From Local Election Laws to National Campaigns: The Impact of Voting Costs on Turnout

Luke Miller *
Georgetown University

March 2, 2025

**Abstract**

This paper examines how local election laws influence voter turnout by altering the competitiveness of an election and shaping national campaign strategies. I develop a structural model where both voters and candidates behave strategically: voters decide whether to cast a ballot based on intensity of preferences, voting costs, and the competitiveness of the election, while candidates adjust their strategies to maximize their probability of winning. I then structually estimate the model using county-level data from the 2008-2020 U.S. presidential elections. Changes in the cost of voting directly impact voter turnout by making it more costly to vote. However, these changes also indirectly affect the competitiveness of the election and campaign strategies, which in turn shape voter turnout. Overall, this paper underscores the importance of considering the indirect effects of changes in voting costs when estimating their impact on voter turnout. Ignoring these factors can result in biased estimates of the true impact of local policies on voter turnout.

# 1 Introduction

Leading up to the 2024 Presidential Election, U.S. lawmakers enacted 700 new voter laws [1]. These legislative changes varied widely. Some states, such as North Carolina, tightened regulations by imposing stricter voter ID requirements. Other states, such as Michigan, expanded access by permitting alternative forms of identification. Simultaneously, nearly one-fifth of polling places have closed since 2012, forcing many voters to travel longer distances and endure extended wait times to cast their ballots.[2]

Understanding the impact of these local policies on voter turnout involves disentangling three key factors:

*I thank my advisor, Laurent Bouton, and Juan Felipe Riaño for their guidance and support throughout this project.

[1] https://tracker.votingrightslab.org/pending/search/?number=7165195077820660

[2] https://abc7chicago.com/post/vanishing-voting-sites-states-see-number-polling-places-decline-ahead-2024-election/15490043/

1. **The direct effect of voting costs:** Policies that increase the time, effort, or financial burden of voting can directly reduce participation.

2. **The indirect effect on election competitiveness:** By lowering turnout, these policies may affect the competitiveness of an election, influencing voter motivation.

3. **The indirect effect on national campaign strategies:** Changes in voter turnout expectations may lead candidates to adjust their mobilization efforts, further shaping electoral outcomes.

The second and third terms have typically been overlooked in existing research. However, they can potentially have a substantial impact on the overall effect of local policies on voter turnout. By supressing turnout, raising the cost of voting can alter the competitive landscape of an election. This could particularly be the case if the policy is targeted at specific groups of voters. If the election becomes more competitive, voters may perceive their vote as more influential, potentially offsetting the initial policy effects. Alternatively if it lowers the competitiveness of the election, voters may become less motivated to participate, amplifying the initial policy effects.

Moreover, shifts in expected turnout can lead to reallocations of campaign resources. For elections at the national level (e.g. U.S. Presidential Elections), candidates may choose to either double down on mobilization efforts in states that increase their voting costs, moving resources out of states with lower costs. Alternatively, they may shift resources away from states that raise their voting costs, increasing efforts in other states.

Existing research has typically ignored these indirect effects, potentially leading to biased estimates of how election laws influence voter turnout. When empirical strategies overcomes such biases, without a structural model of voter behavior and campaign strategy, it becomes difficult to extrapolate how changes in election laws will shape future elections.

To fill this gap, I develop a structural model of voter behavior and campaign strategy.

- **Voters** decide whether to cast a ballot based on the strength of their political preferences, the cost of voting, and how competitive the election is.

- **Campaigns** aim to maximize the probability of winning, and so adjust their strategies in response to the behavior of the voters.

To quantify the three listed dynamics, I structurally estimate my model using data from U.S. Presidential Elections from 2008 to 2020. To assess the impact of local policies on voter turnout, I simulate a scenario in which the cost of voting doubles in a single state for counties that lean toward a particular party. The cost of voting is unaffected in the remaining states and in counties that lean toward the opposing party in the affected state.

For the party whose supporters experienced an increase in voting costs, they increase their campaign spending in the state by 5% on average. For the opposing party, they decrease their spending by 5% on average in the affected state. However, this masks significant heterogeneity. Depending on the exact characteristic of the state, parties can increase their spending by up to 33% or decrease their spending by up to 20%. These changes in campaign strategy have notable impacts on voter turnout. Adjustments in candidate effort can lead to shifts in turnout ranging from a 3% increase to a 5% decrease in the affected counties, on top of the direct effects from increasing voting costs.

Differences in the cost of voting, even within the same state, can be quite substantial. Certain groups can wait longer (Chen et al. 2022), or must travel farther to vote (Bagwe, Margitic, and Stashko 2022). The type of acceptable identification varies across states (Cantoni and Pons 2021) as does the number of early voting days and the availability of mail-in ballots (Li, Pomante, and Schraufnagel 2018).

Understanding how these local policies interact with national campaigns is crucial for understanding how election laws shape voter turnout. This paper aims to help us better understand these interactions through a novel structural model of voter behavior and campaign strategy so we may quantify these interactions.

## 2 Literature

Strömberg (2008) provides a seminal paper structurally estimating how campaign strategies adapt to an electoral system. Specifically, he examines how the structure of the Electoral College shapes the intensity with which Presidential candidates campaign in each state. States with more electoral votes and those with a closer expected margin of victory receive more visits. As in my model, voter preferences lie along a continuum, and campaigns allocate effort to shift votes at the state level. However, my approach differs in two key ways: I account for voter abstention, and further, I allow for the endogenous response of both voters' turnout decisions and campaign strategies to the competitiveness of the election. Finally, I use county level results compared to state level results for a more detailed analysis.

My model is also related to the work of Kawai, Toyama, and Watanabe (2021), who, like me, structurally estimate a model of voter turnout on U.S. Presidential Election data. Both their model and mine build on the foundational frameworks of Downs (1957) and Riker and Ordeshook (1968), where voter turnout is determined by the following inequality:

$$p \cdot \Delta u - c > 0$$

where $p$ is the probability of an individual's vote being pivotal, $\Delta u$ is the utility differential between the candidates, and $c$ is the cost of voting. Like Kawai, Toyama, and Watanabe (2021), I do not assume $p$ represents the true probability of the voter casting a decisive vote. Instead, I follow their terminology and refer to $p$ as the *voter's perception of voting efficacy.* However, my approach differs in that I endogenize $p$, making it a function of aggregate turnout. Specifically, I assume $p$ is monotonically increasing in the closeness of the election, capturing the idea that individuals perceive their vote as more influential when the race is tighter. I estimate the exact functional form from the data. Additionally, I introduce strategic interactions between voters and campaigns.

Models which keep $p$ as the true probability of the individual's vote being pivotal fail to match the data, even in relatively small elections (Coate, Conlin, and Moro (2008)). The reason for this is relatively straightforward: the probability an individual's vote is pivotal in determining the outcome of an election is extremely low in large elections, unless near equal levels of expected turnout for both sides. For instance, suppose there are 500,000 voters in a given election [3]. If a random individual has a 24.75% chance of voting for candidate A, a 25.25% chance of voting for candidate B, and a 50% chance of abstaining, then the probability of being pivotal is approximately 1e-7%. If this difference rises to 24.5% and 25.5%, this probability falls to 1e-23%, and by 23.5% and 26.5%, this probability plummets to 1e-197% [4].

Given the implausability of these numbers, researchers developed alternative ways to model voter turnout while keeping the same general framework of the Downsian model. For instance, Castanheira (2003) proposes voters care not only about the election outcome, but also about the margin of victory. This means individuals may show up to vote, even if the election is not expected to be a near tie. Other extensions introduce social motivations for voting, where social pressure or group identity can influence turnout (Coate and Conlin (2004); Feddersen and Sandroni (2006); Levine and Mattozzi (2020)). A final strand of the literature shifts focus away from modeling voters as strategic agents, instead emphasizing the role candidates play in shaping turnout (Shachar and Nalebuff (1999)). In such models, candidates have an incentive to exert more effort the closer the election. Higher effort by candidates causes higher levels of turnout in closer elections, even if voters themselves are entirely disregarding the probability their own vote affects the outcome of the election.

One goal of the present paper is to develop a general framework which can nest the intuition of these various models and can be structually estimated using data. To achieve this, I adopt a flexible specification for the voter's perception of voting efficacy, imposing only that it monotonically increases as the election becomes more competitive. The data then determine the precise functional form mapping electoral competitiveness to perceived efficacy. This flexibility allows my model to nest the classical Riker and Ordeshook (1968) framework, while also accommodating alternative mechanisms, such as the margin-based approach of Castanheira (2003).

