Democracy on the Line: Polling Place Closures and the Impact on Wait Times in the 2016 Presidential Election in Georgia

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In 2013, Georgia, a state previously required to gain approval from the U.S. Department of Justice for changes in its voting procedures under Section 5 of the Voting Rights Act, was no longer subject to this restriction. Between the 2012 and 2016 presidential elections, Georgia closed a substantial percentage of its polling places while South Carolina's polling place count remained relatively unchanged due to state regulations. Based on wait times reported by voters in each state during the general elections in 2006, 2008, 2012, and 2016, we perform a difference-in-difference analysis with Georgia as the treatment state and South Carolina as the control to examine the impact of the polling place closures on wait times in Georgia's 2016 election. We estimate that due to these polling place closures Georgia's average wait time to vote increased by 78% in that election, which is equivalent to 7.2 minutes given the average wait time of 16.5 minutes in 2016. This increase in the average wait time to vote suggests that not only did Georgia close some polling places, the state did not redistribute the voting resources from the closed polling places to the remaining ones (e.g. mothballed voting machines), thereby lowering the total capacity in the state for voting.

Key words: voting, queue, lines, waiting, capacity pooling, resource allocation

1. Introduction

In the 2013 *Shelby County* v. *Holder* case, the Supreme Court of the United States decided that Section 4 of the Voting Rights Act was unconstitutional. This provision qualified certain areas of the country with a history of voter discrimination, including the state of Georgia, to gain approval from the U.S. Department of Justice for any changes in the voting process under Section 5 (The Brennan Center for Justice (2019), The United States Department of Justice (2019a,b)). Following the ruling, the office of the Secretary of State for Georgia sent a memo to local election officials in February 2015 to promote the consolidation of polling places (The Leadership Conference Education Fund (2019)).

Research on polling place closures (and changes) has focused on the impact of closures on turnout. A reduction in the number of polling locations increases the average distance voters need to travel to vote. That increases the cost to vote, which theory suggests should reduce turnout (Riker and

Ordeshook (1968)). Empirical evidence generally supports a negative impact on voting (Haspel and Knotts (2005), Brady and McNulty (2011), Cantoni (2016), Yoder (2019)). However, there is evidence of mitigating factors: some voters are willing to substitute in-person election day voting with other voting methods, such as absentee ballot or early voting; and the mere notification (generally through postal mail) of a voting location change can prompt some to vote (Clinton et al. (2019)).

Instead of turnout, our interest is on the impact of polling place closures on the wait time to vote. Research in settings such as healthcare (Camacho et al. (2006), Gillespie and Hillyer (2002), Batt and Terwiesch (2015)), retail (Davis and Vollmann (1990), Allon et al. (2011)), and transportation (Taylor (1994)) has shown that time waiting is disliked and costly to businesses and customers. Long lines at the polls have the potential to disenfranchise voters in an election, which can influence the decision to vote: from a survey on the 2008 U.S. election, an estimated 11.1% of voters did not vote because of long lines (Alvarez et al. (2008)). Beyond a contemporaneous effect, waiting could dissuade voters from participating in future elections: in Florida, evidence shows that voters who experienced longer waits in the 2012 election had a lower probability of voting in the next presidential election (Cottrell et al. (2017)). A number of studies document voter wait time disparities related to factors such as race, political party, and income (Highton (2006), Stewart III (2012), Famighetti et al. (2014), Pettigrew (2017)), and others have linked those differences to unbalanced allocation of voting resources such as poll workers and voting machines (Famighetti et al. (2014), Pettigrew (2017), Cachon and Kaaua (2019)). Our empirical research focuses on how polling place closures in Georgia may have impacted voter wait times in the 2016 election.

From queuing theory (Kleinrock (1975)), the time to vote depends on the characteristics of demand (e.g., turnout, volatility throughout the day, etc.) and capacity (e.g., number of poll workers, voting machines, etc.) Presuming that polling place closures reduce turnout, all else being equal (e.g., capacity), voter waiting times should be reduced, as shown by the top mechanism in Fig.1 - if fewer voters arrive to the polls, then the lower burden on the system should reduce the time each voter waits to vote.

