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“A Structural Model of Turnout and Voting in Multiple Elections”
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by

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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. (*JEL D72; keywords: elections, turnout, selective abstention, split-ticket voting.*)

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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.² 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 then 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

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

²We discuss the related literature in Section 2.

in a common ideological space, and citizens derive a direct benefit from fulfilling their civic duty of voting.³ Citizens may be uncertain about candidates' positions and may have different information about the candidates running in the various 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 various 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.

³Since 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 apply this model to the study of citizens' behavior in U.S. presidential and congressional 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, and 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.⁴ *Ethical-voter models* (e.g., Coate and Conlin (2004), Feddersen and Sandroni (2006) and Harsanyi (1980)), endogenize the concept of civic duty.⁵ 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 com-

⁴Note, however, that as the size of the electorate N increases, p_i^e converges to zero, thus making the term $p_i^e b_i^e$ (and hence pivotal calculations) negligible in large elections.

⁵Like our model, ethical-voter 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)).

ponent 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.⁶ 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.⁷

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.⁸ 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

⁶This effect also vanishes in large electorates.

⁷Another 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).

⁸For another interesting empirical analysis of pivotal-voter models using data from local school budget referenda in Oregon, see Hansen, Palfrey and Rosenthal (1987).

words, the only way the theory behind pivotal-voter models can explain actual turnout, is 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.⁹ 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.¹⁰ 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.¹¹ Unlike our paper, however, all these studies ignore the issue of abstention and focus exclusively on the behavior of voters.

⁹Shachar 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.

¹⁰For other empirical analyses of the role of information in elections see, e.g., Alvarez (1998), and Palfrey and Poole (1987).

¹¹Note, 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 a situation where there is a continuum of citizens who face m simultaneous two-candidate elections for a variety of public offices. For each election, citizens have to decide whether to vote or abstain, and if they vote, which candidate to support.

Let i denote a generic citizen, e a generic election, and $J^e = \{a_e, b_e\}$ the set of candidates in election $e = 1, \dots, m$. Each candidate $j_e \in J^e$ is characterized by an ideological position $y^{j_e} \in Y$, where $y^{a_e} \neq y^{b_e}$ for all $e = 1, \dots, m$, and $Y \subseteq R^r$, $r \geq 1$, is the (r -dimensional) ideological space.

For each election $e \in \{1, \dots, m\}$, 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, $F_i^e(y^a, y^b)$. Hence, $\Delta_i^e = F_i^e(\cdot)$ 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 $\Delta_i = \{\Delta_i^1, \dots, \Delta_i^m\}$ denote citizen i 's information set.

The assumption that there is a continuum of citizens implies 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 $e \in \{1, \dots, m\}$). 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

$$u_i(y) = - \sum_{\ell=1}^r (y_\ell^i - y_\ell)^2 \tag{1}$$

which is single-peaked at y^i .¹²

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 voting potentially costly in this framework. In particular, given her information regarding the candidates in election e , $\Delta_i^e = F_i^e(y^a, y^b)$, and her ideological position y^i , citizen i 's cost

¹²For 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).

of voting for candidate a_e is equal to

$$c_i(a_e; y^i, \Delta_i^e) = \int_{\{(y^a, y^b) \in Y \times Y: u_i(y^a) < u_i(y^b)\}} [u_i(y^b) - u_i(y^a)] dF_i^e(y^a, y^b), \quad (2)$$

and her cost of voting for candidate b_e is equal to

$$c_i(b_e; y^i, \Delta_i^e) = \int_{\{(y^a, y^b) \in Y \times Y: u_i(y^a) > u_i(y^b)\}} [u_i(y^a) - u_i(y^b)] dF_i^e(y^a, y^b). \quad (3)$$

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.