Additionally, my model can fit within the group-based models of Coate and Conlin (2004) and Feddersen and Sandroni (2006), where individuals vote expecting others in their group to do the same. Such behavior raises the overall

[3] This is roughly the size of average U.S. Congressional District

[4] These calculations are based on formulas found in Myerson (2000), who provides a simple analytical formula for the probability of an individual's vote being pivotal in large elections.

efficacy of voting for the individual. This mechanism allows these models to display high levels of turnout, even when the election is not expected to be close. If the estimated perception of voting efficacy remains high in less competitive elections (though varies across the range of competitiveness), it would provide empirical support for group-based models of turnout.

Furthermore, I incorporate campaign behavior into the model, recognizing that candidates and parties strategically adjust their mobilization efforts in response to voter turnout expectations. By integrating these strategic interactions, my framework can capture the key insights from models of campaign strategy, such as in Shachar and Nalebuff (1999).

In sum, my model offers a flexible framework capable of accommodating a wide range of existing theories of voter turnout. By estimating the key parameters, my approach enables a data-driven evaluation of competing theories, shedding light on the mechanisms that drive voter participation.

Finally, my model relates to a broader empirical literature that examines how changes in key components of the Downsian model influence voter turnout. Several studies investigate how variations in voting costs impact participation rates (Cantoni and Pons (2021); Cantoni (2020); Bagwe, Margitic, and Stashko (2022)). Others analyze the effect of electoral competitiveness on turnout (Bursztyn et al. (2024); Fraga, Moskowitz, and Schneer (2022); Ainsworth, Munoz, and Gomez (2022); Enos and Fowler (2014)). Additionally, research on campaign spending highlights its role in shaping voter participation (Enos and Fowler (2018); Gerber (2004); Stratmann (2009)). By building a strctural frame work to estimate the impact of these factors on voter turnout, my approach can disentangle the complex interactions between these components while also providing the ability to extrapolate how changes in election laws will shape future elections.

# 3 Model

Two candidates, $D$ (Democrat) and $R$ (Republican), compete in a national election. To win the election, a candidate must accumulate 270 electoral votes. Each state $s \in S$ gives its assigned electoral votes $l_s$ to a candidate using a first-pass the post election. Candidates have a fixed, exogenous amount of effort, denoted $E_D$ and $E_R$, which they allocate strategically across all states to maximize their probability of winning the election. Voters care only about the election outcome of their respective state.

Within a given state there are $J_s$ counties. A given county $j_s \in J_s$ accounts for fraction $w_{j_s}$ of the total population.

There are three stages of the model:

1. **Pre-campaign stage:** Individuals hold initial preferences over the two parties.

2. **Campaign stage:** Candidates choose where to campaign based on observed preferences and individuals update the intensity of their utility

differential based on the campaigning.

3. **Election stage:** Individuals decide whether to vote and who to vote for.

I will first discuss voter behavior in stages 1 and 3, then return to stage 2 to discuss campaign strategy.

## 3.1 Stage 1: Pre-Campaign Stage

In the pre-campaign stage, individuals have pre-existing preferences for the two candidates. Let $\tilde{x}_{i,j_s}$ denote the utility differential between candidate $R$ and candidate $D$ for individual $i$ in county $j_s$ and state $s$. If $\tilde{x}_{i,j_s} > 0$ the individual prefers $R$; if $\tilde{x}_{i,j_s} < 0$ the individual prefers $D$.

The utility differential is decomposed as follows:

$$\tilde{x}_{i,j_s} \equiv \mu_{j_s} - \eta_{j_s} - \delta_s - \epsilon_{i,j_s}$$

Here, $\mu_{j_s}$ represents the baseline county-level utility in favor of $R$, capturing systematic differences in preferences across counties. The term $\eta_{j_s}$ is a county-specific utility shock, assumed to be independently and identically Normally distributed with mean 0 and variance $\sigma_\eta^2$. Similarly, $\delta_s$ represents a state-level utility shock that affects preferences across all voters equally within the state. Like $\eta_{j_s}$ this shock is also assumed to be independently and identically Normally distributed, with mean 0 and variance $\sigma_\delta^2$. Finally, $\epsilon_{i,j_s}$ is an individual-specific utility shock, with a cumulative distribution function denoted as $H(\cdot)$. This distribution is assumed to be symmetric around zero.

## 3.2 Stage 3: Election Stage

During the campaign stage, candidates exert effort at the state level to influence voter preferences and, ultimately, the election outcome. Let $e_{s,D}$ and $e_{s,R}$ represent the effort levels of the $D$ and $R$ candidates, respectively, in state $s$. At this stage, an additional county specific partisan shock, denoted as $\eta^p_{j_s}$, affects voter preferences. This shock follows an independent and identically distributed Normal distribution with mean 0 and variance $\sigma_\eta^2$, similar to the county-level shock $\eta_{j_s}$ in stage 1. The presence of $\eta^p_{j_s}$ pushes all voters either towards more extreme or more moderate ideological positions.

The post-campaigning utility differential is given by:

$$x_{i,j_s} = \begin{cases} -u_D(e_{s,D}) + \mu_{j_s} - \eta_{j_s} - \delta_s + \eta^p_{j_s} - \epsilon_{i,j_s} & \text{if } \tilde{x}_{i,j_s} < 0, \\ u_R(e_{s,R}) + \mu_{j_s} - \eta_{j_s} - \delta_s - \eta^p_{j_s} - \epsilon_{i,j_s} & \text{if } \tilde{x}_{i,j_s} > 0. \end{cases}$$

The functions $u_D(e_{s,D})$ and $u_R(e_{s,R})$ map the effort levels of the candidates to the utility differential between the candidates. These functions are assumed to be increasing and concave in the effort levels. Note I assume candidates can only influence the utility of individuals already predisposed to support them. This assumption is consistent with the idea that candidates primarily focus on mobilizing their base, rather than persuading individuals with initial support for the opposing party to switch sides. Further, candidates choose how much effort to exert at the state level, not the county level.

Beyond candidate preferences, voters face a cost of voting, denoted as $c_{j_s}$, which varies by county. A voter will choose to participate in the election only if the expected benefit of voting outweighs this cost.

To capture the expectations, I introduce $p(\sigma_{s,D}, \sigma_{s,R})$, where $\sigma_{s,D}$ and $\sigma_{s,R}$ represent the fraction of individuals voting for candidates $D$ and $R$, respectively, in state $s$. This term reflects how individuals perceive the effectiveness of their vote. I assume $p(\sigma_{s,D}, \sigma_{s,R})$ is a function of state-level aggregate turnout, which monotonically increases as $\sigma_{s,D}$ and $\sigma_{s,R}$ approach the same value. That is, as the election becomes more competitive, individuals perceive their vote as more influential. The exact functional form used will be discussed in the estimation section.

A voter in precinct $j_s$ will cast a ballot for $D$ if they prefer $D$ (i.e., $\tilde{x}_{i,j_s} < 0$) and their expected utility from voting exceeds their voting cost:

$$p(\sigma_{s,D}, \sigma_{s,R}) \cdot |x_{i,j_s}| > c_{j_s}.$$

Similarly, a voter in precinct $j_s$ will cast a ballot for $R$ if they prefer $R$ (i.e., $\tilde{x}_{i,j_s} > 0$) and:

$$p(\sigma_{s,D}, \sigma_{s,R}) \cdot x_{i,j_s} > c_{j_s}.$$

Let $\sigma_{j_s,D}$ and $\sigma_{j_s,R}$ denote the fraction of individuals in county $j_s$ voting for candidates $D$ and $R$, respectively. Assuming the shocks are small enough that turnout is an interior solution, we can aggregate individual turnout decisions to the county level. The proportion of individuals voting for $D$ is:

$$\begin{aligned}\sigma_{j_s,D} &= 1 - H\left(-u_D(e_{s,D}) + \mu_{j_s} + \frac{c_{j_s}}{p(\sigma_{s,D}, \sigma_{s,R})} - \eta_{j_s} - \delta_s + \eta^p_{j_s}\right) \\ &= H\left(u_D(e_{s,D}) - \mu_{j_s} - \frac{c_{j_s}}{p(\sigma_{s,D}, \sigma_{s,R})} + \eta_{j_s} + \delta_s - \eta^p_{j_s}\right). \qquad (1)\end{aligned}$$

Similarly, the fraction of individuals voting for $R$ is:

$$\sigma_{j_s,R} = H\left(u_R(e_{s,R}) + \mu_{j_s} - \frac{c_{j_s}}{p(\sigma_{s,D}, \sigma_{s,R})} - \eta_{j_s} - \delta_s - \eta^p_{j_s}\right). \qquad (2)$$

Note that within a single county, the fraction of individuals voting for $D$ and $R$ is itself a function of the aggregate turnout at the state level, $\sigma_{s,D}$ and $\sigma_{s,R}$.

