking is that there are significant differences in regret experienced from action rather than inaction. (e.g., Kahneman and Tversky (1982)). Individuals in our model experience a positive (endogenous) "regret" from voting, which is represented by the expected payoff loss derived from potentially making voting mistakes.[21] The "regret" from abstaining is represented by the foregone opportunity of fulfilling one's civic duty.[22]

To summarize, our formulation of a citizen's objective function is based on behavioral assumptions supported by evidence in psychology of decision making. As in other behavioral models of turnout (such as, for example, the ethical-voter models), the behavioral component is then integrated into the standard formulation of the calculus of voting equation. Unlike other existing models, we also provide a joint framework for the analysis of turnout and voting. Although in our setting the driving force of abstention and voting decisions is the disutility of potentially making voting mistakes, as shown in the Proposition above, the model implies optimal voting behaviors that are consistent with expected utility maximization in a spatial setting.

4 Empirical Specification

We use the model described in Section 3 to analyze empirically the turnout and voting behavior of citizens in U.S. presidential and congressional elections. In this section, we describe the specification of the model that we structurally estimate using individual-level

[21] Notice that individuals in our model experience disutility from voting for the wrong candidate even if their vote is not pivotal. This assumption is consistent with empirical evidence by Ordòñez and Connolly (2000), who find that also people not responsible for the outcome feel non-negligible regret. It is also consistent with the theory of the "illusion of control" by Langer (1975), according to which individuals tend to behave as if they had control of a situation (and hence affect the outcome), even in cases where it is clearly not the case. It is therefore the perception of responsibility for potential outcomes and not the true responsibility that matters for the possibility of making the wrong choices (see, e.g., Zeelenberg et al. (2000)).

[22] While in our model individuals get disutility from making voting mistakes, they do not get a utility boost from making the right choice. This is one important aspect, consistent with the literature on counterfactual thinking and regret, that distinguishes our model from the one of Matsusaka (1995).

data for the 2000 elections.[23]

Citizens differ along several observed dimensions. In addition to a district of residence h, each citizen has a vector of demographic characteristics x, which includes the citizen's age, race, gender, education, religion and income. Citizens also differ with respect to their general attitude toward political parties and may either feel an attachment to a specific party or no attachment at all. Following the literature, we refer to feelings of partisan attachment as *party identification* and let $k = (Dem, Rep, Ind)$ be a vector of mutually exclusive indicator variables denoting a citizen's party identification, where $Dem = 1$, $Rep = 1$, or $Ind = 1$ indicates that the citizen identifies herself as a democrat, republican, or independent, respectively.

In our model, citizens also differ with respect to their ideological positions, information, and civic duty. These are all characteristics which are not observable by us (the researchers). Hence, to carry out our empirical analysis, we need to specify the distributions of these characteristics in the population, and the way they relate to individual characteristics that are observable.[24] Each citizen i has an ideological position $y^i(x_i, k_i) \in Y$, which we allow to depend on the citizen's demographic characteristics and party identification. We let $F_y(y \mid x, k)$ denote the distribution of citizens' ideological positions which we assume to be a Beta distribution over the support $Y = [-1, 1]$ with parameters α and β, where

$$\alpha = \exp(\alpha_x x + \alpha_k k)$$

and

$$\beta = \exp(\beta_k k).^{25}$$

[23] The 2000 presidential election represents a salient event in recent U.S. history. However, similar empirical analyses can also be conducted for any other presidential election year for which comparable data are available.

[24] To simplify the estimation of the model, we assume that, conditional on an individual's observed characteristics, her ideological position, information and civic duty are independent from each other. Hence, the only form of dependence in the distributions of citizens' unobserved heterogeneity which we allow is the one induced by the citizens' observed demographic characteristics and party identification.

[25] The family of Beta distributions is the most flexible family of parametric distributions for continuous random variables with a finite support (see, e.g., Johnson and Kotz 1970; vol. 1, pp. 37-56).

With respect to citizens' information, we assume that for each election $e \in \{P, H\}$, a citizen can be either informed or uninformed about the candidates in the election. The information potentially available to citizens depends on the election. In each election, each candidate is either an incumbent or a challenger. For each candidate $j \in \{R_P, D_P, R_H, D_H\}$ we let q_j be an indicator that takes the value one if the candidate is an incumbent and zero otherwise. We refer to an election where neither candidate is an incumbent as an open election. Incumbents who run for reelection to a seat in Congress as well as presidential candidates (regardless of their incumbency status), have public records of their activities while in office. For example, the history of roll call voting by each member of Congress is readily available. Therefore, their positions can in principle be known before an election. Challengers who run for a congressional seat, on the other hand, typically do not have comparable records.[26] Hence, before the elections, the only information potentially available on challengers who run for Congress are the distributions from which they are drawn.

Based on these considerations, we assume that if a citizen is *informed* in the presidential election, she knows y^{D_P} and y^{R_P}. Similarly, if a citizen residing in district h is *informed* in congressional election H, she knows q_{D_H} and q_{R_H}, and if $q_{D_H} = q_{R_H} = 1$, she knows y^{D_H} and y^{R_H}; if $q_{D_H} = 1$ and $q_{R_H} = 0$, she knows y^{D_H} and $F_H\left(y^{D_H}, y^R \mid y^{D_H} < y^R\right)$; if $q_{D_H} = 0$ and $q_{R_H} = 1$, she knows y^{R_H} and $F_H\left(y^D, y^{R_H} \mid y^D < y^{R_H}\right)$; and if $q_{D_H} = q_{R_H} = 0$, she knows $F_H\left(y^D, y^R \mid y^D < y^R\right)$. On the other hand, if a citizen is *uninformed*, we assume she has uniform priors over the possible positions of candidates running for elections. In particular, we let $U_P(y^D, y^R \mid y^D < 0 < y^R)$ and $U_H(y^D, y^R \mid y^D < y^R)$ denote the uniform distributions of the citizen's priors over the positions of the Republican and the Democratic candidates in the presidential and the congressional election, respectively.[27]

We let $\pi(x, k, w)$ denote the probability that a citizen is informed in some election, which

[26] Although many individuals who run for Congress have prior experience in public offices at the local or state level (see, e.g., Diermeier, Keane and Merlo (2005)), public records of their activities either do not exist or are not easily accessible.

[27] Consistent with basic stylized facts about American politics (which we assume to be known even by uninformed voters), the restrictions we impose guarantee that the within party range of the positions of presidential candidates is smaller than that of congressional candidates for both parties. See, e.g., Poole and Rosenthal (1997).

we allow to depend on the citizen's demographic characteristics x and party identification k, as well as a vector of additional variables w that we use to predict the citizen's unobserved information and that do not enter into other components of the model:

$$\pi(x,k,w)=\frac{\exp(\theta_x x+\theta_k k+\theta_w w)}{1+\exp(\theta_x x+\theta_k k+\theta_w w)}.$$

Moreover, $\pi^P(k)\,\pi(x,k,w)$, $\pi^H(k)\,\pi(x,k,w)$, and $\pi^{PH}(k)\,\pi(x,k,w)$ are the probabilities of being informed only in the presidential election, only in the congressional election, or in both elections, respectively, where

$$\pi^P(k)=\frac{\exp\left(\theta_k^P k\right)}{1+\exp\left(\theta_k^P k\right)+\exp\left(\theta_k^H k\right)},$$

$$\pi^H(k)=\frac{\exp\left(\theta_k^H k\right)}{1+\exp\left(\theta_k^P k\right)+\exp\left(\theta_k^H k\right)},$$

and

$$\pi^{PH}(k)=\frac{1}{1+\exp\left(\theta_k^P k\right)+\exp\left(\theta_k^H k\right)}.$$

Abusing notation, we let Δ_i^P, Δ_i^H, Δ_i^{PH}, and Δ_i^U denote the information set of a generic citizen i who is informed only in the presidential election, informed only in the congressional election, informed in both elections, or uninformed in both elections, respectively.