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

$$\max_{t_i^e \in \{0, 1\}, v_i^e \in \{a_e, b_e\}} t_i^e [d_i - c_i(v_i^e; y^i, \Delta_i^e)]. \quad (4)$$

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 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:

$$v_i^{e*}(y^i, \Delta_i^e) = \begin{cases} a_e & \text{if } c_i(b_e; y^i, \Delta_i^e) > c_i(a_e; y^i, \Delta_i^e) \\ b_e & \text{if } c_i(b_e; y^i, \Delta_i^e) < c_i(a_e; y^i, \Delta_i^e) \end{cases} \quad (5)$$

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

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

Proposition 1 *If a generic citizen i participates in election $e \in \{1, \dots, m\}$ where candidates a_e and b_e are running, her optimal voting rule is given by:*

$$v_i^{e*}(y^i, \Delta_i^e) = \begin{cases} a_e & \text{if } E[u_i(y^a) - u_i(y^b) \mid \Delta_i^e] > 0 \\ b_e & \text{if } E[u_i(y^a) - u_i(y^b) \mid \Delta_i^e] < 0 \end{cases}$$

If $E[u_i(y^a) - u_i(y^b) \mid \Delta_i^e] = 0$, 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 , $c_i(a_e) < c_i(b_e)$ if and only if $E[u_i(y^a) - u_i(y^b) \mid \Delta_i^e] > 0$. Since $u_i(y^a) - u_i(y^b) = -(u_i(y^b) - u_i(y^a))$, using the definitions of $c_i(a_e)$ and $c_i(b_e)$ contained in equations (2) and (3), we have that

$$\begin{aligned} c_i(a_e; y^i, \Delta_i^e) - c_i(b_e; y^i, \Delta_i^e) &= \int_{\{(y^a, y^b) \in Y \times Y: u_i(y^a) < u_i(y^b)\}} [u_i(y^b) - u_i(y^a)] dF_i^e(y^a, y^b) + \\ &\quad \int_{\{(y^a, y^b) \in Y \times Y: u_i(y^a) > u_i(y^b)\}} [u_i(y^b) - u_i(y^a)] dF_i^e(y^a, y^b) \\ &= \int [u_i(y^b) - u_i(y^a)] dF_i^e(y^a, y^b) \\ &\equiv E[u_i(y^b) - u_i(y^a) \mid \Delta_i^e]. \end{aligned}$$

Note this is a general result which does not depend on the functional form of $u_i(y)$. ■

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

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

Hence, citizen i 's optimal turnout rule in election e is:¹³

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

When we consider the m elections faced by a citizen i all together, it should be clear that differences in Δ_i^e across elections may make it optimal for the citizen to participate in some elections and abstain in others.¹⁴ 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

¹³If a citizen is indifferent between voting and abstaining we assume that the tie is broken in favor of participation. This assumption is, however, inconsequential.

¹⁴The 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.

m 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 a society is facing two elections (i.e., $m = 2$). The set of candidates in each election is $\{a_1, b_1\}$ and $\{a_2, b_2\}$, respectively, and each candidate is characterized by a position in the (unidimensional) liberal-conservative ideological space $Y = [-1, 1]$. In particular, we have that $y^{a_1} = 0$, $y^{b_1} = 1$, $y^{a_2} = 0$, and $y^{b_2} = 1/2$.

Each citizen i has an ideological position $y^i \in [-1, 1]$. 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 2, and can either be informed or uninformed in election 1. 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 1, she knows that $y^{a_1} \in Y^{a_1} = \{-1, -1/2, 0, 1/2\}$, $y^{b_1} \in Y^{b_1} = \{-1/2, 0, 1/2, 1\}$, $y^{a_1} < y^{b_1}$, and $\Pr \{(y^{a_1}, y^{b_1}) \in Y^{a_1} \times Y^{b_1} : y^{a_1} < y^{b_1}\} = 1/10$. We refer to a citizen who is informed (uninformed) in election 1 as an informed (partially informed) citizen, and let Δ_U^1 , Δ_I^1 , and Δ_I^2 denote the information of an informed and uninformed citizen in election 1, and of an informed citizen in election 2, respectively.

When the ideological space is unidimensional (i.e., $r = 1$), it is straightforward to show that Proposition 1 implies that each citizen's optimal voting rule in each election is a "cutoff" rule: that is, for each election $e = 1, 2$, and each citizen i , given i 's information set Δ_i^e , there exists a cutoff point $\tau_i^e(\Delta_i^e) \in [-1, 1]$ such that citizen i votes for candidate a_e in election e if $y^i < \tau_i^e(\Delta_i^e)$ and votes for b_e if $y^i > \tau_i^e(\Delta_i^e)$. In particular, for any Δ_i^e , we have that

$$\tau_i^e(\Delta_i^e) = \frac{E \left[(y^{b_e})^2 - (y^{a_e})^2 \mid \Delta_i^e \right]}{2E [y^{b_e} - y^{a_e} \mid \Delta_i^e]}. \quad (8)$$