## 3.3 Stage 2: Campaign Stage

### 3.3.1 Candidates' Objective Function

Candidates allocate a fixed, exogenous amount of resources to maximize their chances of winning the election. Denote the total amount of resources available to candidate $D$ as $E_D$ and to candidate $R$ as $E_R$.

Due to computational constraints, I make the simplifying assumption that candidates consider certain states safely won and do not allocate resources to them. In practice, I set the effort to zero in these states when estimating the model. This assumption matches the reality of U.S. Presidential Elections, where certain states are considered safe for each party (e.g. California for the Democrats and Alabama for the Republicans) and Presidential candidates allocate essentially zero resources to them when campaigning. [5] Data from the Wesleyan Media Projects further validates this assumption. Over 85% of television advertising over the 2008 - 2020 Presidential Elections occurred in just 10 states each year on average.[6] Further, over 90% of campaign visits by Presidential candidates were to just 10 states over the same period on average.[7] The safe states contribute their electoral votes to the candidate's total. Let $EV_D$ denote the number of electoral votes won by the Democratic candidate from safe states, and $EV_R$ denote the number of electoral votes won by the Republican candidate from safe states.

The focus of campaign strategy is then the allocation of resources across the remaining "swing states" where electoral outcomes are uncertain. Candidates make these allocation decisions based on observable factors, such as county-specific partisan leanings ($\mu_{j_s}$) and the cost of voting ($c_{j_s}$). I assume they know the distribution of individual-level shocks ($\eta$, $\eta^p$, $\delta$), though they do not know the exact realization.

The goal of each candidate is to secure a majority of the electoral votes (i.e., at least 270). The Democratic candidate's objective function is given by:

$$\max_{\mathbf{e_{s,D}}} Pr\left(EV_D + \sum_s D_s l_s \geq 270\right) \quad \text{subject to} \quad \sum_{s \in S} e_{s,D} \leq E_D$$

where $l_s$ represents the number of electoral votes for state $s$, and $D_s = 1$ if the Democratic candidate wins the state and 0 otherwise. [8] The vector $\mathbf{e_{s,D}}$ represents the effort levels exerted by the Democratic candidate in each state, with $e_{s,D} \in \mathbf{e_{s,D}}$ denoting the effort level exerted by the Democratic candidate in state $s$. Total effort is constrained by the total available effort $E_D$. The Republican candidate faces a similar optimization problem.

The probability that the Democratic candidate wins a given state is:

$$Pr(\sigma_{s,D}(e_{s,D}, e_{s,R}) > \sigma_{s,R}(e_{s,D}, e_{s,R})) \equiv p_s(e_{s,D}, e_{s,R})$$

where $\sigma_{s,D}$ and $\sigma_{s,R}$ represent the share of the population voting for the Democratic and Republican candidates, respectively. Given the independence of the county-level and state-level shocks, I use the Central Limit Theorem

[5] See for instance: https://fairvote.org/report/2008-s-shrinking-battleground-and-its-stark-impact-on-campaign-activity/

[6] Author's calculations based on data from the Wesleyan Media Project.

[7] Author's calculations based on data compiled by FairVote.

[8] Note I ignore the fact that some state, such as Maine and Nebraska, allocate electoral votes by congressional district.

to approximate the distribution of the sum of the electoral votes won by the Democratic candidate as a normal distribution:

$$\sum_{s \in S} D_s l_s \sim N\left(\sum_{s \in S} p_s(e_{s,D}, e_{s,R}) l_s, \sum_{s \in S} p_s(e_{s,D}, e_{s,R})(1 - p_s(e_{s,D}, e_{s,R})) l_s^2\right)$$

Using this approximation, the Democratic candidate's objective function becomes:

$$\max_{e_{s,D}} \Phi\left(\frac{\sum_s p_s(e_{s,D}, e_{s,R}) l_s - (270 - EV_D)}{\sqrt{\sum_s p_s(e_{s,D}, e_{s,R})(1 - p_s(e_{s,D}, e_{s,R})) l_s^2}}\right) \quad \text{s.t.} \quad \sum_s e_{s,D} \leq E_D \quad (3)$$

where $\Phi(\cdot)$ is the cumulative distribution function of the standard normal distribution.

Likewise, the objective function for the Republican candidate is:

$$\max_{e_{s,R}} \Phi\left(\frac{\sum_s (1 - p_s(e_{s,D}, e_{s,R})) l_s - (270 - EV_R)}{\sqrt{\sum_s p_s(e_{s,D}, e_{s,R})(1 - p_s(e_{s,D}, e_{s,R})) l_s^2}}\right) \text{ s.t. } \sum_s e_{s,R} \leq E_R \quad (4)$$

### 3.3.2 Calculating the probability of winning a state

The probability of winning a state depends on individual-level voting decisions:

$$Pr(\sigma_{s,D}(e_{s,D}, e_{s,R}) > \sigma_{s,R}(e_{s,D}, e_{s,R})) = Pr\left(\sum_{j_s} w_{j_s} \sigma_{j_s,D} - \sum_{j_s} w_{j_s} \sigma_{j_s,R} > 0\right) \quad (5)$$

where, using the results from section 3.2,

$$\sigma_{j_s,D} = H\left(u_D(e_{s,D}) - \mu_{j_s} - \frac{c_{j_s}}{p(\sigma_{s,D}, \sigma_{s,R})} + \eta_{j_s} + \delta_s - \eta^p_{j_s}\right)$$

and

$$\sigma_{j_s,R} = H\left(u_R(e_{s,R}) + \mu_{j_s} - \frac{c_{j_s}}{p(\sigma_{s,D}, \sigma_{s,R})} - \eta_{j_s} - \delta_s - \eta^p_{j_s}\right)$$

There are two key challenges in solving for the probability of winning a state given by equation 5. First, the probability of winning a state is a function of three random variables: $\eta_{j_s}$, $\eta^p_{j_s}$, and $\delta_s$. Second, turnout in a given county is a function of the state-wide turnout, making a direct calculation of the probability of winning a state difficult.

To overcome the first of these challenges, I make the simplifying assumption that candidates ignore the county-level shocks $\eta_{j_s}$ and $\eta^p_{j_s}$ and focus only on the state-level shock $\delta_s$. Intuitively, if the standard deviation of the county-level shocks is small relative to the state-level shock, candidates can treat the county-level shocks as noise and focus on the state-level shock. I show in appendix A that this approximation is valid under certain conditions.

Define $\tilde{\sigma}_{j_s,D}$ and $\tilde{\sigma}_{j_s,R}$ as the county-level voting outcomes under this approximation:

$$\tilde{\sigma}_{j_s,D} \equiv H\left(u_D(e_{s,D}) - \mu_{j_s} - \frac{c_{j_s}}{p(\sigma_{s,D},\sigma_{s,R})} + \delta_s\right)$$

$$\tilde{\sigma}_{j_s,R} \equiv H\left(u_R(e_{s,R}) + \mu_{j_s} - \frac{c_{j_s}}{p(\sigma_{s,D},\sigma_{s,R})} - \delta_s\right)$$

Under this setup, the probability the Democratic candidate wins state $s$ can be expressed as:

$$p_s(e_{s,D}, e_{s,R}) \approx Pr\left(\sum_{j_s} w_{j_s}\tilde{\sigma}_{j_s,D} - \sum_{j_s} w_{j_s}\tilde{\sigma}_{j_s,R} > 0\right)$$

where $w_{j_s}$ represents the fraction of the voting age population in county $j_s$.

To find the probability of winning a state, define $\hat{\delta}_s$ as the threshold where the weighted sum of Democratic supporters equals that of Republican supporters:

$$\sum_{j_s} w_{j_s} H\left(u_D(e_{s,D},e_{s,R}) - \mu_{j_s} - \frac{c_{j_s}}{p(\sigma_{D,s},\sigma_{R,s})} + \hat{\delta}_s\right)$$
$$= \sum_{j_s} w_{j_s} H\left(u_R(e_{s,D},e_{s,R}) + \mu_{j_s} - \frac{c_{j_s}}{p(\sigma_{D,s},\sigma_{R,s})} - \hat{\delta}_s\right) \tag{6}$$

If $\delta_s$ exceeds $\hat{\delta}_s$, each county is pushed further in favor of the Democratic candidate. As a result, the Democratic candidate wins the state. Likewise, if $\delta_s$ falls below $\hat{\delta}_s$, the Republican candidate wins the state. Therefore, to calculate the probability of winning a state, I find the $(\hat{\delta}_s, \sigma_{s,D}, \sigma_{s,R})$ that satisfy equation 6. Appendix B provides more details on this process.