The last component of citizens' characteristics that is not observed by the econometrician is their direct benefit from voting. Here we assume that citizen i derives a benefit d_i from fulfilling her civic duty of voting which we allow to depend on the citizen's demographic characteristics x and party identification k, as well as a vector of additional variables z that we use to predict the citizen's unobserved civic duty and that do not enter into other components of the model. We let $F_d(d \mid x,k,z)$ denote the distribution of civic duty in the population. Since the benefit from voting is relative to the cost of voting, $F_d(d \mid x,k,z)$ is defined over the support $[0,\bar{c}]$, where $\bar{c}$ is the maximum cost of voting. In particular, we assume that d_i can only take the value 0 ("low") or $\bar{c}$ ("high"), and $F_d(d \mid x,k,z)$ is a Bernoulli distribution with parameter

$$\gamma=\frac{\exp(\gamma_x x+\gamma_k k+\gamma_z z)}{1+\exp(\gamma_x x+\gamma_k k+\gamma_z z)}$$

denoting the probability that the value of civic duty is high.[28]

5 Data and Estimation

We consider the U.S. presidential and congressional elections of 2000.[29] Our empirical analysis relies on two sources of data: the American National Election Studies (NES), and the Poole and Rosenthal NOMINATE scores.[30]

The 2000 NES contains detailed individual-level information on the participation and voting decisions in presidential and congressional elections of a representative (cross-section) sample of the American voting-age population.[31] For each individual in the sample, we observe the congressional district where he or she resides, h, the identity of the Democratic and the Republican candidate competing for election in his or her congressional district, (D_H, R_H), and whether any of the candidates is an incumbent in that district, (q_{D_H}, q_{R_H}). For each of the two elections (presidential and congressional) faced by each individual, the NES also contains self-reported information on whether the individual abstains in the election, votes for the Democratic candidate or votes for the Republican candidate.[32] We let $V_P^i \in \{A, R, D\}$ and $V_H^i \in \{A, R, D\}$ denote citizen i's choices in the presidential and congressional election, respectively, where A denotes abstention and D or R indicate that the citizen voted

[28] In estimation, we also considered the more general specification where $F_d(d \mid x, k, z)$ is a Beta distribution over the support $[0, \overline{c}]$ with parameters $\delta = \exp(\delta_x x + \delta_k k + \delta_z z)$ and $\zeta = \exp(\zeta_k k)$. However, we could not reject the simpler Bernoulli specification at conventional significance levels.

[29] Recall that the presidential candidates were George W. Bush (R) and Al Gore (D). Bush won the election and the Republican party also obtained a majority in the House of Representatives.

[30] Both data sets are online at http://www.umich.edu/~nes and http://voteview.com, respectively.

[31] Consistent with our theoretical analysis, we drop from our sample individuals who reside in Washington D.C. (since they do not face congressional elections) and those who face uncontested congressional elections (since they do not have the option of voting either for the Republican or the Democratic candidate). After eliminating observations with missing values in any of the variables we consider in our analysis, the sample size is equal to 979.

[32] For discussions of potential limitations of the survey data on participation and voting in the NES see, e.g., Anderson and Silver (1986), Palfrey and Poole (1987), Wolfinger and Rosenstone (1980) and Wright (1993). Note, however, that the NES represent the best and most widely used source of individual-level data on electoral participation and voting.

for the Democratic or the Republican candidate, respectively. We refer to $V^i = (V^i_P, V^i_H) \in \{AA, AD, AR, DA, RA, DD, DR, RD, RR\}$ as citizen i's observed participation and voting profile.

The NES also contains detailed information on individual demographic characteristics and self-reported party identification. In our analysis, we consider the following variables: the variable Age denotes an individual's age; $Black$ is a race indicator variable that equals one if an individual is black; $Lowedu$ is a dummy variable denoting whether an individual does not have a high school degree; $Highedu$ is a dummy variable denoting whether an individual has a college degree; $Female$ is a gender indicator variable that is equal to one if an individual is a woman; $Lowinc$ is a dummy variable denoting whether an individual's family income is lower than median family income; $Christian$ is a dummy variable that is equal to one if an individual is either catholic or protestant and zero otherwise; and Dem, Rep and Ind are three (mutually exclusive) dummy variables denoting whether an individual considers him or herself to be a democrat, a republican or an independent, respectively.[33] Using the notation we introduced to describe our structural model, we have that $x = (Age$, $Black$, $Lowedu$, $Highedu$, $Female$, $Lowinc$, $Christian)$ and $k = (Dem$, Rep, $Ind)$.

As described in Section 4, our empirical analysis also relies on variables that may help predict (or identify) an individual's unobserved information status and civic duty. The variables contained in the NES that are related to information are the following: $Attention$ is a dummy variable denoting whether an individual paid attention to electoral campaigns; $News$ is a dummy variable denoting whether an individual followed news about presidential and congressional campaigns; $Watch$ is a dummy variable denoting whether an individual watched television programs about electoral campaigns; and $Contact$ is a dummy variable denoting whether an individual was contacted by any political party to talk about the campaigns. The variables contained in the NES that are related to civic duty are the following: $CareP$ and $CareH$ are two dummy variables denoting whether an individual cares about

[33] Consistent with most of the empirical literature on voting in U.S. national elections, we classify independents leaning democrats as democrats and independents leaning republicans as republicans. However, we also estimated our model by treating such individuals as independents. This change has little effect on our main empirical results.

the presidential and the congressional election, respectively; $Jury$ is a dummy variable denoting whether an individual considers serving on juries an important duty for a citizen; $Interest$ is a dummy variable denoting whether an individual is interested in government and public affairs; $Discuss$ is a dummy variable denoting whether an individual discusses politics with other people; and $Talk$ is a dummy variable denoting whether anybody talked to the individual about registering and voting. Using the notation introduced in Section 4, we let $z = (Attention, News, Watch, Contact)$ and $w = (CareP, CareH, Jury, Interest, Discuss, Talk)$. The sample distributions of participation and voting profiles are reported in Table 1, both for the overall sample and by party identification. Descriptive statistics of all the variables we use in our analysis are contained in Table 2.

To measure the positions of candidates competing in the 2000 presidential and congressional elections, we use the Poole and Rosenthal NOMINATE scores in 2000. Using data on roll call voting by each member of Congress and support to roll call votes by each President, Poole and Rosenthal developed a methodology to estimate the positions of all politicians who ever served either as Presidents or members of Congress, on the liberal-conservative ideological space $[-1, 1]$. These estimates, which are comparable across politicians and across time, are contained in their NOMINATE Common Space Scores data set.[34] These estimates provide the measures of the ideological positions of the presidential candidates, y^{D_P} and y^{R_P}, and the measures of the positions of all incumbents in any congressional election H, y^{D_H} and y^{R_H}. In addition, we use the empirical distributions of these estimates for Democratic and Republican members of the House of Representatives in 2000 as our measures of the distri-

[34] Although candidates' positions can change over time based on changes in roll call voting, there is strong evidence that they are stable over time (see, e.g., Poole (2003)). For details about the methodology and the data see Poole (1998) and Poole and Rosenthal (1997, 2001). Note that the Poole and Rosenthal NOMINATE data set also contains estimates of the positions of politicians on a second dimension, which we do not use in our analysis. In fact, according to Poole and Rosenthal (1997), after 1970 the second dimension has become irrelevant and "roll call voting again became largely a matter of positioning on a single, liberal-conservative dimension" (p. 5). For a discussion of potential limitations of the methodology proposed by Poole and Rosenthal see, e.g., Heckman and Snyder (1997). For a comparison of alternative estimation procedures see Clinton et al. (2004). Note, however, that none of the other procedures has been used to generate a comprehensive data set similar to the one by Poole and Rosenthal.

butions $F_H(\cdot \mid \cdot)$. In particular, we assume that $F_H(\cdot \mid \cdot) = F_L(\cdot \mid \cdot)$ for all $H \in L$, where $L \in \{Northeast, Midwest, West, South\}$ denotes a region of the United States. This specification allows us to capture important geographic differences among congressional candidates for each party, while at the same time allowing us to accurately characterize each empirical distribution function.[35] Table 3 contains the positions of the presidential candidates and descriptive statistics of the distributions of Democratic and Republican representatives in each of the four regions we consider.