Since in this example all citizens are informed in election 2, $\tau_i^2(\Delta_I^2) = 1/4$ for all citizens. On the other hand, if citizen i is informed in election 1, $\tau_i^1(\Delta_I^1) = 1/2$, and if she is uninformed in election 1, $\tau_i^1(\Delta_U^1) = 0$. It follows that, conditional on participating in both elections, informed citizens would vote for candidates a_1 and a_2 if their ideological position is less than $1/4$, for a_1 and b_2 if their ideological position is between $1/4$ and $1/2$, and for b_1 and b_2 if their ideological position is greater than $1/2$. Similarly, conditional on participating

in both elections, partially informed citizens would vote for candidates a_1 and a_2 if their ideological position is less than 0, for b_1 and a_2 if their ideological position is between 0 and $1/4$, and for b_1 and b_2 if their ideological position is greater than $1/4$.¹⁵

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., $c_i^1(y^i, \Delta_1^1) = c_i^2(y^i, \Delta_1^2) = 0$). It follows that informed citizens participate in both elections and partially informed citizens always participate in election 2. Using the definitions in (2) and (3), and citizens' optimal voting rules characterized in Proposition 1, we have that the cost of voting in election 1 for partially informed citizens is

$$c_i^1(y^i, \Delta_U^1) = \begin{cases} 0 & \text{if } y^i \in [-1, -\frac{3}{4}] \cup [\frac{3}{4}, 1] \\ \frac{3-4|y_i|}{40} & \text{if } y^i \in [-\frac{3}{4}, -\frac{1}{2}] \cup [\frac{1}{2}, \frac{3}{4}] \\ \frac{7-12|y_i|}{40} & \text{if } y^i \in [-\frac{1}{2}, \frac{1}{4}] \cup [\frac{1}{4}, \frac{1}{2}] \\ \frac{11-28|y_i|}{40} & \text{if } y^i \in [-\frac{1}{4}, \frac{1}{4}] \end{cases} \quad (9)$$

The cost in (9) is increasing in y^i for $y^i < 0$ and decreasing for $y^i > 0$. In fact, the result that the cost of voting in an election is single-peaked in correspondence of the cutoff point is general, and follows from the fact that the payoff function $u_i(y)$ is strictly decreasing in $|y^i - y|$ and concave.¹⁶

Given (9), since citizens participate in election 1 if $c_i^1(\cdot) \leq d_i = 1/4$ and abstain otherwise, it follows that partially informed citizens with positions $y^i \in [-1/28, 1/28]$ participate in election 2 and selectively abstain in election 1. All other citizens participate in both elections.

By combining citizens' optimal participation and voting decisions, we obtain that for the

¹⁵For the purpose of the example we ignore the case where a citizen is indifferent between voting for either candidate and hence randomizes.

¹⁶To see that this is the case, note that when citizen i optimally votes for candidate a_e (which occurs if $y^i < \tau_i^e$), she makes a voting mistake for any candidates' positions pair (y^{a_e}, y^{b_e}) such that $y^i > (y^{a_e} + y^{b_e})/2$. Clearly, the closer y^i is to the cutoff point τ_i^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 ideological positions $y^j < y^k < \tau_j^e = \tau_k^e$, for any candidates' positions pair (y^{a_e}, y^{b_e}) for which both citizens make a voting mistake by voting for candidate a_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 b^e .

citizenry in this example we would observe individuals voting for each possible combination of candidates in the two elections (i.e., citizens voting for a_1 and a_2 , a_1 and b_2 , b_1 and a_2 , and b_1 and b_2 , respectively), as well as individuals who selectively abstain in election 1. 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 individuals abstaining in both elections and individuals who selectively abstain in election 2. These conclusions extend to the general specification of the model considered above.

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 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.¹⁷

The research on counterfactual thinking is based on the evidence that events (choices) are not evaluated in isolation, but are compared to *hypothetical* events (choices) that “might have” or “should have” happened. 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

¹⁷The 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.

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 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. According to this literature, it is typically the case that, controlling for the outcome, people experience a more intense regret over actions taken than from actions foregone (e.g., Kahneman and Tversky (1982)). Consistent with this evidence, individuals in our model experience a positive “regret” from voting, which is represented by the expected payoff loss derived from potentially making voting mistakes.¹⁸ The “regret” from abstaining is represented by the foregone opportunity of fulfilling one’s civic duty.¹⁹

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.²⁰ Although in our setting the driving force of abstention and voting decisions is

¹⁸Notice 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 Ordóñez 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)).