Therefore, the probability that the Democratic candidate wins the state is given by:

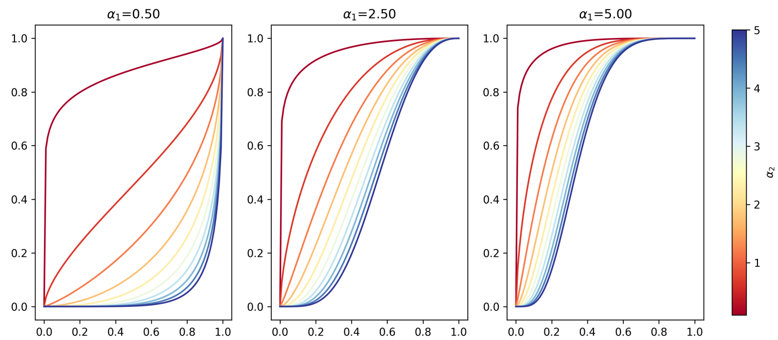
$$p_s(e_{s,D}, e_{s,R}) \approx 1 - F(\hat{\delta}_s) \tag{7}$$

where $F(\cdot)$ represents the cumulative distribution function of the state-wide shock $\delta_s$. With this approximation, the probability of winning a state can be expressed as a function of the threshold $\hat{\delta}_s$.

#### 3.3.3 Equilibrium strategies

With the framework for calculating the probability of winning a state in place, I can now solve for the equilibrium strategies of the candidates. I use a root-finding algorithm to find the effort levels that satisfy the first-order conditions of

Figure 1: Probability of being pivotal for range of $\alpha_1$ and $\alpha_2$




the optimization problems for each candidate (equations 3 and 4). More details on this process can be found in the appendix C.

# 4 Estimation

## 4.1 Perceived efficacy of voting

To fit with the intuition of the Downsian model, I require that the perceived efficacy of voting be monotonically increasing in the closeness of the election. However, rather than imposing a specific functional form, I adopt a flexible specification that accommodates a variety of potential mechanisms, allowing the data to determine the exact shape of the function.

With this in mind, I estimate the following functional form for the perceived efficacy of voting:

$$p(\sigma_{s,D}, \sigma_{s,R}) = 1 - (1 - \sigma_s^{\alpha_1})^{\alpha_2}$$

Where

$$\sigma_s = \begin{cases} \frac{\sigma_{s,D}}{\sigma_{s,R}} & \text{if } \sigma_{s,R} > \sigma_{s,D} \\ \frac{\sigma_{s,R}}{\sigma_{s,D}} & \text{if } \sigma_{s,D} > \sigma_{s,R} \end{cases}$$

and both $\alpha_1 > 0$ and $\alpha_2 > 0$. I estimate these parameters as part of the structural estimation. Figure 1 shows the perceived efficacy of voting for a range of $\alpha_1$ and $\alpha_2$.

As shown in the figure, if $\alpha_1$ is low and $\alpha_2$ is high, we can get functional form similar to Riker and Ordeshook (1968) where the probability of being pivotal is essentially 0 until the election is very close. However, the model can also accommodate a wide range of other functional forms.

Table 1: Parameters estimated in the model

| Parameter | Description | Estimated |
|---|---|---|
| $\mu_{j_s}$ | Baseline county-level utility in favor of $R$ | $\beta_\mu \cdot X_{\mu,j_s}$ |
| $c_{j_s}$ | Cost of voting in county $j_s$ | $\exp(\beta_c \cdot X_{c,j_s})$ |
| $\alpha_1$ | Shape parameter for perceived efficacy | $\exp(\beta_{\alpha_1})$ |
| $\alpha_2$ | Shape parameter for perceived efficacy | $\exp(\beta_{\alpha_2})$ |
| $\theta$ | Effect of campaign effort | $\exp(\beta_\theta)$ |
| $\sigma_\eta$ | Variance of county-level shock | $\exp(\beta_\eta)$ |

### 4.2 Effect of campaign effort

The effect of campaign effort on voter preferences is estimated as:

$$u_D(e_{s,D}) = \theta\sqrt{e_{s,D}}$$

$$u_R(e_{s,R}) = \theta\sqrt{e_{s,R}}$$

where $\theta$ is estimated as part of the structural estimation. The square root is chosen to ensure that the utility of voting for a candidate is increasing in the effort exerted by that candidate, but at a decreasing rate.

### 4.3 Parameters

Table 1 shows the parameters estimated in the model and the functional form used to estimate them. For each county, I construct a set of covariates capturing the baseline utility in favor of the Republican candidate ($\mu_{j_s}$), and the cost of voting in the county ($c_{j_s}$). I then take a vector of coefficients ($\beta_\mu$, $\beta_c$, $\beta_{\alpha_1}$, $\beta_{\alpha_2}$, and $\beta_{\sigma_\eta}$), and transform them to the parameters of interest using the listed functional form. $c_{j_s}$, $\alpha_1$, $\alpha_2$, and $\sigma_\eta$ are all exponentiated to ensure they are positive.

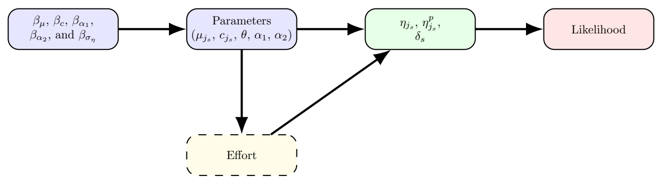
### 4.4 Estimation procedure

The model is estimated using maximum likelihood. There are three key components to the likelihood function: $\eta_{j_s}$, $\eta^p_{j_s}$, and $\delta_s$. All the shocks are assumed to be Normally distributed with mean 0. Figure 2 shows a diagram of the parameter estimation process.

## 5 Data

I compile county-level demographic data, cost of voting data, and election results for U.S. Presidential Elections from 2008 to 2020. Table 2 shows summary

Figure 2: Parameter estimation process




statistics for the data used in the estimation. The county-level demographic data, including age, race, education, income, and employment status, comes from the American Community Survey (ACS). The election results are sourced from the MIT Election Data and Science Lab, which provides comprehensive county-level returns for federal elections.

Data on the number of polling places in each county comes from the United States Election Assistance Commission's (EAC) Election Administration and Voting Survey. This is a biannual survey of election officials in all 50 states and territories on the administration of federal elections. To get a measure of cost of voting associated with the number of polling places, I calculate the number of people assigned to each polling place in each county by dividing the total voting age population by the number of polling places. Unfortunately, about 10% of counties do not report the number of polling places. For this reason, I impute the number of polling places in these counties using a state-level Elastic Net regression with the number of polling places as the dependent variable and the demographic data and year as the independent variables.

Because polling place assignment varies widely across counties, I apply a log transformation to this measure to account for its skewness. Since demographic data are expressed as fractions, I also transform the logged polling data into percentiles for comparability. The county with the highest number of people per polling place is assigned a percentile of 1, while the county with the lowest is assigned a percentile of 0. By normalizing the data to all be between 0 and 1, it is easier for my algorithm to estimate the parameters of interest.

Research shows the impact of polling place assignment differs between urban and rural areas (Bagwe, Margitic, and Stashko 2022). For this reason, I include an interaction term between the number of people per polling place and the urban/rural status of the county. Urban counties are defined as those with a population density of at least 350 people per square mile.

In addition to number of people per polling place, I incorporate state-level Voter ID law strictness as a measure of voting accessibility. This data is obtained from Li, Pomante, and Schraufnagel (2018), which classifies states into five categories:

- 4 = photo ID strictly enforced
- 3 = non-photo ID strictly enforced

- 2 = photo ID not strictly enforced
- 1 = non-photo ID required not strictly enforced
- 0 = no ID required, only signature.

Taking a similar approach to the data on the number of people assigned to a particular polling place, I transform this data to percentiles.

Finally, I also include a dummy variable to indicate if the state conducted the entire election by mail-in ballot. These states include Colorado, Hawaii, Oregon, Utah, and Washington. I additionally assume the number of people per polling place in these states is at the zero percentile, as voters are not impacted by the number of polling places. This data again comes from Li, Pomante, and Schraufnagel (2018).