As explained in the Introduction, our analysis models an important component of a citizen's cost of voting, which is related to her information about the ideological positions of the candidates competing in an election, and to her own ideological position relative to the candidates'. At the same time, however, it has been often pointed out that the cost of voting also has an exogenous component (e.g., Wolfinger and Rosenstone (1980)), which is related to a variety of external factors (like, for example, the weather conditions on election day, or the day of the week when an election is held, or many other unobservable factors). In our empirical analysis, we account for the possible existence of external factors that may contribute to explain abstention by introducing an exogenous probability that each individual in any given location abstains in both elections. In order to minimize the number of additional parameters that need to be estimated, we consider only eight possible locations that correspond to the eight census regions of the continental United States, and let $\rho = (\rho_1, ..., \rho_8)$ denote the vector of the parameters that measure these probabilities, $p = (p_1, ..., p_8)$, where $p_\ell = \exp(\rho_\ell) / [1 + \exp(\rho_\ell)]$, $\ell = 1, ..., 8$.[36]

We estimate our model by maximum likelihood. The contribution to the likelihood of each observation in the sample is equal to the probability of observing profile $V \in \{AA$, AD, AR, DA, RA, DD, DR, RD, $RR\}$, conditional on the vector of characteristics $X = (h, x, k, z, w, \Delta)$, given the vector of the model parameters $\phi = (\alpha_x, \alpha_k$, β_k, $\theta_x, \theta_k, \theta_w$, θ_k^P, θ_k^H,

[35] It would be unfeasible to characterize non-parametricly a separate distribution function for each party in each state (let alone each district), since the number of representatives of either party in each state in any given year is small. The alternative of using recent historical data from each state (or district) is also unfeasible because of the small number of observations for each state or district due to the relatively long tenure in office of incumbents.

[36] Note that in our sample there are no individuals who reside in any of the external states.

$\gamma_x, \gamma_k, \gamma_z, \rho)$. Given X and ϕ, the probability of each participation and voting profile observed in the data can be calculated using equations (5) and (7), the Corollary, and the specification of the structural model described in Section 4. The log-likelihood function is then equal to the sum of the log of the probability of each individual participation and voting profile observed in the data, over all the individuals in the sample. The likelihood function is reported in the Appendix.

6 Results

In this section, we summarize our estimates and our main empirical findings, discussing each component of the model in turn. The maximum likelihood estimates (and standard errors) of the model parameters are reported in Table 4. Before interpreting the estimates and discussing their implications, we begin by assessing the fit of the model.

6.1 Goodness of Fit

In Table 5, we compare the distribution of the participation and voting profiles predicted by the model to their empirical distribution. Since in our sample only one citizen abstains in the presidential election while voting in the congressional election, we combine the profiles AD and AR with the profile where citizens abstain in both elections, AA, and denote the combined profile by AA^+. To assess how well the model fits the data we use Pearson's chi-square goodness-of-fit test:

$$n \sum_{V \in \Omega} \frac{[f(V) - \widehat{f}(V)]^2}{\widehat{f}(V)} \sim \chi^2_{(6)},$$

where, for each profile $V \in \Omega = \{AA^+, DA, RA, DD, DR, RD, RR\}$, $f(V)$ denotes the empirical frequency of the profile, $\widehat{f}(V)$ denotes the frequency predicted by the estimated model, and n is the number of observations.[37] As we can see from Table 5, the estimated model tracks aggregate observed citizens' participation and voting decisions in the 2000 presidential and congressional elections remarkably well, and the goodness-of-fit test cannot reject the model at conventional significance levels.

[37] The critical value of a chi-square test with six degrees of freedom at the 5% level of confidence is 12.59. This is, however, an upper bound because it does not take into account that the parameters in the model are estimated.

In order to explore further the extent to which our model fits the patterns of selective abstention and split-ticket voting observed in the data, we then combine the profiles in Ω into four profiles corresponding to abstention (AA^+), selective abstention (DA and RA), straight-ticket voting (DD and RR), and split-ticket voting (DR and RD), and compare the predictions of the model to the empirical distributions by citizens' demographic characteristics and party identification.[38] As before, the criterion we use to assess the fit of the model is Pearson's chi-square test.[39] Table 6 reports the goodness-of-fit test statistic and the corresponding p-value for each demographic characteristic and party identification.[40] In all of these cases, we cannot reject the null hypothesis that the model is a good approximation of the data generating process at conventional significance levels. We conclude that the estimated model performs extremely well in reproducing observed patterns of participation and voting in individual-level data, both at the aggregate level and by individual characteristics.

6.2 Out-of-sample Validation

In order to further validate the model, we assess its performance out of sample. Given our estimates for the year 2000, we forecast the behavior of citizens in the 2004 presidential and congressional elections using the 2004 NES and NOMINATE scores.[41] To provide a term

[38] In addition of being interested in this broader classification of participation and voting profiles per se, partitioning the sample by demographic characteristics and party identification reduces the number of observations in each subsample. The broader classification rules out the possibility that some of the cells in the subsamples corresponding to each individual profile are either empty or contain very few observations (a situation that compromises the informativeness of a statistical comparison between model predictions and data).

[39] The goodness-of-fit test in this case is a chi-square with three degrees of freedom. The corresponding critical value at the 5% confidence level is 7.81.

[40] Note that for the overall sample, the value of the test statistic for the broader classification of profiles is 3.736, with a corresponding p-value of 0.291.

[41] After eliminating observations with missing values in any of the variables we consider in our analysis, the sample size in the 2004 NES is equal to 758. Note that the 2004 NES does not contain information on two variables that we used in estimation, namely $Jury$ and $Talk$, and has only partial information on $News$. To overcome this data limitation, we ran a logit regression of each of these variables on all other individual characteristics in the 2000 sample, and used the estimated relationships to calculate imputed values for these variables in the 2004 sample.

of comparison, we also perform the same exercise with an unrestricted statistical (multinomial logit) model, estimated using all the data we used in the estimation of our structural model. Such model represents the most flexible non-structural alternative to our model. In particular, using the 2000 NES and NOMINATE scores, we estimate a multinomial logit of the seven possible profiles $V = \{AA^{+}, DA, RA, DD, DR, RD, RR\}$, as a function of Age, $Black$, $Lowedu$, $Highedu$, $Female$, $Lowinc$, $Christian$, Dem, Rep, $Attention$, $News$, $Watch$, $Contact$, $CareP$, $CareH$, $Jury$, $Interest$, $Discuss$, $Talk$, regional dummies, two dummy variables denoting whether or not an incumbent of each party is running in each congressional election, and the candidates' positions in these elections.[42] Including the constants, this specification has 186 parameters.[43] We then use the estimated statistical model to predict behavior for the 2004 sample.[44]

In Table 7, we report the 2004 empirical distributions of participation and voting profiles, and the distributions predicted by the structural model as well as the multinomial logit model. These statistics are reported both for the overall sample and for each of the three subsamples of citizens defined by their party identification (democrats, republicans, and independents). For each model, we also report the value of the Pearson's chi-square test and its corresponding p-value.

There are several interesting findings that emerge from Table 7. The forecasting performance of the structural model in the overall sample is no worse than that of the unrestricted multinomial logit model. Since the structural model has only 57 parameters compared to the 186 parameters of the unrestricted statistical model, we conclude that the cross-equations restrictions imposed by the structure of our model cannot be rejected (either within or out of sample). Not surprisingly, we can statistically reject the hypothesis that the distribution

[42] Consistent with our previous analysis, we measure a candidate's position with his NOMINATE score if the candidate is an incumbent, and with the average NOMINATE score of the members of the House of Representatives of the same party and region as the candidate if he is a challenger.

[43] Note that since the positions of the presidential candidates are the same for all citizens, they are included in the constant terms. To economize on space, the estimates of the multinomial logit model are not reported here, but are available from the authors.

[44] Note that by construction, the multinomial logit model fits the within-sample frequencies of participation and voting profiles in the overall 2000 sample exactly.

of participation and voting profiles predicted by either model is the same as the empirical distribution. Nevertheless, both models are capable of reproducing some important features of the data such as, for example, the decrease in abstention and selective abstention from 2000 to 2004. Furthermore, when we consider the behavior of democrats, republicans and independents separately, the structural model outperforms the statistical model in each of the three subsamples, and predicts the behavior of republicans remarkably well.[45] The combined results of the internal and external validation exercises suggest that the model is empirically plausible, and there is no obvious alternative model that dominates it. In addition, an important advantage of the structural model is that its estimated parameters have a clear interpretation and it can be used to conduct policy experiments.