Unlike voter turnout, the impact of polling place closures on voter wait times is ambiguous with respect to capacity, the lower mechanism in Fig.1. A critical question is how county administrators manage the capacity of the closed polling locations. A natural option, as appears to have been done in Texas (Simpson (2016)), is to take the resources from closed locations and redistribute them proportionally to the remaining locations. (See Allen and Bernshteyn (2006), Yang et al. (2009, 2013) for analytical methods to allocate capacity across locations.) That approach, which we refer to as "capacity pooling," continues to utilize all resources, just in fewer locations. Supported by theory (Cachon and Terwiesch (2013)), but contrary to popular opinion in the media (The

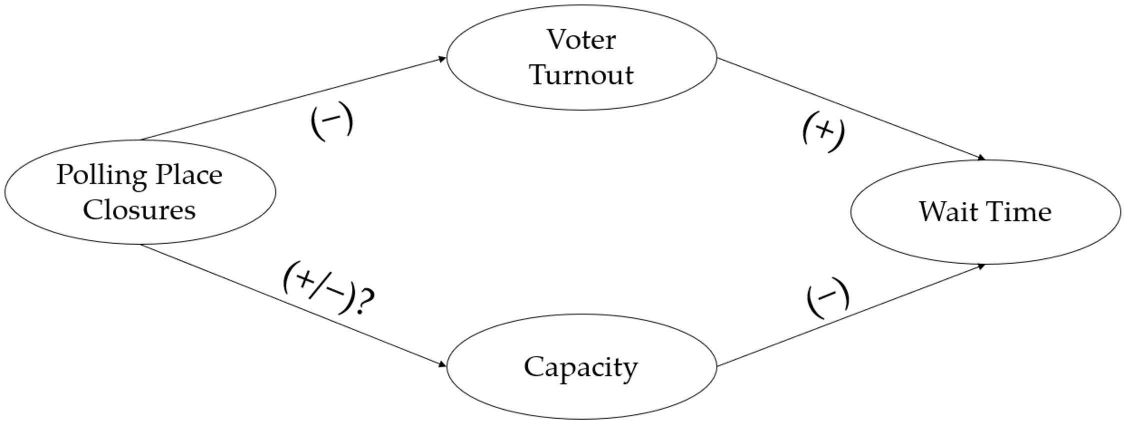

Figure 1 **Mechanisms through which polling place closures may impact voter wait times**

Leadership Conference Education Fund (2019)), capacity pooling should reduce voter wait time (holding all else constant, such as demand). This occurs because capacity pooling mitigates the primary inefficiency associated with multiple locations, the possibility that resources are idle at some locations while voters are waiting at other locations.

Capacity pooling is not the only option for managing resources. The capacity in closed polling locations could be distributed to a select few of the remaining locations. Voters in those lucky locations would experience an improvement, but voters in the other locations could experience a degradation in service. Due to the non-linearity in the response of wait time to capacity in queuing systems, the overall net effect of this imbalanced redistribution of capacity could be negative (Kleinrock (1975)). The least beneficial of approaches is merely to mothball or cancel the capacity from resources of the closed polling locations, leaving the remaining locations with the same capacity but more voters. A state might take this approach if it has the (real or stated) motivation to reduce the overall budget for conducting an election. In fact, there is some evidence that Georgia indeed took some of its existing capacity out of service in the 2018 general election (Niesse (2018)). Such an approach leads polling closures to cause an increase in voter wait time, as shown in Fig.1.

In sum, our goal is to estimate how polling place closures in Georgia after the *Shelby County* v. *Holder* decision impacted waiting time for voters in Georgia in the 2016 election. Given the existence of multiple mechanisms, we use a difference-in-difference methodology and control for the impact of polling place closures on voter turnout (i.e., the top mechanism in Fig.1). We find that voters in Georgia in the 2016 presidential election experienced a 78% increase in the average wait time to vote, or about 7.2 minutes based on Georgia's average wait time of 16.5 minutes in the 2016 election. This finding is inconsistent with the use of a capacity pooling strategy (redistributing voting resources to remaining locations). Instead, it is consistent with a strategy that combines polling place closures with a reduction in capacity, possibly by mothballing the capacity of the closed locations, thereby imposing on voters greater costs both through the distance needed to travel and the time waiting to vote.

2. Methodology and Data

We use a difference-in-difference (DD) methodology to examine the effect of polling place closures, following *Shelby County* v. *Holder*, on wait times in Georgia in the 2016 election. Given that polling place closures were motivated by the office of the Secretary of State of Georgia, we take the entire state of Georgia as our treatment group. It is important to confirm that the state was actually treated with polling place closures between the 2012 and 2016 elections. Georgia reported the number of polling places in the state to the Election Administration and Voting Survey (EAVS) in 2006 and every two years afterwards, with the exception of 2012 (see Table EC.1). *VICE News* (Arthur and McCann (2018)) conducted a survey of all 159 counties to estimate the magnitude of polling place closures in Georgia and found that among the 84 that reported, the total number of polling places declined by 7.48% between the 2012 and 2016 presidential elections. We view that estimate as a lower bound because of potential reporting bias: counties that closed a substantial number of polling places may be less likely to respond to an informal survey. To provide another measure of closures, we define the imputed number of polling places in 2012 as $\widehat{PollPlaces}_{2012}$ and estimate it using Eq.1, which accounts for differences in turnout across elections (Fig.2) and expected growth. We find $\widehat{PollPlaces}_{2012} = 3,159$, which suggests there was a 13.90% decline in the number of polling places from 2012 to 2016 in Georgia. We conclude that Georgia was indeed treated with polling place closures.