While my estimation procedure does not require state-level effort data (this is endogenously determined by the model), I need a measure of total available effort for each candidate to calculate equilibrium effort levels. I measure this effort using campaign spending data from the Wesleyan Media Project, which tracks total expenditures on television ads by each candidate in each state. As discussed above, I only calculate the equilibrium effort levels of the top swing states in each election. The remaining states are assumed to receive zero effort from the candidates. In practice, I choose the top ten states in terms of total campaign spending. To get the total amount of spending, I sum the amount spent by each candidate in each state for each election year. A detailed breakdown of these expenditures is presented in Tables 3 and 4. In order for the effort levels to be comparable to the values of the other parameters in the model, I use data in the hundreds of millions of dollars.

# 6 Results

Table 5 presents the estimated coefficients for the model. The $\mu$ coefficients determine shifts in counties' political alignment, with negative values pushing counties towards a Democratic baseline and positive values pushing them towards a Republican baseline. For the cost-related variables, positive coefficients imply that an increase in the respective variable raises the cost of voting in a county. The Not All By Mail variable, both urban and rural People per Polling Site, and Voter ID Law variables have positive and statistically significant coefficients. This translates to states which do not conduct elections entirely by mail-in ballot, have higher numbers of people assigned to a polling site, and have stricter voter ID laws impose higher costs of voting on the individuals.

Table 2: Summary Statistics

| Variable | Mean | Std | Min | 25% | 50% | 75% | Max |
|---|---|---|---|---|---|---|---|
| Dem. Turnout | 0.263 | 0.095 | 0.045 | 0.192 | 0.258 | 0.327 | 0.658 |
| Rep. Turnout | 0.359 | 0.099 | 0.059 | 0.296 | 0.359 | 0.427 | 0.764 |
| Frac. Male 18-29 | 0.078 | 0.028 | 0.012 | 0.064 | 0.071 | 0.083 | 0.437 |
| Frac. Female 18-29 | 0.070 | 0.024 | 0.005 | 0.058 | 0.065 | 0.075 | 0.283 |
| Frac. Male 30-49 | 0.126 | 0.022 | 0.050 | 0.114 | 0.124 | 0.135 | 0.342 |
| Frac. Female 30-49 | 0.120 | 0.017 | 0.023 | 0.110 | 0.120 | 0.130 | 0.197 |
| Frac. Male 50-64 | 0.104 | 0.015 | 0.032 | 0.095 | 0.104 | 0.112 | 0.231 |
| Frac. Female 50-64 | 0.105 | 0.014 | 0.034 | 0.098 | 0.105 | 0.113 | 0.217 |
| Frac. Male 65-79 | 0.064 | 0.020 | 0.011 | 0.051 | 0.061 | 0.073 | 0.218 |
| Frac. Female 65-79 | 0.071 | 0.020 | 0.016 | 0.058 | 0.069 | 0.080 | 0.240 |
| Frac. White | 0.781 | 0.179 | 0.086 | 0.664 | 0.841 | 0.929 | 0.998 |
| Frac. Black | 0.110 | 0.146 | 0.000 | 0.009 | 0.040 | 0.160 | 0.791 |
| Frac. AIAN | 0.008 | 0.037 | 0.000 | 0.001 | 0.002 | 0.004 | 0.796 |
| Frac. Asian | 0.013 | 0.019 | 0.000 | 0.003 | 0.006 | 0.014 | 0.205 |
| Frac. Hispanic | 0.067 | 0.082 | 0.000 | 0.019 | 0.040 | 0.079 | 0.831 |
| Frac. HS Only | 0.348 | 0.077 | 0.055 | 0.301 | 0.351 | 0.401 | 0.556 |
| Frac. Some Coll. | 0.297 | 0.048 | 0.113 | 0.266 | 0.299 | 0.328 | 0.455 |
| Frac. Coll. Only | 0.142 | 0.060 | 0.030 | 0.098 | 0.130 | 0.174 | 0.480 |
| Frac. Coll. Plus | 0.079 | 0.049 | 0.007 | 0.048 | 0.065 | 0.097 | 0.483 |
| Log Density | 3.457 | 1.578 | -2.250 | 2.468 | 3.308 | 4.388 | 8.380 |
| Year 2008 | 0.281 | 0.450 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 |
| Year 2012 | 0.210 | 0.408 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| Year 2016 | 0.255 | 0.436 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 |
| Year 2020 | 0.254 | 0.435 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 |
| Not All By Mail | 0.980 | 0.140 | 0.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| Urban x People per Polling Place | 0.001 | 0.008 | -0.001 | -0.001 | -0.001 | -0.001 | 0.106 |
| Rural x People per Polling Place | 0.014 | 0.025 | -0.001 | 0.006 | 0.011 | 0.017 | 1.000 |
| Log Real Median HH Income Frac. | 0.424 | 0.128 | 0.000 | 0.339 | 0.414 | 0.500 | 1.000 |
| Voter ID Laws Frac. | 0.347 | 0.376 | 0.000 | 0.000 | 0.250 | 0.750 | 1.000 |
| Frac. Employed | 0.596 | 0.081 | 0.136 | 0.547 | 0.604 | 0.654 | 0.855 |

Note: Dem. Turnout and Rep. Turnout is calculated by taking the total number of Dem and Rep votes, respectively, and dividing it by the total voting age population in the county. Demographic data comes from the American Community Survey. Polling site data comes from the Election Administration and Voting Survey. Voter ID law data comes from Li, Pomante, and Schraufnagel (2018). Both people per polling site and real median household income are first logged, and then transformed to percentiles. Density is measured as the number of people per $km^2$.

Table 3: Democratic Advertisement Spending

| 2008 States | Spending | 2012 States | Spending | 2016 States | Spending | 2020 States | Spending |
|---|---|---|---|---|---|---|---|
| CO | 0.084 | CO | 0.198 | CO | 0.013 | AZ | 0.303 |
| FL | 0.286 | FL | 0.499 | FL | 0.360 | FL | 0.580 |
| IA | 0.078 | IA | 0.159 | GA | 0.043 | GA | 0.099 |
| MI | 0.103 | NC | 0.188 | IA | 0.044 | MI | 0.261 |
| MO | 0.082 | NH | 0.125 | NC | 0.124 | MN | 0.098 |
| NC | 0.085 | NV | 0.136 | NH | 0.027 | NC | 0.257 |
| OH | 0.176 | OH | 0.409 | NV | 0.070 | NV | 0.064 |
| PA | 0.238 | VA | 0.435 | OH | 0.160 | PA | 0.412 |
| VA | 0.206 | VT | 0.105 | PA | 0.199 | VA | 0.126 |
| WI | 0.094 | WI | 0.098 | VA | 0.070 | WI | 0.260 |
| Total | 1.432 | | 2.351 | | 1.110 | | 2.461 |

Note: Spending is reported in hundreds of millions of dollars. Data comes from the Wesleyan Media Project.

Table 4: Republican Advertisement Spending

| 2008 States | Spending | 2012 States | Spending | 2016 States | Spending | 2020 States | Spending |
|---|---|---|---|---|---|---|---|
| CO | 0.070 | CO | 0.106 | CO | 0.041 | AZ | 0.171 |
| FL | 0.143 | FL | 0.314 | FL | 0.165 | FL | 0.329 |
| IA | 0.039 | IA | 0.081 | GA | 0.016 | GA | 0.151 |
| MI | 0.074 | NC | 0.108 | IA | 0.017 | MI | 0.142 |
| MO | 0.066 | NH | 0.027 | NC | 0.054 | MN | 0.042 |
| NC | 0.061 | NV | 0.069 | NH | 0.028 | NC | 0.204 |
| OH | 0.161 | OH | 0.211 | NV | 0.031 | NV | 0.021 |
| PA | 0.204 | VA | 0.251 | OH | 0.067 | PA | 0.130 |
| VA | 0.104 | VT | 0.024 | PA | 0.071 | VA | 0.061 |
| WI | 0.064 | WI | 0.045 | VA | 0.055 | WI | 0.076 |
| Total | 0.986 | | 1.236 | | 0.544 | | 1.325 |

Note: Spending is reported in hundreds of millions of dollars. Data comes from the Wesleyan Media Project.