6.3 Citizens' Preferences, Information, and Civic Duty

Our estimates allow us to quantify the relationships between observed individual characteristics and unobserved citizens' ideological preferences, information, and civic duty. The parameters α_x, α_k, and β_k characterize the distributions of citizens' positions on the liberal-conservative ideological space $[-1, 1]$ conditional on their demographic characteristics x and party identification k, $F_y(y \mid x, k)$. In order to interpret the estimates we obtained, note that given our specification the mean of each of these conditional distributions is equal to

$$\frac{\alpha - \beta}{\alpha + \beta} = \frac{\exp\left(\alpha_x x + \alpha_k k\right) - \exp\left(\beta_k k\right)}{\exp\left(\alpha_x x + \alpha_k k\right) + \exp\left(\beta_k k\right)}.$$

Hence, for example, a negative (positive) coefficient in α_x denotes that, holding everything else constant, citizens with the corresponding characteristic are on average relatively more liberal (conservative). As we can see from the estimates reported in Panel A of Table 4, once we condition for party identification, some of the citizens' demographic characteristics are systematically related to their ideological positions. *Ceteris paribus*, blacks tend to be more liberal than non-blacks; individuals with relatively high levels of education (i.e., with at least a college degree) are more liberal than individuals with lower levels of education

[45] From a purely statistical point of view, we cannot reject the hypothesis that the distribution of profiles predicted by the structural model is equal to the one in the data either for the republicans or the independents. In the case of the independents, however, this is simply an artifact of the small number of observations in the subsample.

(i.e., without a high school degree) and intermediate levels of education; and individuals who are either catholic or protestant tend to be more conservative than those who are not christians.[46] On the other hand, the relationships between individuals' age, income and gender and their ideological positions are not statistically different from zero. Furthermore, democrats are on average more liberal than independents, which in turn are on average more liberal than republicans. In fact, the estimated distribution of republicans' ideological positions stochastic dominates the distribution of independents' ideological positions, which in turn stochastic dominates that of democrats' positions.

Note that unlike most empirical studies of voting in U.S. national elections, we do not use self-reported measures of citizens' ideological placement.[47] Rather, we adopt a revealed preference approach and estimate the distributions of unobserved ideological positions of citizens from their observed participation and voting decisions, conditional on their observed characteristics and the identity of the candidates in the elections they face.[48] A main advantage of this approach is that the estimated distributions we recover have the same support of the distribution of candidates' ideological positions (which is the same across elections), and the estimated citizens' positions are comparable across individuals.[49]

The parameters θ_x, θ_k, θ_w, θ_k^P, and θ_k^H fully characterize the probabilities citizens are informed about electoral candidates, where a positive (negative) coefficient denotes a higher (lower) probability of being informed. As we can see from the estimates reported in Panel B of Table 4, citizens' party identification as well as some of their demographic characteristics are systematically related to their information status. Specifically: blacks and christians tend to be more informed than non-blacks and non-christians, respectively; information is

[46] Degan (2007) obtains similar findings from the estimation of a dynamic model of voting in the 1968 and 1972 presidential elections.

[47] A variable in the NES that is widely used in empirical work, for example, contains citizens' self-reported placements on a liberal-conservative 7-point scale (see, e.g., Mebane (2000)).

[48] Note that this is the standard approach in empirical microeconomics and has been used for a wide range of applications including, for example, the estimation of individual valuations from the observed behavior of bidders in auctions.

[49] Clearly, this is not the case for existing categorical variables of citizens' self-placement on ideological scales.

(weakly) increasing in education level; and individuals with income lower than the median tend to have lower information (although this effect is also relatively weak from a statistical point of view). Also, note that all the covariates in the vector of additional variables w that we introduced to help us identify citizens' unobserved information status are, in fact, positively and significantly related to the probability of being informed. That is, individuals who pay attention to political campaigns, those who follow news or TV programs about presidential and congressional campaigns, and those who are contacted by parties to talk about electoral campaigns are predicted to be relatively more informed about the positions of candidates in presidential and congressional elections.

In order to quantify some of the relationships, in the second column of Table 8 we report the (average) marginal probabilities of being informed in some election by demographic characteristics and party identification.[50] These estimates indicate that, unconditionally, older and more educated individuals tend to be more informed than their younger and less educated counterparts, respectively; blacks are slightly more informed than non-blacks; women tend to be less informed than men; individuals whose income is below the median tend to be less informed than those with higher levels of income; and christians are noticeably more informed than non christians. We also find that partisans are on average more informed than independents and that, among partisans, republicans are on average more informed than democrats.

Turning attention to the relationship between citizens' characteristics and their sense of civic duty, the parameters γ_x, γ_k, and γ_z quantify the probability citizens have a high sense of civic duty, or a high direct benefit from participating in an election. Given our specification, a positive (negative) coefficient indicates that the corresponding variable is positively (negatively) associated with a high sense of civic duty. Similar to our results on information, the estimates reported in Panel C of Table 4 indicate that most demographic characteristics of citizens' and their party identification are systematically related to their

[50]Note that the estimated average probability of being informed in some election in the overall sample is equal to 0.63 (and the probabilities of being informed only in the presidential election, only in the congressional election, or in both elections are equal to 0.38, 0.21 and 0.04, respectively).

civic duty.[51] Also, all the variables in z that we introduced to help us identify citizens' unobserved civic duty are positively and significantly related to the probability of having high civic duty. That is, caring about congressional and presidential elections, considering serving on juries an important duty, being interested in public affairs, talking about politics with other people, and having been told about registering and voting, are all important predictors of citizens having a high sense of civic duty.

The third column in Table 8 contains estimates of the (average) marginal probabilities of having high civic duty by demographic characteristics and party identification.[52] These estimates suggest that older and more educated individuals are on average more likely to have a high sense of civic duty than their younger and less educated counterparts, respectively; blacks have a slightly lower sense of civic duty than non-blacks; women have a lower sense of civic duty than men; individuals whose income is below the median tend to have a much lower probability of having high civic duty than those with higher levels of income; and christians are on average much more likely to have a high sense of civic duty than non-christians. We also find that partisans are more likely to have a high sense of civic duty than independents, and republicans are more so inclined than democrats.[53]

Finally, the parameter vector ρ characterizes the probability citizens abstain in both elections due to "exogenous" components of the cost of voting which we do not model (e.g., environmental factors). Given our specification, the estimates reported in Panel D of Table 4 imply that on average this probability is equal to 5% (ranging from 0.2% to 11% across the eight census regions of the continental United States).[54] Since the overall abstention rate in both presidential and congressional elections predicted by our model is equal to the one in the data, this implies that the "endogenous" component of the cost of voting we model accounts for 82% of the abstention rate we observe in the data.

[51] Only the effect of race and gender is not statistically significant.

[52] Note that the estimated average probability of having a high sense of civic duty in the overall sample is equal to 0.66.

[53] This result is in line with Shachar and Nabeluff (1999) who find that republicans have a higher ex-ante propensity to turnout than democrats.

[54] The estimated probability for each of the eight regions is equal to 0.062, 0.073, 0.002, 0.037, 0.109, 0.005, 0.091, and 0.005, respectively.

6.4 Citizens' Turnout and Voting Behavior

Our estimated model implies a positive relationship between information and turnout. In each election, uninformed citizens are more likely to make "voting mistakes" and hence have larger costs of voting. It follows that citizens who are uninformed in an election are more likely to abstain in that election than informed citizens. The difference in the participation behavior of informed and uninformed citizens predicted by the model is most noticeable in presidential elections, where informed citizens (who know the positions of the presidential candidates and hence have no cost of voting) never abstain. Uninformed citizens, on the other hand, are uncertain about the positions of the presidential candidates, and may therefore optimally choose to abstain if their cost of voting is larger than their benefit of fulfilling their civic duty of participating in the election. Uninformed citizens abstain more than informed ones also in congressional elections, but since even informed citizens face some uncertainty about the positions of congressional challengers, abstention rates in congressional elections are positive also among informed citizens.

Consistent with what we observe in the data, our estimated model predicts that overall abstention is higher in congressional elections than in the presidential election, due to the fact that some individuals vote in the presidential election but abstain in the congressional election (selective abstention). In fact, our estimates imply that the average cost of voting in the presidential election is smaller than in a congressional election, which is a direct consequence of the fact that, in general, there is more information, and hence less uncertainty, about presidential candidates than congressional candidates.[55]

When combined with our previous findings that independents are systematically less informed than democrats, who are in turn less informed than republicans (Table 8), these results also explain the fact that independents are relatively more likely to abstain than

[55] Note that in standard spatial models of voting (e.g., Downs (1957), Enelow and Hinich (1984) and Riker and Ordeshook (1968)), abstention typically arises either out of "indifference" (when the two candidates are equally distant from a citizen's ideal point), or out of "alienation" (when they are both too distant from a citizen's ideal point). This is not the case in our model (see Degan (2006)). Also note that explanations of abstention based on indifference and/or alienation are typically not supported by the data (e.g., Poole and Rosenthal (1984)).

partisan citizens, and that democrats are relatively more likely to abstain than republicans (Table 1).