¹⁹While 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).

²⁰In existing ethical-voter models, if an individual votes, she always votes for her (known) preferred alternative.

the disutility of potentially making voting mistakes, as shown in Proposition 1, the model implies optimal voting behaviors that are consistent with expected utility maximization in a spatial setting.

4 Turnout and Voting in U.S. National Elections

In this section, we apply the general framework illustrated in Section 3 to analyze empirically turnout and voting in U.S. national elections in a presidential election year.²¹ We consider a situation where citizens face two simultaneous elections (i.e., $m = 2$): a presidential election and a congressional election.²² 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). Hence, the environment analyzed in Section 3 corresponds to the situation faced by the citizens within a generic district.

Let $h \in \{1, \dots, 435\}$ denote a generic congressional district, P the presidential election, H the congressional election in district h , and $e \in \{P, H\}$ a generic election.²³ 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.²⁴ Each candidate j is characterized by a position y^j in a unidimensional liberal-conservative ideological space $Y = [-1, 1]$ (i.e., $r = 1$), and is either an incumbent or a challenger. We let q_j be an indicator that takes the value one if candidate j is an incumbent and zero otherwise. We refer to an election where neither candidate is an incumbent as an open election.

²¹In 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.

²²Consistent 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.

²³The total number of U.S. congressional districts is 435.

²⁴We 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.

To capture the fact that within each election the democratic candidate is typically more liberal than the republican candidate, we assume that presidential and congressional candidates are drawn from populations of potential candidates with distribution functions $F_P(y^D, y^R | y^D < y^R)$ and $F_H(y^D, y^R | y^D < y^R)$, respectively. Note that these functions may be different for presidential and congressional elections, and they may also differ across districts in congressional elections.

In each district there is a continuum of heterogeneous citizens.²⁵ Citizens differ along several observed dimensions. Each citizen residing in district h 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.

Citizens also differ with respect to some unobserved characteristics. In particular, citizens’ ideological positions, information, and civic duty are not observable by the econometrician.²⁶ 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 $F_y(y | x, k)$ 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

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

²⁵By 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.

²⁶To 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.

and

$$\beta = \exp(\beta_k k).^{27}$$

Another dimension of unobserved heterogeneity is represented by citizens' information. For each election $e \in \{P, H\}$, a citizen can either be informed about the candidates in election e or uninformed. The information potentially available to citizens depends on the 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.²⁸ 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.²⁹ 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^{DP} and y^{RP} . Similarly, if a citizen residing in district h is *informed* in congressional election H , she knows q_{DH} and q_{RH} , and if $q_{DH} = q_{RH} = 1$, she knows y^{DH} and y^{RH} ; if $q_{DH} = 1$ and $q_{RH} = 0$, she knows y^{DH} and $F_H(y^{DH}, y^R \mid y^{DH} < y^R)$; if $q_{DH} = 0$ and $q_{RH} = 1$, she knows y^{RH} and $F_H(y^D, y^{RH} \mid y^D < y^{RH})$; and if $q_{DH} = q_{RH} = 0$, she knows $F_H(y^D, y^R \mid y^D < y^R)$.³⁰ 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

²⁷The 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).

²⁸For example, the history of roll call voting by each member of Congress is readily available.

²⁹Although 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.

³⁰Note that for each election H , there is either an incumbent Republican running against a Democratic challenger (i.e., $q_{RH} = 1$ and $q_{DH} = 0$), or a Democratic incumbent running against a Republican challenger (i.e., $q_{RH} = 0$ and $q_{DH} = 1$), or a Democratic and a Republican incumbent running against each other (i.e., $q_{RH} = 1$ and $q_{DH} = 1$, which may occur after redistricting), or the election is open (i.e., $q_{RH} = 0$ and $q_{DH} = 0$).

in the presidential and the congressional election, respectively.³¹ The information a generic individual i possesses is summarized in her information set Δ_i .