Table 5: Estimated Coefficients

| Parameter | Variable | Coefficient | Standard Error | P-Value |
|---|---|---|---|---|
| $\mu$ | Frac. Male 18–29 | -3.323 | 0.177 | 0.000 |
| | Frac. Female 18–29 | -3.927 | 0.213 | 0.000 |
| | Frac. Male 30–49 | -2.280 | 0.167 | 0.000 |
| | Frac. Female 30–49 | -6.188 | 0.287 | 0.000 |
| | Frac. Male 50–64 | -2.729 | 0.286 | 0.000 |
| | Frac. Female 50–64 | -5.734 | 0.326 | 0.000 |
| | Frac. Male 65–79 | -3.214 | 0.336 | 0.000 |
| | Frac. Female 65–79 | -4.447 | 0.343 | 0.000 |
| | Frac. White | 1.739 | 0.180 | 0.000 |
| | Frac. Black | -0.631 | 0.181 | 0.000 |
| | Frac. AIAN | -0.338 | 0.191 | 0.076 |
| | Frac. Asian | 2.240 | 0.237 | 0.000 |
| | Frac. Hispanic | 0.036 | 0.179 | 0.840 |
| | Frac. HS Only | -0.376 | 0.084 | 0.000 |
| | Frac. Some Coll. | 0.774 | 0.072 | 0.000 |
| | Frac. Coll. Only | 0.145 | 0.092 | 0.116 |
| | Frac. Coll. Plus | -2.845 | 0.127 | 0.000 |
| | Log Density | -0.070 | 0.003 | 0.000 |
| | Year 2008 | 2.010 | 0.249 | 0.000 |
| | Year 2012 | 1.389 | 0.274 | 0.000 |
| | Year 2016 | 2.037 | 0.229 | 0.000 |
| | Year 2020 | 2.241 | 0.250 | 0.000 |
| Cost | Cost Constant | 0.411 | 0.023 | 0.000 |
| | Not All By Mail | 0.162 | 0.014 | 0.000 |
| | Urban $\times$ People per Polling Place | 3.880 | 0.390 | 0.000 |
| | Rural $\times$ People per Polling Place | 0.362 | 0.111 | 0.001 |
| | Log Real Median HH Income Frac. | -0.315 | 0.019 | 0.000 |
| | Voter ID Laws Frac. | 0.087 | 0.006 | 0.000 |
| | Frac. Employed | -0.622 | 0.028 | 0.000 |
| Prob. Pivotal | Constant 1 | -0.836 | 0.197 | 0.000 |
| | Constant 2 | 0.366 | 0.146 | 0.012 |
| $\theta$ | Constant | -0.521 | 0.040 | 0.000 |
| $\sigma_\eta$ | Constant | -1.454 | 0.005 | 0.000 |
| $\sigma_\delta$ | Constant | -0.465 | 0.072 | 0.000 |

Note: The table reports the estimated coefficients, standard errors, and p-values for the model. The variables include demographic fractions, economic indicators, and other relevant factors. The coefficients represent the effect of each variable on the dependent variable. Standard errors are reported in parentheses. P-values indicate the statistical significance of the coefficients.

Table 6 shows how the coefficients for the probability of being pivotal ($\alpha_1$ and $\alpha_2$), the effect of campaign effort ($\theta$), the variance of the county-level shock ($\sigma_\eta^2$), and the variance of the state-level shock ($\sigma_\delta^2$) are transformed into the parameters of interest.

Figure 3 illustrates the estimated perceived efficacy of voting across the full range of $\sigma_s$ (defined as the ratio of votes for the losing candidates to the winning candidate). The first panel displays estimates for competitive states, where equilibrium effort levels are calculated, while the second panel shows the corresponding estimates for non-competitive states, i.e. where I assume equilibrium effort levels are zero. Perceived efficacy is clustered near 1 in competitive states, indicating that voters in these contexts believe their participation is more impactful. In contrast, perceived efficacy is notably lower and more dispersed in non-competitive states, where individual votes are seen as less consequential. This pattern reflects a core prediction of the Downsian framework: perceived efficacy—and thus the motivation to vote—declines as elections become less competitive.

To better understand how these dynamics translate into actual turnout costs and behavior, Figures 4 and 5 present the estimated distributions of $\mu_{j_s}$ and $c_{j_s}$ for all counties. As with the perceived efficacy plots, the left-hand panels focus on competitive counties, while the right-hand panels cover the rest. These estimates feed directly into the turnout decision via the term $\frac{c}{p(\sigma_{D,s}, \sigma_{R,s})}$, as defined in equations 1 and 2. Accordingly, Figure 5 also plots this adjusted cost measure across counties to highlight how the interaction between cost and efficacy varies with competitiveness.

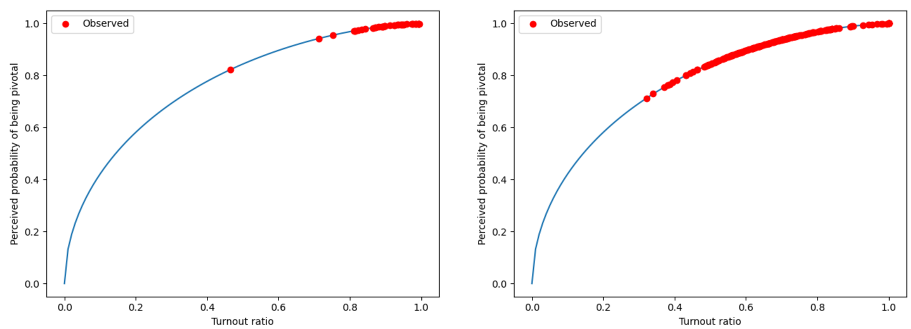
The results show a clear pattern: the perceived efficacy of voting increases the adjusted cost of voting in non-competitive states, which in turn lowers turnout. In competitive states, the perceived efficacy of voting is closer to 1 for most states.

A notable feature of the results is the relatively gradual decline in perceived efficacy across levels of competitiveness. If voters based their behavior solely on the true probability of being pivotal, we would expect perceived efficacy to remain close to zero in all but the most tightly contested elections, particularly given the large electorates involved. Instead, the estimated relationship is much flatter, suggesting that voters do not fully internalize the near-impossibility of pivotality in large-scale elections. Rather than responding exclusively to objective closeness, voters appear to perceive meaningful differences in efficacy even in moderately competitive contexts. This nuance helps explain why turnout does not collapse entirely in less competitive settings and provides empirical support for group-based models which predict high levels of turnout even in non-competitive elections.

Table 6: Remaining Parameters

| **Parameter** | **Value** |
|---|---|
| Prob. Piv. Parameters | $\alpha_1 : 0.43; \quad \alpha_2 : 1.44$ |
| $\theta$ | 0.59 |
| $\sigma_\eta$ | 0.23 |
| $\sigma_\delta$ | 0.63 |

Figure 3: Estimated Perceived Efficacy of Voting




(a) Estimating Equilibrium Effort (b) Equilibrium Effort Set to 0

*Note: The figures show the estimated perceived efficacy of voting with and without campaign effort. Turnout ratio is the ratio of votes for the losing candidate to the winning candidate. Values of 1 indicate a tie, while values of 0 indicate the winning candidate receives all votes.*

# 7 Discussion

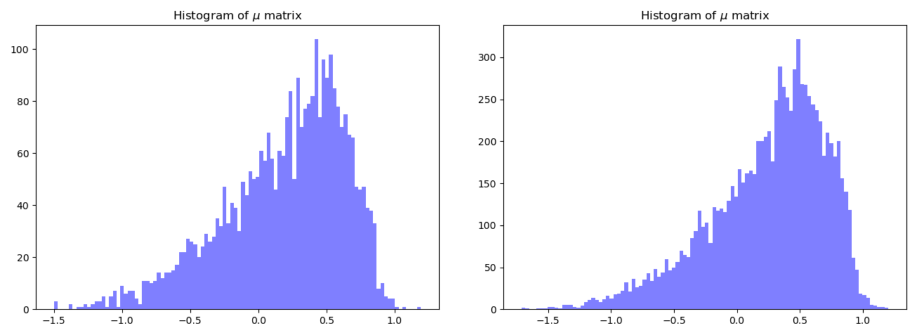
## 7.1 Validation

I begin by evaluating the relationship between the model's predicted equilibrium effort levels and observed measures of actual campaign effort. The equilibrium effort levels are intended to represent the total campaign activity in each state during each election year, capturing a combination of tactics such as television advertising, digital advertising, candidate visits, rallies, door-to-door canvassing, and phone banking. While no comprehensive dataset of all forms of campaign effort exists, I compile several key proxies for the elections held between 2008 and 2020. Specifically, I gather data on total television advertisement spending by each candidate in each state from the Wesleyan Media Project. Additionally, I collect data on candidate visits to each state over the election cycle. For the 2020 election, I also include data on total Facebook advertisement spending by each candidate in each state, sourced from OpenSecrets.