Our model is not the only one that generates a positive relationship between information and turnout. Feddersen and Pesendorfer (1996) consider a pivotal voter model with asymmetric information where some voters are uncertain about the realization of a state variable that affects the utility of all voters. Their analysis shows that uninformed voters may strictly prefer to abstain rather than vote for either candidate even when they are not indifferent between the two candidates and voting is costless. In their model, voters condition their actions not only on their information, but also on what they can infer about the state of the world in the event their vote is pivotal. Hence, it may be an equilibrium for the uninformed voters to abstain and to let the informed voters decide the electoral outcome (see also Feddersen and Pesendorfer (1999)). Although the two models are very different, both in our analysis and in that of Feddersen and Pesendorfer, citizens take into account the consequence of voting for the "wrong" candidate, and this may lead to abstention. Their analysis, however, is purely theoretical and since their argument relies on the probability that an individual vote may decide an election, the mechanism they describe is unlikely to be empirically relevant in large elections such as U.S. presidential and congressional elections.

Palfrey and Poole (1987) develop an index of voter information and, consistent with our results, find that individuals with a high level of information tend to be much more likely to vote (see also Alvarez (1998)).[56] In addition, our analysis also explains observed patterns of participation and voting behavior in presidential and congressional elections.

With respect to the observed behavior of voters in U.S. national elections, note that our estimated model accounts for the amount of split-ticket voting observed in the data. As illustrated in the example of Section 3.1, straight-ticket and split-ticket voting naturally arise as possible outcomes in our model. Given the heterogeneity in candidates' ideological positions across congressional districts, the estimated distributions of citizens' ideological positions and information imply predicted voting behaviors that are consistent with the citizens' voting profiles observed in the data.

[56] Their index of voter information in the 1980 presidential election is based on NES data about voter perceptions of candidates' positions on several issues measured on a 7-point scale.

There is a large empirical literature in political science that analyzes the issue of split-ticket voting in U.S. national elections.[57] The goal of these studies, however, is to test alternative theories of why voters may split their ticket.[58] The results of our analysis indicate that the observed behavior of voters in presidential and congressional elections is consistent with the predictions of a standard spatial model of voting with asymmetric information.

7 Policy Experiments

An appealing feature of the structural approach is that we can use the estimated model to conduct a variety of policy experiments. Here, we consider three counterfactual experiments. In the first two experiments, we quantify the potential effects of policies that may increase citizens' information and civic duty, respectively, on their turnout and voting behavior. In particular, we consider a situation where all citizens are informed in both presidential and congressional elections (i.e., $\pi = 1$ and $\pi^{PH} = 1$), and one where all citizens have a high sense of civic duty (i.e., $\gamma = 1$), and we compare the participation and voting behavior implied by our model under each of these counterfactual scenarios to the predictions of the estimated model in the baseline scenario. In the third experiment, we then assess the extent to which incumbents may have an advantage over challengers in congressional elections because of the superior information available on politicians who are already in office. In particular, we consider a situation where the only information potentially available to citizens about the two candidates in the congressional election in their district is the distribution $F_H\left(y^D, y^R \mid y^D < y^R\right)$.[59]

[57] See, e.g., Burden and Kimball (2002) and Mebane (2000).

[58] Theoretical research on split-ticket voting in U.S. national elections has focused mainly on the policy implications of divided government, and falls broadly within two categories. A first group of theories (e.g., Chari, Jones, and Marimon (1997) and Jacobson (1990)), postulate that there are different issues surrounding the presidential and the congressional elections, thus providing different (election specific) incentives for citizens and candidates. A second group of theories (e.g., Alesina and Rosenthal (1996) and Fiorina (1992)), argue that since the policy-making process entails some compromise between the executive and the legislature, citizens with relatively moderate positions may vote for candidates of different parties for President and Congress in an attempt to moderate the final policy outcome.

[59] In other words, we treat each congressional election as if it were an open election, by suppressing the information relative to the ideological position of incumbents.

The results of our first two experiments are summarized in Table 9. When all citizens are informed (Experiment 1) or all citizens have a high sense of civic duty (Experiment 2), the overall abstention rate in both elections reduces to the level induced by exogenous factors, which is equal to 5%. This is due to the fact that, barring unusual circumstances that may prevent an individual from going to vote, citizens with a high sense of civic duty would never deliberately abstain (regardless of the cost of voting induced by the possibility of making voting mistakes), and informed citizens would not choose to abstain in the presidential election (regardless of their sense of civic duty). However, while in a situation where all citizens have a high sense of civic duty selective abstention disappears (for the same reason described above), when all citizens are informed, the fraction of voters who selectively abstain increases from 9% to 27%. This result is due to the fact that even when citizens are informed, the presence of challengers always entails some uncertainty in congressional elections, and hence the possibility of making voting mistakes. Although when all citizens are informed the overall abstention rate in congressional elections decreases by 5 percentage points, the combined effect of a much larger reduction in the overall abstention rate in the presidential election (which decreases by 23 percentage points) results in a noticeable increase in the fraction of citizens who participate in the presidential election but abstain in congressional elections. Hence, while making citizens more responsible drastically reduces abstention in all elections, making them more informed may have a relatively small effect in some elections.

Turning attention to the effect of information and civic duty on voting, we find that when all citizens are informed, the fraction of individuals who split their ticket increases by 4 percentage points. The overall vote share of Democratic candidates in the elections for the House of Representatives also increases by 5 percentage points (from 49% to 54%). When all citizens have a high sense of civic duty, on the other hand, there are no noticeable changes in the aggregate behavior of voters. This result seems to indicate that increasing citizens' political information would be more likely to affect electoral outcomes than forcing everybody to vote.[60]

Table 10 contains the results of our third experiment regarding the incumbency advantage

[60] This conclusion has to be taken with "a grain of salt" since the NES sample we use is not representative of the U.S. population at the district level, but only at the national level.

in congressional elections. Since this experiment does not affect citizens' behavior in the presidential election, in the table we report the distributions of participation and voting profiles in congressional elections both for the overall sample and for each of the three subsamples of citizens defined by their party identification (democrats, republicans, and independents). Note that these distributions refer to the individuals in our sample who are facing congressional elections where incumbents are running, and we distinguish between elections where the incumbent is a Democrat or a Republican.[61] Overall, we find that eliminating the information advantage of Democratic incumbents reduces the proportion of individuals voting for them by about 2 percentage points. Conversely, we do not find any effect for Republican incumbents.[62] This asymmetry is due to the fact that in the data there is less variation among the ideological positions of Republican candidates than Democratic candidates, which implies that the Republican "brand name" conveys relatively more information to the voters than the Democratic one. Hence, the additional information that their behavior in office provides to the voters has a larger effect for Democratic candidates than for Republicans.

It is also interesting to notice that the effect of removing the information advantage of incumbents on the behavior of independents is negligible, regardless of the party affiliation of the incumbent. Furthermore, while the voting behavior of partisan voters does not appear to be very sensitive to the information available on incumbents of their own party, the voting choices of republican voters change significantly in favor of Democratic incumbents when they have an information advantage. In fact, removing the information advantage of Democratic incumbents reduces the proportion of republicans voting for them by about 5 percentage points. The effect on the behavior of democrats when the incumbent is a Republican is much smaller (about 1 percentage point).

8 Concluding Remarks

Understanding citizens' electoral behavior represents a fundamental step in the analysis of democratic institutions. The contribution of this paper is to propose a new framework, based on citizens' heterogeneity in ideological preferences, information, and sense of civic duty, for

[61] The number of observations is equal to 420 and 446, respectively.

[62] Note that the effect on abstention is negligible (the overall abstention rate in congressional elections increases by 1 percentage point, and the increase is similar for democrats, republicans, and independents).

analyzing citizens' participation and voting decisions in multiple simultaneous elections.