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

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

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

and

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

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

³¹Consistent with basic stylized facts about American politics (which we assume to be known even by uninformed voters), the restrictions we impose guarantee that in any election the Republican candidate is relatively more conservative than the Democratic candidate, and 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).

components of the model. We let $F_d(d | x, k, z)$ denote the distribution of civic duty in the population. Since the benefit from voting is relative to the cost of voting, $F_d(d | x, k, z)$ 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 $F_d(d | x, k, z)$ 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.³²

5 Data and Estimation

We consider the U.S. presidential and congressional elections of 2000.³³ Our empirical analysis relies on two sources of data: the American National Election Studies (NES), and the Poole and Rosenthal NOMINATE scores.³⁴

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.³⁵ 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,

³²In estimation, we also considered the more general specification where $F_d(d | x, k, z)$ is a Beta distribution over the support $[0, \bar{c}]$ 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.

³³Recall 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.

³⁴Both data sets are online at <http://www.umich.edu/~nes> and <http://voteview.com>, respectively.

³⁵Consistent 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.

votes for the Democratic candidate or votes for the Republican candidate.³⁶ 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 for the Democratic or the Republican candidate, respectively. We refer to $V^i = (V_P^i, V_H^i) \in \{AA, AD, AR, DA, RA, DD, DR, RD, RR\}$ 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.³⁷ Using the notation we introduced to describe our structural model, we have that $x = (\textit{Age}, \textit{Black}, \textit{Lowedu}, \textit{Highedu}, \textit{Female}, \textit{Lowinc}, \textit{Christian})$ and $k = (\textit{Dem}, \textit{Rep}, \textit{Ind})$.

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;

³⁶For 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.

³⁷Consistent 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.

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 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 $z = (\textit{Attention}, \textit{News}, \textit{Watch}, \textit{Contact})$ and $w = (\textit{CareP}, \textit{CareH}, \textit{Jury}, \textit{Interest}, \textit{Discuss}, \textit{Talk})$. 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 2000.³⁸ 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 $[-1, 1]$.³⁹ These estimates, which are comparable across politicians and across time, are contained in their NOMINATE Common Space Scores data set.⁴⁰ These estimates

³⁸Although 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)).

³⁹For 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.

⁴⁰For 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

provide the measures of the ideological positions of the presidential candidates, y^{DP} and y^{RP} , and the measures of the positions of all incumbents in any congressional election H , y^{DH} and y^{RH} . 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 distributions $F_H(\cdot | \cdot)$. In particular, we assume that $F_H(\cdot | \cdot) = F_L(\cdot | \cdot)$ 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.⁴¹ 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, 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).⁴² 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

 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).

⁴¹Note that 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.

⁴²See, e.g., Wolfinger and Rosenstone (1980).

regions of the continental United States, and let $\rho = (\rho_1, \dots, \rho_8)$ denote the vector of the parameters that measure these probabilities, $p = (p_1, \dots, p_8)$, where $p_\ell = \exp(\rho_\ell) / [1 + \exp(\rho_\ell)]$, $\ell = 1, \dots, 8$.⁴³

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 $\phi = (\alpha_x, \alpha_k, \beta_k, \theta_x, \theta_k, \theta_w, \theta_k^P, \theta_k^H, \gamma_x, \gamma_k, \gamma_z, \rho)$. Given X and ϕ , the probability of each participation and voting profile observed in the data can be calculated using equations (5) and (7), Proposition 1, and the specification of the structural model described in Section 4.⁴⁴ 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:

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

⁴³Note that in our sample there are no individuals who reside in any of the external states.

⁴⁴The calculations of $c_i^e(\cdot)$, $v_i^{e*}(\cdot)$ and $t_i^{e*}(\cdot)$ are similar to the ones in the example of Section 3.1.

where, for each profile $V \in \Omega = \{AA^+, DA, RA, DD, DR, RD, RR\}$, $f(V)$ denotes the empirical frequency of the profile, $\hat{f}(V)$ denotes the frequency predicted by the estimated model, and n is the number of observations.⁴⁵ 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.

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.⁴⁶ As before, the criterion we use to assess the fit of the model is Pearson's chi-square test.⁴⁷ Table 6 reports the goodness-of-fit test statistic and the corresponding p -value for each demographic characteristic and party identification.⁴⁸ 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.

⁴⁵The 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.

⁴⁶In 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).

⁴⁷The 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.

⁴⁸Note 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.