To assess the model's accuracy, I compare predicted effort levels with actual effort across these measures. Table 7 reports the correlations between predicted and observed effort levels. For each type of campaign activity, I calculate the share of total national effort allocated to each state, providing a measure of rela-

Figure 4: Estimated $\mu$ for all counties

Estimating Equilibrium Effort | Equilibrium Effort Set to 0




*Note: The figures show the estimated baseline county-level utility in favor of the Republican candidate ($\mu$). The left panel shows the estimated $\mu$ for counties where the equilibrium effort levels are calculated, while the right panel shows the corresponding estimates for non-competitive states. .*

tive effort. I then compute the correlation between these empirical distributions and share of total effort allocated to each state based on the model's predicted equilibrium effort levels.

The results indicate that the model successfully captures substantial variation in campaign effort across states. The strongest correlation is observed for Facebook advertisement spending in 2020, with a value of 0.81, followed by presidential visits (0.70) and television advertising (0.63). These findings suggest that the model provides a credible approximation of the distribution of campaign effort across states.

Table 7: Correlation between Predicted and Actual Effort Levels

| **Effort Type** | **Correlation** |
|---|---|
| Total Television Advertisment | 0.63 |
| Presidential Visits | 0.70 |
| Total Facebook Advertisements | 0.81 |

*Note: The table reports the correlation between the model's predicted effort levels and actual effort levels across different types of campaign activities. The correlations are calculated based on the share of total national effort allocated to each state.*

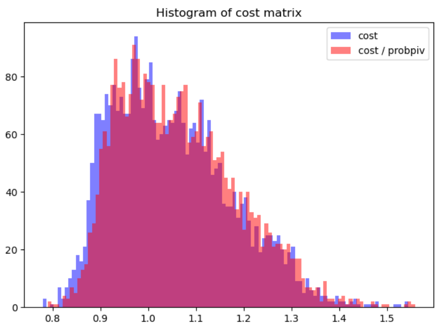
## 7.2 Counterfactuals

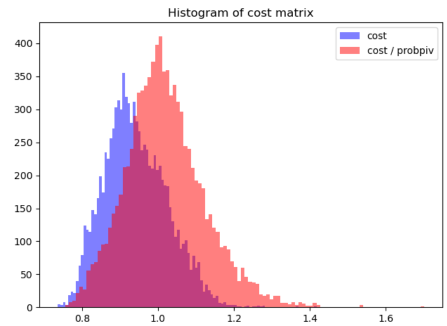
To understand how elasticities interact with equilibrium effects, I conduct a counterfactual analysis simulating shocks to the cost of voting for multiple counties. The effects of such changes can be broken down into three components:

- **Direct Effect:** Higher voting costs lead to a reduction in voter turnout.

Figure 5: Estimated $\mu$ for all counties

Estimating Equilibrium Effort | Equilibrium Effort Set to 0




*Note: The figures show the estimated cost of voting adjusted by the perceived efficacy of voting* ($\frac{c}{p(\sigma_{D,s},\sigma_{R,s})}$) *for all counties. The left panel shows the estimates for counties where the equilibrium effort levels are calculated, while the right panel shows the corresponding estimates for non-competitive states.*

- **Indirect Effect 1:** Voters adjust their turnout decisions in response to changes in the competitiveness of the election.
- **Indirect Effect 2:** Candidates adjust their campaign strategies in response to these changes.

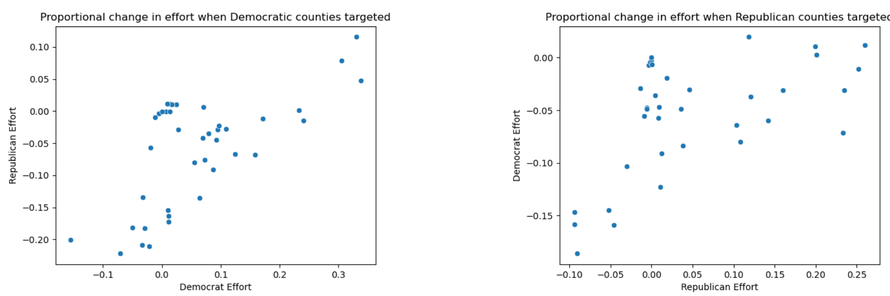
To explore these dynamics, I simulate scenarios in which the cost of voting doubles for all counties in a single state that lean toward a particular party. For example, consider a case where a state targets counties with $\mu_{j_s} > 0$, disproportionately affecting Republican-leaning areas through restrictive voting measures. In this simulation, only those counties experience higher voting costs, while all other counties within the state—and all other states nationwide—remain unchanged.

The results reveal notable shifts in campaign strategy. On average, when voting costs double in counties favoring one party, the candidate representing that party increases their campaign spending by approximately 5%, in an attempt to offset anticipated turnout declines. This means they must reallocate resources from other states, lowering the probability of winning in those states. Conversely, the opposing candidate decreases their spending by about 5%. However, these averages mask substantial variation: in some cases, candidates increase their spending by as much as 33%, while in others, they reduce it by nearly 20%.

Figure 6 summarizes these effects across 40 states (10 from each year used in the analysis - 2008, 2012, 2016, 2020). The left panel displays changes in effort when voting costs rise in Democratic-leaning counties, while the right panel shows the analogous effects in Republican-leaning counties. Each point represents the outcome of a simulation where only one state's partisan counties experience increased voting costs, with all other states held constant. In total, I conduct 80 simulations—40 targeting Democratic-leaning counties and 40 targeting Republican-leaning counties.

The results highlight a general pattern: candidates tend to increase spending when their core supporters face higher voting costs, attempting to compensate for the potential loss in turnout. However, there are important exceptions. In some instances, the affected candidate's effort remains largely unchanged - or even decreases - as they opt to accept the turnout decline in their base. In these cases, the opposing candidate reallocates resources to other, more competitive states, increasing their chances of winning these states. These findings underscore the complex strategic adjustments that arise when voter costs are unevenly distributed, revealing how localized changes in voting access can ripple through national campaign strategies.

Figure 6: Changes in Effort Levels




Shock on Democratic Counties

Shock on Republican Counties

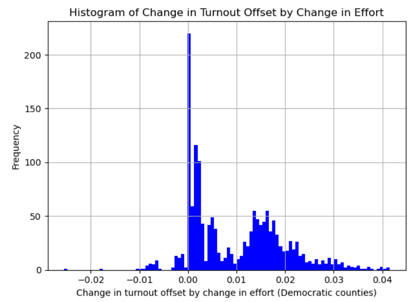
Figure 7: Turnout Changes in Affected and Unaffected Counties

On average, changes in candidate behavior offset about 1% of the turnout decline caused by higher voting costs. However, the magnitude varies across states. It can offset 5% of the turnout in some states, while in others, it can lead to a further 2.5% decrease. Figure 8 illustrates the distribution of these effects across all counties in the 80 simulations.

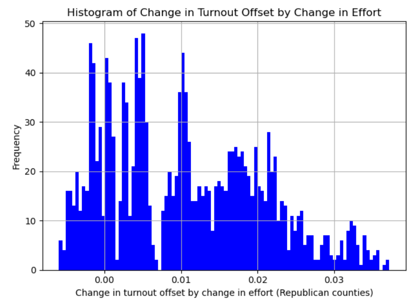
# 8 Conclusion

This paper presents a model of voter turnout that accounts for both individual-level turnout decisions and campaign strategies. Individuals weigh the cost of voting against the perceived impact of their vote, while candidates adjust their campaign strategies to maximize their chances of winning. Importantly, I impose that the perceived efficacy of voting is a function of the closeness of the election, monotonically increasing as the election becomes closer. However, I allow the exact slope of this relationship to be estimated from the data. I

Figure 8: Percent Change in Turnout offset by Campaign Effort




Shock on Democratic Counties




Shock on Republican Counties

Figure 9: Turnout Changes in Affected and Unaffected Counties

then structurally estimate the model using county-level data for the 2008, 2012, 2016, and 2020 U.S. presidential elections.

A counterfactual analysis highlights the risks of ignoring candidates' strategic responses when evaluating policy changes. While higher voting costs directly suppress turnout, campaigns often offset some of these effects by ramping up mobilization efforts. However, there are instances where candidates choose to scale back their spending in states where their supporters encounter higher voting costs, amplifying the effects of these barriers.

More broadly, this study aims to enhance our understanding of voter behavior by quantifying how turnout responds to both policy-driven factors, such as voting costs, and strategic individual-level and candidate-level decisions. These insights have important implications for electoral policy, particularly in discussions on voting accessibility and campaign finance regulations. By clarifying the interplay between institutional constraints, candidate strategies, and voter decision-making, I hope to provide a framework for assessing the broader consequences of election policies and political competition.