We have applied our framework to study empirically the issue of turnout and voting in U.S. national (presidential and congressional) elections, using individual-level data for the 2000 elections. We have shown that our estimated model is capable of replicating the patterns of abstention, selective abstention, split-ticket voting, and straight-ticket voting observed in the data. Moreover, we have used the estimated model to quantify the relationships between a variety of citizens' characteristics and their ideological preferences, information, and civic duty, and to assess the potential effects of several policies on citizens' turnout and voting behavior. For example, we have shown that policies that increase citizens' information about electoral candidates have similar effects on abstention than policies that increase their sense of civic duty. However, while an increase in civic duty also reduces selective abstention and has a negligible effect on split-ticket voting, the effect of more information is to increase selective abstention as well as the relative fraction of voters who split their ticket.

It is important to observe that the framework we have proposed in this paper is quite general, and can be applied to analyze empirically the electoral behavior of individuals facing any number of simultaneous elections, including local elections and referenda, as well as having ideological preferences over more than one policy dimension. At the same time, our model is rather simple, and abstracts from a number of factors like, for example, differences in candidates' competence, or citizens' preferences over candidates' personal traits (e.g., charisma), which may also play an important role in explaining the data. We plan to explore these issues in future work.

Appendix

We present here the derivation of the likelihood function. To simplify notation, let $D_i^e(\cdot) = 1\{v_i^{e*}(\cdot) = D_e\}$, $R_i^e(\cdot) = 1\{v_i^{e*}(\cdot) = R_e\}$, $C_i^P(\cdot) = 1\left\{c_i^P(\cdot) < c_i^H(\cdot)\right\}$, and $C_i^H(\cdot) = 1\left\{c_i^H(\cdot) < c_i^P(\cdot)\right\}$ where $1\{\cdot\}$ is an indicator equal to one when the expression inside the braces is true and zero otherwise. Also, let ℓ_i denote the region where citizen i resides, so that p_{ℓ_i} denotes the exogenous probability that citizen i abstains in both elections. For each participation and voting profile $V^i \in \{AA,\ AD,\ AR,\ DA,\ RA,\ DD,\ DR,\ RD,\ RR\}$, our structural model implies that:

$$
\begin{aligned}
&\Pr\{V^i = AA\} = \\
&(1-p_{\ell_i})\int\{\pi^P(k_i)\,\pi(x_i,k_i,w_i)\cdot 0+ \\
&\quad \pi^H(k_i)\,\pi(x_i,k_i,w_i)\,F_d(\min\left\{c_i^P\left(y^i,\Delta_i^H\right),c_i^H\left(y^i,\Delta_i^H\right)\right\}\mid x_i,k_i,z_i)+ \\
&\quad \pi^{PH}(k_i)\,\pi(x_i,k_i,w_i)\cdot 0+ \\
&\quad (1-\pi(x_i,k_i,w_i))\,F_d(\min\left\{c_i^P\left(y^i,\Delta_i^U\right),c_i^H\left(y^i,\Delta_i^U\right)\right\}\mid x_i,k_i,z_i)\}dF_y(y^i\mid x_i,k_i)+p_{\ell_i},
\end{aligned}
$$

$$
\begin{aligned}
&\Pr\{V^i = AD\} = \\
&(1-p_{\ell_i})\int\{\pi^P(k_i)\,\pi(x_i,k_i,w_i)\cdot 0+ \\
&\quad \pi^H(k_i)\,\pi(x_i,k_i,w_i)\cdot \\
&\qquad [F_d(c_i^P\left(y^i,\Delta_i^H\right)\mid x_i,k_i,z_i)-F_d(c_i^H\left(y^i,\Delta_i^H\right)\mid x_i,k_i,z_i)]C_i^H\left(y^i,\Delta_i^H\right)D_i^H\left(y^i,\Delta_i^H\right)+ \\
&\quad \pi^{PH}(k_i)\,\pi(x_i,k_i,w_i)\cdot 0+ \\
&\quad (1-\pi(x_i,k_i,w_i))\cdot \\
&\qquad [F_d(c_i^P\left(y^i,\Delta_i^U\right)\mid x_i,k_i,z_i)-F_d(c_i^H\left(y^i,\Delta_i^U\right)\mid x_i,k_i,z_i)]C_i^H\left(y^i,\Delta_i^U\right)D_i^H\left(y^i,\Delta_i^U\right)\} \\
&\quad dF_y(y^i\mid x_i,k_i),
\end{aligned}
$$

$$
\begin{aligned}
&\Pr\{V^i = AR\} = \\
&(1-p_{\ell_i})\int\{\pi^P(k_i)\,\pi(x_i,k_i,w_i)\cdot 0+ \\
&\quad \pi^H(k_i)\,\pi(x_i,k_i,w_i)\cdot \\
&\qquad [F_d(c_i^P\left(y^i,\Delta_i^H\right)\mid x_i,k_i,z_i)-F_d(c_i^H\left(y^i,\Delta_i^H\right)\mid x_i,k_i,z_i)]C_i^H\left(y^i,\Delta_i^H\right)R_i^H\left(y^i,\Delta_i^H\right)+ \\
&\quad \pi^{PH}(k_i)\,\pi(x_i,k_i,w_i)\cdot 0+ \\
&\quad (1-\pi(x_i,k_i,w_i))\cdot \\
&\qquad [F_d(c_i^P\left(y^i,\Delta_i^U\right)\mid x_i,k_i,z_i)-F_d(c_i^H\left(y^i,\Delta_i^U\right)\mid x_i,k_i,z_i)]C_i^H\left(y^i,\Delta_i^U\right)R_i^H\left(y^i,\Delta_i^U\right)\} \\
&\quad dF_y(y^i\mid x_i,k_i),
\end{aligned}
$$

$$
\begin{aligned}
&\Pr\{V^i = DA\} = \\
&(1-p_{\ell_i})\int\{\pi^P(k_i)\,\pi(x_i,k_i,w_i)\,F_d(c_i^H(y^i,\Delta_i^P)\mid x_i,k_i,z_i)\,D_i^P(y^i,\Delta_i^P)+ \\
&\quad \pi^H(k_i)\,\pi(x_i,k_i,w_i)\cdot \\
&\qquad [F_d(c_i^H(y^i,\Delta_i^H)\mid x_i,k_i,z_i)-F_d(c_i^P(y^i,\Delta_i^H)\mid x_i,k_i,z_i)]C_i^P(y^i,\Delta_i^H)\,D_i^P(y^i,\Delta_i^H)+ \\
&\quad \pi^{PH}(k_i)\,\pi(x_i,k_i,w_i)\,F_d(c_i^H(y^i,\Delta_i^{PH})\mid x_i,k_i,z_i)\,D_i^P(y^i,\Delta_i^{PH})+ \\
&\quad (1-\pi(x_i,k_i,w_i))\cdot \\
&\qquad [F_d(c_i^H(y^i,\Delta_i^U)\mid x_i,k_i,z_i)-F_d(c_i^P(y^i,\Delta_i^U)\mid x_i,k_i,z_i)]C_i^P(y^i,\Delta_i^U)\,D_i^P(y^i,\Delta_i^U)\} \\
&\quad dF_y(y^i\mid x_i,k_i),
\end{aligned}
$$

$$
\begin{aligned}
&\Pr\{V^i = RA\} = \\
&(1-p_{\ell_i})\int\{\pi^P(k_i)\,\pi(x_i,k_i,w_i)\,F_d(c_i^H(y^i,\Delta_i^P)\mid x_i,k_i,z_i)\,R_i^P(y^i,\Delta_i^P)+ \\
&\quad \pi^H(k_i)\,\pi(x_i,k_i,w_i)\cdot \\
&\qquad [F_d(c_i^H(y^i,\Delta_i^H)\mid x_i,k_i,z_i)-F_d(c_i^P(y^i,\Delta_i^H)\mid x_i,k_i,z_i)]C_i^P(y^i,\Delta_i^H)\,R_i^P(y^i,\Delta_i^H)+ \\
&\quad \pi^{PH}(k_i)\,\pi(x_i,k_i,w_i)\,F_d(c_i^H(y^i,\Delta_i^{PH})\mid x_i,k_i,z_i)\,R_i^P(y^i,\Delta_i^{PH})+ \\
&\quad (1-\pi(x_i,k_i,w_i))\cdot \\
&\qquad [F_d(c_i^H(y^i,\Delta_i^U)\mid x_i,k_i,z_i)-F_d(c_i^P(y^i,\Delta_i^U\mid x_i,k_i,z_i)]C_i^P(y^i,\Delta_i^U)\,R_i^P(y^i,\Delta_i^U)\} \\
&\quad dF_y(y^i\mid x_i,k_i),
\end{aligned}
$$