$$\widehat{PollPlaces}_{2012} = \max\{PollPlaces_{2010}, PollPlaces_{2014}\} \times PollPlaces_{2008} / \max\{PollPlaces_{2006}, PollPlaces_{2010}\} \tag{1}$$

The DD method requires a control for the treated sample. We propose South Carolina as a control for Georgia in the DD for several reasons. First, Section 5 of the Voting Rights Act fully covered both Georgia and South Carolina prior to 2013. However, while the *Shelby County* v. *Holder* ruling allowed both states to close polling places without Department of Justice approval, state regulations in South Carolina discouraged closures in the state (The Leadership Conference Education Fund (2019)). Consequently, the total number of polling places in South Carolina (see Fig.3) remained relatively unchanged over the period of interest, increasing by just 0.91% between the 2012 and 2016 elections (according to the EAVS). Second, South Carolina is situated adjacent to Georgia in the Southern United States. States close in distance may be more likely to share

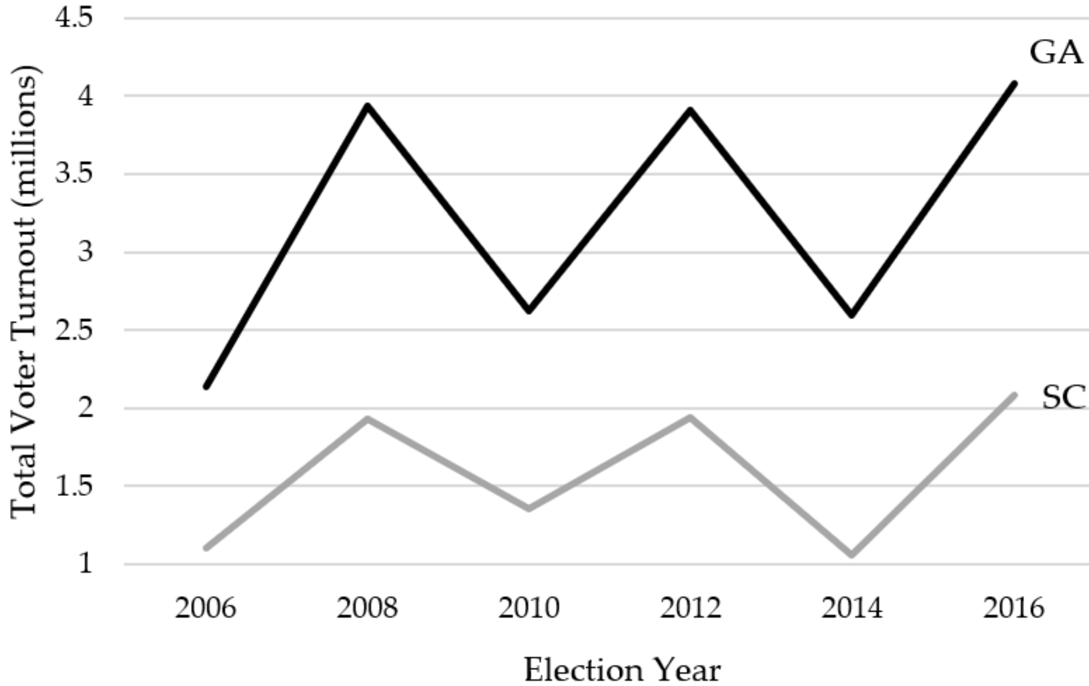

Figure 2 **Voter turnout in Georgia and South Carolina by election year**

similar characteristics (e.g., Card and Krueger (1994)). For example, Georgia and South Carolina may have similar voting cultures (as evidenced by each state's complete coverage under the Voting Rights Act prior to 2013) and Election Day weather which can impact voter behavior. Third, at least as early as 2006, according to the *Verified Voting Foundation*, Georgia and South Carolina use, throughout the entire state, direct-recording electronic (DRE) voting machines (rather than paper ballots for example) (See `https://www.verifiedvotingfoundation.org/about-vvf/` for more information on the *Verified Voting Foundation.*) Voting times on DREs can differ substantially from voting times on paper ballots within the same election (Stewart III (2015)), but that is not a concern in our study.