# References

Ainsworth, Robert, Emanuel Garcia Munoz, and Andres Munoz Gomez (2022). "District competitiveness increases voter turnout: evidence from repeated redistricting in North Carolina". In: *University of Florida*.

Bagwe, Gaurav, Juan Margitic, and Allison Stashko (2022). *Polling Place Location and the Costs of Voting*. Tech. rep. Technical Report. https://jmargitic. github. io/JM/Margitic_JMP. pdf.

Bursztyn, Leonardo et al. (2024). "Identifying the effect of election closeness on voter turnout: Evidence from swiss referenda". In: *Journal of the European Economic Association* 22.2, pp. 876–914.

Cantoni, Enrico (2020). "A precinct too far: Turnout and voting costs". In: *American Economic Journal: Applied Economics* 12.1, pp. 61–85.
Cantoni, Enrico and Vincent Pons (2021). "Strict ID laws don't stop voters: Evidence from a US nationwide panel, 2008–2018". In: *The Quarterly Journal of Economics* 136.4, pp. 2615–2660.
Castanheira, Micael (2003). "Victory margins and the paradox of voting". In: *European Journal of Political Economy* 19.4, pp. 817–841.
Chen, M Keith et al. (2022). "Racial disparities in voting wait times: Evidence from smartphone data". In: *Review of Economics and Statistics* 104.6, pp. 1341–1350.
Coate, Stephen and Michael Conlin (2004). "A group rule—utilitarian approach to voter turnout: Theory and evidence". In: *American Economic Review* 94.5, pp. 1476–1504.
Coate, Stephen, Michael Conlin, and Andrea Moro (2008). "The performance of pivotal-voter models in small-scale elections: Evidence from Texas liquor referenda". In: *Journal of Public Economics* 92.3-4, pp. 582–596.
Downs, Anthony (1957). "An economic theory of political action in a democracy". In: *Journal of political economy* 65.2, pp. 135–150.
Enos, Ryan D and Anthony Fowler (2014). "Pivotality and turnout: Evidence from a field experiment in the aftermath of a tied election". In: *Political Science Research and Methods* 2.2, pp. 309–319.
— (2018). "Aggregate effects of large-scale campaigns on voter turnout". In: *Political Science Research and Methods* 6.4, pp. 733–751.
Feddersen, Timothy and Alvaro Sandroni (2006). "A theory of participation in elections". In: *American Economic Review* 96.4, pp. 1271–1282.
Fraga, Bernard L, Daniel J Moskowitz, and Benjamin Schneer (2022). "Partisan alignment increases voter turnout: Evidence from redistricting". In: *Political behavior* 44.4, pp. 1883–1910.
Gerber, Alan S (2004). "Does campaign spending work? Field experiments provide evidence and suggest new theory". In: *American Behavioral Scientist* 47.5, pp. 541–574.
Kawai, Kei, Yuta Toyama, and Yasutora Watanabe (2021). "Voter turnout and preference aggregation". In: *American Economic Journal: Microeconomics* 13.4, pp. 548–586.
Levine, David K and Andrea Mattozzi (2020). "Voter turnout with peer punishment". In: *American Economic Review* 110.10, pp. 3298–3314.
Li, Quan, Michael J Pomante, and Scot Schraufnagel (2018). "Cost of voting in the American states". In: *Election Law Journal: Rules, Politics, and Policy* 17.3, pp. 234–247.
Myerson, Roger B (2000). "Large poisson games". In: *Journal of Economic Theory* 94.1, pp. 7–45.
Riker, William H and Peter C Ordeshook (1968). "A Theory of the Calculus of Voting". In: *American political science review* 62.1, pp. 25–42.
Shachar, Ron and Barry Nalebuff (1999). "Follow the leader: Theory and evidence on political participation". In: *American Economic Review* 89.3, pp. 525–547.

Stratmann, Thomas (2009). “How prices matter in politics: The returns to campaign advertising”. In: *Public Choice* 140, pp. 357–377.
Strömberg, David (2008). “How the Electoral College influences campaigns and policy: the probability of being Florida”. In: *American Economic Review* 98.3, pp. 769–807.

# A Approximating the probability of winning a state

To justify the approximation, I conduct a monte carlo simulation. As in the main text, I assume the variance of the county-level shocks is small relative to the state-level shock. I assume there are 100 counties in the state.

I set $\delta_\sigma$ to be significantly larger than the other shocks, and simulate the probability of winning a state under different parameter values.

Table 8: Simulation Results

| **Avg. $\mu$** | **Mean Prob. D wins** | **Mean Prob. D wins** ($\eta = \eta^p = 0$) | **Mean Square Error** |
|---|---|---|---|
| -1 | 0.546 | 0.545 | 1.87e-05 |
| 0 | 0.507 | 0.504 | 2.76e-05 |
| 1 | 0.464 | 0.460 | 1.94e-05 |

# B Solving for $\hat{\delta}_s$

To solve for $\hat{\delta}_s$, I must ensure that the equilibrium conditions hold. Define

$$\begin{aligned} F(\hat{\delta}, \sigma_D, \sigma_R) = &\sum_{j_s} w_{j_s} H\left(u_D(e_{s,D}, e_{s,R}) - \mu_{j_s} - \frac{c_{j_s}}{p(\sigma_{D,s}, \sigma_{R,s})} + \hat{\delta}\right) \\ &- \sum_{j_s} w_{j_s} H\left(u_R(e_{s,D}, e_{s,R}) + \mu_{j_s} - \frac{c_{j_s}}{p(\sigma_{D,s}, \sigma_{R,s})} - \hat{\delta}\right) \end{aligned}$$

In equilibrium, $F(\hat{\delta}, \sigma_D, \sigma_R) = 0$. To solve for these values, I use a multi-diemensional root-finding algorithm.

# C Solving for equilibrium strategies

For any given set of parameters, I must solve for the equilibrium strategies of the candidates. Let:

$$f^D(e_{1,D}, e_{2,D}, \dots) \equiv \frac{\sum_s p_s(e_{s,D}, e_{s,R}) l_s - (270 - EV_D)}{\sqrt{\sum_s p_s(e_{s,D}, e_{s,R})(1 - p_s(e_{s,D}, e_{s,R})) l_s^2}}$$

and

$$f^R(e_{1,R}, e_{2,R}, \dots) \equiv \frac{\sum_s (1 - p_s(e_{s,D}, e_{s,R}))l_s - (270 - EV_R)}{\sqrt{\sum_s p_s(e_{s,D}, e_{s,R})(1 - p_s(e_{s,D}, e_{s,R}))l_s^2}}$$

where $e_{1,D}$ and $e_{1,R}$ represent the effort levels exerted by the Democratic and Republican candidates in the first state, respectively.

We can now rewrite the optimization problems of the candidates as:

$$\max_{\mathbf{e_{s,D}}} \Phi(f^D(e_{1,D}, e_{2,D}, \dots)) \text{ s.t. } \sum_s e_{s,D} \leq E_D$$

Likewisehe objective function for $R$ is:

$$\max_{\mathbf{e_{s,R}}} \Phi(f^R(e_{1,R}, e_{2,R}, \dots)) \text{ s.t. } \sum_s e_{s,R} \leq E_R$$

To solve for the equilibrium strategies, I build a system of equations using the first-order conditions of the optimization problems:

$$\begin{aligned}
\phi(\cdot)\frac{\partial f^D(e_{1,D}, e_{2,D}, \dots)}{\partial e_{1,D}} &= \lambda_D \\
\phi(\cdot)\frac{\partial f^D(e_{1,D}, e_{2,D}, \dots)}{\partial e_{2,D}} &= \lambda_D \\
&\vdots \\
\phi(\cdot)\frac{\partial f^R(e_{1,R}, e_{2,R}, \dots)}{\partial e_{1,R}} &= \lambda_R \\
\phi(\cdot)\frac{\partial f^R(e_{1,R}, e_{2,R}, \dots)}{\partial e_{2,R}} &= \lambda_R \\
&\vdots \\
\sum_s e_{s,D} = E_D \quad &, \sum_s e_{s,R} = E_R
\end{aligned}$$

where $\lambda_D$ and $\lambda_R$ are the Lagrange multipliers for the Democratic and Republican candidates, respectively. For each candidate, I solve this system of equations using a numerical optimization algorithm. Note this becomes a nested fixed-point problem, as for each guess of the equilibrium strategies, I need to solve the probability of each candidate winning the state.