$$
\begin{aligned}
&\Pr\{V^i = DD\} = \\
&(1-p_{\ell_i})\int\{\pi^P(k_i)\,\pi(x_i,k_i,w_i)\,[1-F_d(c_i^H(y^i,\Delta_i^P)\mid x_i,k_i,z_i)]D_i^P(y^i,\Delta_i^P)\,D_i^H(y^i,\Delta_i^P)+ \\
&\quad \pi^H(k_i)\,\pi(x_i,k_i,w_i)\cdot \\
&\qquad [1-F_d(\max\{c_i^P(y^i,\Delta_i^H),c_i^H(y^i,\Delta_i^H)\}\mid x_i,k_i,z_i)]D_i^P(y^i,\Delta_i^H)\,D_i^H(y^i,\Delta_i^H)+ \\
&\quad \pi^{PH}(k_i)\,\pi(x_i,k_i,w_i)\,[1-F_d(c_i^H(y^i,\Delta_i^{PH})\mid x_i,k_i,z_i)]D_i^P(y^i,\Delta_i^{PH})\,D_i^H(y^i,\Delta_i^{PH})+ \\
&\quad (1-\pi(x_i,k_i,w_i))\cdot \\
&\qquad [1-F_d(\max\{c_i^P(y^i,\Delta_i^U),c_i^H(y^i,\Delta_i^U)\}\mid x_i,k_i,z_i)]D_i^P(y^i,\Delta_i^U)\,D_i^H(y^i,\Delta_i^U)\} \\
&\quad dF_y(y^i\mid x_i,k_i),
\end{aligned}
$$

$$
\begin{aligned}
&\Pr\{V^i = DR\} = \\
&(1-p_{\ell_i})\int\{\pi^P(k_i)\,\pi(x_i,k_i,w_i)\,[1-F_d(c_i^H(y^i,\Delta_i^P)\mid x_i,k_i,z_i)]D_i^P(y^i,\Delta_i^P)\,R_i^H(y^i,\Delta_i^P)+ \\
&\quad \pi^H(k_i)\,\pi(x_i,k_i,w_i)\cdot \\
&\qquad\quad [1-F_d(\max\{c_i^P(y^i,\Delta_i^H),c_i^H(y^i,\Delta_i^H)\}\mid x_i,k_i,z_i)]D_i^P(y^i,\Delta_i^H)\,R_i^H(y^i,\Delta_i^H)+ \\
&\quad \pi^{PH}(k_i)\,\pi(x_i,k_i,w_i)\,[1-F_d(c_i^H(y^i,\Delta_i^{PH})\mid x_i,k_i,z_i)]D_i^P(y^i,\Delta_i^{PH})\,R_i^H(y^i,\Delta_i^{PH})+ \\
&\quad (1-\pi(x_i,k_i,w_i))\cdot \\
&\qquad\quad [1-F_d(\max\{c_i^P(y^i,\Delta_i^U),c_i^H(y^i,\Delta_i^U)\}\mid x_i,k_i,z_i)]D_i^P(y^i,\Delta_i^U)\,R_i^H(y^i,\Delta_i^U)\} \\
&\quad dF_y(y^i\mid x_i,k_i),
\end{aligned}
$$

$$
\begin{aligned}
&\Pr\{V^i = RD\} = \\
&(1-p_{\ell_i})\int\{\pi^P(k_i)\,\pi(x_i,k_i,w_i)\,[1-F_d(c_i^H(y^i,\Delta_i^P)\mid x_i,k_i,z_i)]R_i^P(y^i,\Delta_i^P)\,D_i^H(y^i,\Delta_i^P)+ \\
&\quad \pi^H(k_i)\,\pi(x_i,k_i,w_i)\cdot \\
&\qquad\quad [1-F_d(\max\{c_i^P(y^i,\Delta_i^H),c_i^H(y^i,\Delta_i^H)\}\mid x_i,k_i,z_i)]R_i^P(y^i,\Delta_i^H)\,D_i^H(y^i,\Delta_i^H)+ \\
&\quad \pi^{PH}(k_i)\,\pi(x_i,k_i,w_i)\,[1-F_d(c_i^H(y^i,\Delta_i^{PH})\mid x_i,k_i,z_i)]R_i^P(y^i,\Delta_i^{PH})\,D_i^H(y^i,\Delta_i^{PH})+ \\
&\quad (1-\pi(x_i,k_i,w_i))\cdot \\
&\qquad\quad [1-F_d(\max\{c_i^P(y^i,\Delta_i^U),c_i^H(y^i,\Delta_i^U)\}\mid x_i,k_i,z_i)]R_i^P(y^i,\Delta_i^U)\,D_i^H(y^i,\Delta_i^U)\} \\
&\quad dF_y(y^i\mid x_i,k_i),
\end{aligned}
$$

and

$$
\begin{aligned}
&\Pr\{V^i = RR\} = \\
&(1-p_{\ell_i})\int\{\pi^P(k_i)\,\pi(x_i,k_i,w_i)\,[1-F_d(c_i^H(y^i,\Delta_i^P)\mid x_i,k_i,z_i)]R_i^P(y^i,\Delta_i^P)\,R_i^H(y^i,\Delta_i^P)+ \\
&\quad \pi^H(k_i)\,\pi(x_i,k_i,w_i)\cdot \\
&\qquad\quad [1-F_d(\max\{c_i^P(y^i,\Delta_i^H),c_i^H(y^i,\Delta_i^H)\}\mid x_i,k_i,z_i)]R_i^P(y^i,\Delta_i^H)\,R_i^H(y^i,\Delta_i^H)+ \\
&\quad \pi^{PH}(k_i)\,\pi(x_i,k_i,w_i)\,[1-F_d(c_i^H(y^i,\Delta_i^{PH})\mid x_i,k_i,z_i)]R_i^P(y^i,\Delta_i^{PH})\,R_i^H(y^i,\Delta_i^{PH})+ \\
&\quad (1-\pi(x_i,k_i,w_i))\cdot \\
&\qquad\quad [1-F_d(\max\{c_i^P(y^i,\Delta_i^U),c_i^H(y^i,\Delta_i^U)\}\mid x_i,k_i,z_i)]R_i^P(y^i,\Delta_i^U)\,R_i^H(y^i,\Delta_i^U)\} \\
&\quad dF_y(y^i\mid x_i,k_i).
\end{aligned}
$$

The log-likelihood function is then equal to the sum of the log of the probability of each individual participation and voting profile observed in the data, over all the individuals in the sample.

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Table 1: Sample Frequencies of Participation and Voting Profiles

Profiles	Overall Sample	Democrats	Republicans	Independents
AA	273	128	79	66
AD	0	0	0	0
AR	1	0	0	1
DA	47	39	4	4
RA	38	6	27	5
DD	285	261	13	11
DR	57	39	12	6
RD	32	5	26	1
RR	246	23	210	13
# of Observations	979	501	371	107

Table 2: Descriptive Statistics

Variable	Mean	Standard Deviation
Age	47.1726	16.7399
Black	0.1032	0.3043
Female	0.5352	0.4990
Lowedu	0.0981	0.2975
Highedu	0.3075	0.4617
Lowinc	0.5536	0.4974
Christian	0.6394	0.4804
Dem	0.5117	0.5001
Rep	0.3790	0.4854
Ind	0.1093	0.3122
Attention	0.7794	0.4149
News	0.8294	0.3763
Watch	0.8243	0.3808
Contact	0.3922	0.4885
CareP	0.7814	0.4135
CareH	0.6629	0.4730
Jury	0.6139	0.4871
Interest	0.5884	0.4924
Discuss	0.7998	0.4004
Talk	0.4443	0.4971

Table 3: Candidates' Positions

House Candidates								
	Democrats				Republicans			
Region	Mean	St. Dev.	Min.	Max.	Mean	St. Dev.	Min.	Max.
Northeast	-0.36	0.10	-0.55	-0.14	0.24	0.14	-0.05	0.62
Midwest	-0.33	0.14	-0.68	-0.01	0.37	0.12	0.13	0.69
South	-0.24	0.14	-0.53	0.15	0.41	0.11	-0.01	0.87
West	-0.35	0.12	-0.62	-0.08	0.43	0.14	0.17	0.81
Presidential Candidates								
	Al Gore				George W. Bush			
	-0.29				0.40			