6.2 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 , $F_y(y | x, k)$. In order to interpret the estimates we obtained, note that given our specification the mean of each of these conditional distributions is equal to

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

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 (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.⁴⁹ 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 stochastically dominates the distribution of independents' ideological positions, which in turn stochastically 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.⁵⁰ Rather, we adopt a revealed

⁴⁹Degan (2007) obtains similar findings from the estimation of a dynamic model of voting in the 1968 and 1972 presidential elections.

⁵⁰A 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)).

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.⁵¹ 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.⁵²

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 (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 7 we report the (average) marginal probabilities of being informed in some election by demographic characteristics and party identification.⁵³ These estimates indicate that, unconditionally,

⁵¹Note 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.

⁵²Clearly, this is not the case for existing categorical variables of citizens' self-placement on ideological scales.

⁵³Note 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 congres-

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 civic duty.⁵⁴ 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 7 contains estimates of the (average) marginal probabilities of having high civic duty by demographic characteristics and party identification.⁵⁵ 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

sional election, or in both elections are equal to 0.38, 0.21 and 0.04, respectively).

⁵⁴Only the effect of race and gender is not statistically significant.

⁵⁵Note that the estimated average probability of having a high sense of civic duty in the overall sample is equal to 0.66.

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.⁵⁶

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).⁵⁷ 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.

6.3 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.

⁵⁶This result is in line with Shachar and Nabeluff (1999) who find that republicans have a higher ex-ante propensity to turnout than democrats.

⁵⁷The 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.

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.⁵⁸

When combined with our previous findings that independents are systematically less informed than democrats, who are in turn less informed than republicans (Table 7), these results also explain the fact that independents are relatively more likely to abstain than 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

⁵⁸Note 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)).

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)).⁵⁹ 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 (suppose that in the example a_e denotes the Democratic candidate and b_e the Republican one in each election $e = 1, 2$, where 1 is the congressional election and 2 the presidential one), 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.

There is a large empirical literature in political science that analyzes the issue of split-ticket voting in U.S. national elections.⁶⁰ The goal of these studies, however, is to test alternative theories of why voters may split their ticket.⁶¹ The results of our analysis indicate that the observed behavior of voters in presidential and congressional elections is consistent with the predictions of a spatial model of voting with asymmetric information.

⁵⁹Their 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.

⁶⁰See, e.g., Burden and Kimball (2002) and Mebane (2000).

⁶¹Theoretical 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.

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 $F_H(y^D, y^R | y^D < y^R)$.⁶²

The results of our first two experiments are summarized in Table 8. 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

⁶²In 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 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.⁶³

Table 9 contains the results of our third experiment regarding the incumbency advantage 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.⁶⁴ 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.⁶⁵ This asymmetry is due to the fact that in the data there is less variation

⁶³This 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.

⁶⁴The number of observations is equal to 420 and 446, respectively.

⁶⁵Note 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).

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 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 $D_i^e(\cdot) = 1\{v_i^{e*}(\cdot) = D_e\}$, $R_i^e(\cdot) = 1\{v_i^{e*}(\cdot) = R_e\}$, $C_i^P(\cdot) = 1\{c_i^P(\cdot) < c_i^H(\cdot)\}$, and $C_i^H(\cdot) = 1\{c_i^H(\cdot) < c_i^P(\cdot)\}$ 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:

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

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

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

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

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

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

and

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

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

Table 2: Descriptive Statistics

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

Table 3: Candidates' Positions

House Candidates								
	Democrats				Republicans			
Region	Mean	St. Dev.	Min.	Max.	Mean	St. Dev.	Min.	Max.
<i>Northeast</i>	-0.36	0.10	-0.55	-0.14	0.24	0.14	-0.05	0.62
<i>Midwest</i>	-0.33	0.14	-0.68	-0.01	0.37	0.12	0.13	0.69
<i>South</i>	-0.24	0.14	-0.53	0.15	0.41	0.11	-0.01	0.87
<i>West</i>	-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					
$\alpha_x:$			$\theta_x:$					
<i>Age</i>	-0.0870	0.0508	<i>Age</i>	-0.2493	1.0596			
<i>Black</i>	-0.1049	0.0344	<i>Black</i>	1.2800	0.6112			
<i>Lowedu</i>	0.0241	0.0315	<i>Lowedu</i>	-0.9605	0.5248			
<i>Highedu</i>	-0.0439	0.0180	<i>Highedu</i>	0.8828	0.5979			
<i>Female</i>	-0.0234	0.0160	<i>Female</i>	0.1885	0.3584			
<i>Lowinc</i>	-0.0188	0.0207	<i>Lowinc</i>	-0.7175	0.4312			
<i>Christian</i>	0.0441	0.0172	<i>Christian</i>	0.7917	0.3495			
$\alpha_k:$			$\theta_k:$					
<i>Dem</i>	5.2047	0.3048	<i>Dem</i>	-2.8015	0.7644			
<i>Rep</i>	5.0409	0.2438	<i>Rep</i>	-1.8809	0.7288			
<i>Ind</i>	4.9181	0.5375	<i>Ind</i>	-3.1038	0.8234			
$\beta_k:$			$\theta_w:$					
<i>Dem</i>	5.2288	0.2987	<i>Attention</i>	1.2890	0.3903			
<i>Rep</i>	4.7949	0.2638	<i>News</i>	0.6882	0.4123			
<i>Ind</i>	4.7913	0.5381	<i>Watch</i>	0.9051	0.4288			
Panel C: Probability of High Civic Duty			<i>Contact</i>	1.2374	0.4362			
			$\theta^p_k:$					
$\gamma_x:$			<i>Dem</i>	2.0160	1.4110			
			<i>Rep</i>	3.8011	2.3183			
			<i>Ind</i>	0.7907	1.9590			
<i>Age</i>	4.2840	0.6612	$\theta^h_k:$					
<i>Black</i>	0.4489	0.3472						
<i>Lowedu</i>	-1.0610	0.3263	<i>Dem</i>	0.4675	1.5009			
<i>Highedu</i>	1.1347	0.2487	<i>Rep</i>	3.8635	2.2986			
<i>Female</i>	0.0453	0.1990	<i>Ind</i>	0.3116	1.7854			
<i>Lowinc</i>	-0.7606	0.2083	Panel D: Probability of Exogenous Abstention					
<i>Christian</i>	0.4340	0.2009						
$\gamma_k:$			$\rho:$					
<i>Dem</i>	-2.8015	0.7644	<i>Region 1</i>	-2.7186	1.2533			
<i>Rep</i>	-1.8809	0.7288	<i>Region 2</i>	-2.5458	0.5578			
<i>Ind</i>	-3.1038	0.8234	<i>Region 3</i>	-6.1888	3.0349			
$\gamma_z:$			<i>Region 4</i>	-3.2643	1.0769			
			<i>CareP</i>	1.0095	0.2349	<i>Region 5</i>	-2.0992	0.3555
			<i>CareH</i>	0.4627	0.2082	<i>Region 6</i>	-5.3582	3.0138
			<i>Jury</i>	0.5835	0.1924	<i>Region 7</i>	-2.3026	0.8941
			<i>Interest</i>	0.3511	0.2065	<i>Region 8</i>	-5.3765	3.2160
			<i>Discuss</i>	0.7136	0.2400	Log-likelihood = -1113.46		
			<i>Talk</i>	0.5471	0.1978			

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

Profile	Data	Model
<i>AA</i> ⁺	0.2799	0.2775
<i>DA</i>	0.0480	0.0639
<i>RA</i>	0.0388	0.0285
<i>DD</i>	0.2911	0.2877
<i>DR</i>	0.0582	0.0573
<i>RD</i>	0.0327	0.0237
<i>RR</i>	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
<i>Dem</i>	4.270	0.234
<i>Rep</i>	0.107	0.991
<i>Ind</i>	1.918	0.590
<i>AgeL</i>	0.878	0.831
<i>AgeM</i>	5.052	0.168
<i>AgeH</i>	1.394	0.707
<i>Black</i>	0.731	0.866
<i>Non-Black</i>	3.608	0.307
<i>Lowedu</i>	1.570	0.666
<i>Mediumedu</i>	5.661	0.129
<i>Highedu</i>	0.268	0.966
<i>Female</i>	4.189	0.242
<i>Male</i>	0.679	0.878
<i>Lowinc</i>	3.731	0.292
<i>Highinc</i>	1.147	0.766
<i>Christian</i>	4.464	0.216
<i>Non-Christian</i>	0.770	0.857

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* ≥ 65.

Table 7: Estimated Marginal Probabilities of Information and Civic Duty

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

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 $Age \geq 55$.

Table 8: 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 9: 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