Table 4: Maximum Likelihood Estimates and Standard Errors

Variable	Estimate	Standard Error	Variable	Estimate	Standard Error
Panel A: Ideological Positions			Panel B: Probability of being Informed		
α_x:			θ_x:		
Age	-0.0870	0.0508	*Age*	-0.2493	1.0596
Black	-0.1049	0.0344	*Black*	1.2800	0.6112
Lowedu	0.0241	0.0315	*Lowedu*	-0.9605	0.5248
Highedu	-0.0439	0.0180	*Highedu*	0.8828	0.5979
Female	-0.0234	0.0160	*Female*	0.1885	0.3584
Lowinc	-0.0188	0.0207	*Lowinc*	-0.7175	0.4312
Christian	0.0441	0.0172	*Christian*	0.7917	0.3495
α_k:			θ_k:		
Dem	5.2047	0.3048	*Dem*	-2.8015	0.7644
Rep	5.0409	0.2438	*Rep*	-1.8809	0.7288
Ind	4.9181	0.5375	*Ind*	-3.1038	0.8234
β_k:			θ_w:		
Dem	5.2288	0.2987	*Attention*	1.2890	0.3903
Rep	4.7949	0.2638	*News*	0.6882	0.4123
Ind	4.7913	0.5381	*Watch*	0.9051	0.4288
Panel C: Probability of High Civic Duty			*Contact*	1.2374	0.4362
			$\theta^P{}_k$:		
			Dem	2.0160	1.4110
γ_x:			*Rep*	3.8011	2.3183
Age	4.2840	0.6612	*Ind*	0.7907	1.9590
Black	0.4489	0.3472	$\theta^H{}_k$:		
Lowedu	-1.0610	0.3263	*Dem*	0.4675	1.5009
Highedu	1.1347	0.2487	*Rep*	3.8635	2.2986
Female	0.0453	0.1990	*Ind*	0.3116	1.7854
Lowinc	-0.7606	0.2083			
Christian	0.4340	0.2009	Panel D: Probability of Exogenous Abstention		
γ_k:					
Dem	-2.8015	0.7644	ρ:		
Rep	-1.8809	0.7288	*Region 1*	-2.7186	1.2533
Ind	-3.1038	0.8234	*Region 2*	-2.5458	0.5578
γ_z:			*Region 3*	-6.1888	3.0349
CareP	1.0095	0.2349	*Region 4*	-3.2643	1.0769
CareH	0.4627	0.2082	*Region 5*	-2.0992	0.3555
Jury	0.5835	0.1924	*Region 6*	-5.3582	3.0138
Interest	0.3511	0.2065	*Region 7*	-2.3026	0.8941
Discuss	0.7136	0.2400	*Region 8*	-5.3765	3.2160
Talk	0.5471	0.1978	Log-likelihood = -1113.46		

Table 5: Profiles Distributions and Goodness-of-Fit Test

Profile	Data	Model
AA$^+$	0.2799	0.2775
DA	0.0480	0.0639
RA	0.0388	0.0285
DD	0.2911	0.2877
DR	0.0582	0.0573
RD	0.0327	0.0237
RR	0.2513	0.2615
$\chi^2_{(6)}$	11.347	
p-value	0.078	

Note: The profile AA$^+$ includes the profiles AA, AD, and AR.

Table 6: Goodness-of-Fit Tests by Individual Characteristics

Variable	$\chi^2_{(3)}$	p-value
Dem	4.270	0.234
Rep	0.107	0.991
Ind	1.918	0.590
AgeL	0.878	0.831
AgeM	5.052	0.168
AgeH	1.394	0.707
Black	0.731	0.866
Non-Black	3.608	0.307
Lowedu	1.570	0.666
Mediumedu	5.661	0.129
Highedu	0.268	0.966
Female	4.189	0.242
Male	0.679	0.878
Lowinc	3.731	0.292
Highinc	1.147	0.766
Christian	4.464	0.216
Non-Christian	0.770	0.857

Note : Since *Age* is a continuous variable, we divided the sample into three age groups: *AgeL* denotes individuals with *Age* $\leq$30, *AgeM* individuals with 30<*Age*<55, *and AgeH* individuals with *Age*$\geq$65.

Table 7: Out-of-sample Predictions

Profile	2004 Data	Structural Model Predictions	Statistical Model Predictions
Overall Sample (n = 758)			
AA$^+$	0.2216	0.1703	0.1755
DA	0.0224	0.0571	0.0412
RA	0.0290	0.0312	0.0318
DD	0.3193	0.3266	0.3388
DR	0.0515	0.0602	0.0717
RD	0.0726	0.0407	0.0292
RR	0.2836	0.3138	0.3118
$\chi^2_{(6)}$		50.047	71.797
p-value		1.414e-8	6.398e-13
Democrats (n = 370)			
AA$^+$	0.2270	0.1497	0.1617
DA	0.0297	0.0898	0.0682
RA	0.0081	0.0076	0.0078
DD	0.6027	0.6037	0.6240
DR	0.0670	0.0695	0.0856
RD	0.0432	0.0108	0.0071
RR	0.0216	0.0688	0.0457
$\chi^2_{(6)}$		77.642	92.815
p-value		4.164e-14	3.265e-17
Republicans (n = 317)			
AA$^+$	0.1546	0.1500	0.1391
DA	0.0063	0.0114	0.0088
RA	0.0505	0.0496	0.0593
DD	0.0315	0.0438	0.0451
DR	0.0252	0.0506	0.0491
RD	0.1104	0.0782	0.0584
RR	0.6215	0.6164	0.6402
$\chi^2_{(6)}$		10.126	20.987
p-value		0.182	0.004
Independents (n = 71)			
AA$^+$	0.4930	0.3688	0.4100
DA	0.0563	0.0913	0.0447
RA	0.0423	0.0719	0.0340
DD	0.1268	0.1453	0.1642
DR	0.0845	0.0543	0.1008
RD	0.0563	0.0289	0.0142
RR	0.1408	0.2396	0.2320
$\chi^2_{(6)}$		10.884	13.718
p-value		0.144	0.056

Note: The profile AA$^+$ includes the profiles AA, AD, and AR.

Table 8: Estimated Marginal Probabilities of Information and Civic Duty

Variable	Probability of being Informed	Probability of having High Civic Duty
Dem	0.59	0.69
Rep	0.76	0.74
Ind	0.32	0.29
AgeL	0.52	0.44
AgeM	0.64	0.66
AgeH	0.65	0.78
Black	0.69	0.63
Non-Black	0.62	0.67
Lowedu	0.30	0.37
Mediumedu	0.57	0.60
Highedu	0.84	0.88
Female	0.60	0.63
Male	0.64	0.70
Lowinc	0.51	0.55
Highinc	0.77	0.80
Christian	0.70	0.73
Non-Christian	0.49	0.54

Note : Since *Age* is a continuous variable, we divided the sample into three age groups: *AgeL* denotes individuals with *Age* ≤30, *AgeM* individuals with 30<*Age*<55, *and AgeH* individuals with *Age*≥55.

Table 9: Policy Experiments on Information and Civic Duty

Profile	Baseline	Experiment 1	Experiment 2
AA^+	0.2775	0.0496	0.0496
DA	0.0639	0.1765	0.0000
RA	0.0285	0.0915	0.0000
DD	0.2877	0.3425	0.4302
DR	0.0573	0.0913	0.0756
RD	0.0237	0.0275	0.0315
RR	0.2615	0.2213	0.4132

Note: The profile AA^+ includes the profiles AA, AD and AR.

Table 10: Policy Experiment on the Incumbency Advantage

	Overall sample		Democrats		Republicans		Independents	
	Baseline	Exp.	Baseline	Exp.	Baseline	Exp.	Baseline	Exp.
Profile	Democratic Incumbent							
A	0.3543	0.3622	0.3296	0.3353	0.2672	0.2789	0.7019	0.7099
D	0.3607	0.3405	0.5432	0.5357	0.1223	0.0757	0.1211	0.1106
R	0.2851	0.2973	0.1273	0.1289	0.6106	0.6455	0.1770	0.1795
Profile	Republican Incumbent							
A	0.3499	0.3608	0.3401	0.3471	0.2752	0.2902	0.6924	0.7031
D	0.2788	0.2753	0.5112	0.5174	0.0785	0.0632	0.0914	0.0945
R	0.3713	0.3639	0.1487	0.1355	0.6463	0.6466	0.2162	0.2024