Eq.2 provides the specification for the DD estimation. $logWait_i$ is the log of the wait time in minutes reported by voter i in the 2006, 2008, 2012, or 2016 Cooperative Congressional Election Study (CCES) in response to the question *Approximately how long did you wait in line to vote.* (Data were not collected for this question in 2010). CCES samples from a 50,000+ pool of adults of which only a fraction vote. CCES is distributed nationwide proportional to the population. Respondents were allowed to choose from the following options: *Not at all*, *Less than 10 minutes*, *10 to 30 minutes*, *31 to 60 minutes*, and *More than 1 hour*. We coded the ranges as: Not at all - 1 minute, Less than 10 minutes - 5 minutes, 10 to 30 minutes - 20 minutes, and 31 to 60 minutes - 45 minutes. Respondents input custom times when the wait was more than one hour so these were manually coded. Because we are analyzing categorical, voter-reported wait times, there is an issue

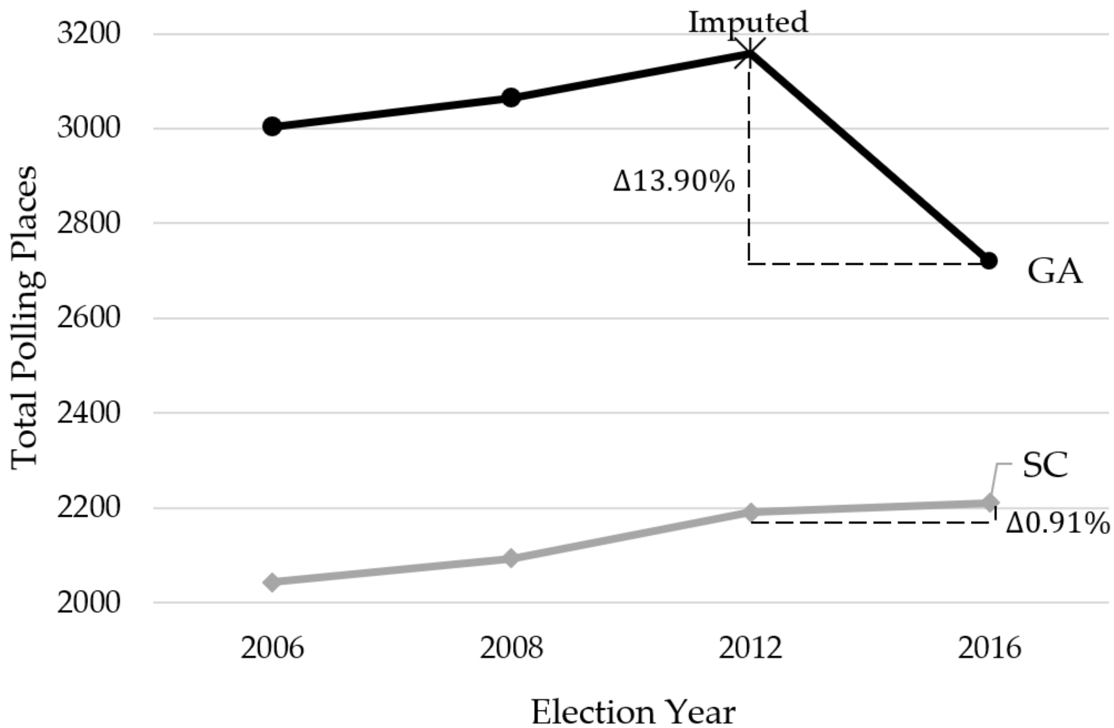

Figure 3 **Total polling places in Georgia and South Carolina across the 2006, 2008, 2012, and 2016 elections using $Poll\widehat{Places}_{2012}$ for Georgia in 2012**

of measurement error, but we do not believe that measurement error in Georgia or South Carolina should be systematically different in either of the states during the elections we study.

$$\begin{aligned} logWait_i = &\beta_0 + \beta_1 Treated_i + \beta_2 Election2006_i + \beta_3 Election2008_i + \beta_4 Election2016_i + \\ &\beta_5(Treated_i \times Election2006_i) + \beta_6(Treated_i \times Election2008_i) + \\ &\beta_7(Treated_i \times Election2016_i) + X_i^{'}\mu + \varepsilon_i \end{aligned} \tag{2}$$

$Treated_i$ is a dummy variable that equals one if voter i is located in Georgia where polling place closures occurred and zero if located in the control state, South Carolina, where polling place closures were prevented. $Election2006_i$, $Election2008_i$, and $Election2016_i$ are dummy variables that equal one in the specified election year and zero otherwise. *Election2006*, *Election2008*, and the excluded base election year 2012 are the pre-treatment elections while *Election2016* is the post-treatment election. (We ignored the 2010 pre-treatment election due to the data constraint described above.) $X_i^{'}$ is the vector of controls. ε_i is the error term, and we cluster these errors by county since county officials are primarily responsible for managing elections in each state (Georgia counties each have a Board of Elections, and South Carolina counties each have a Board of Voter

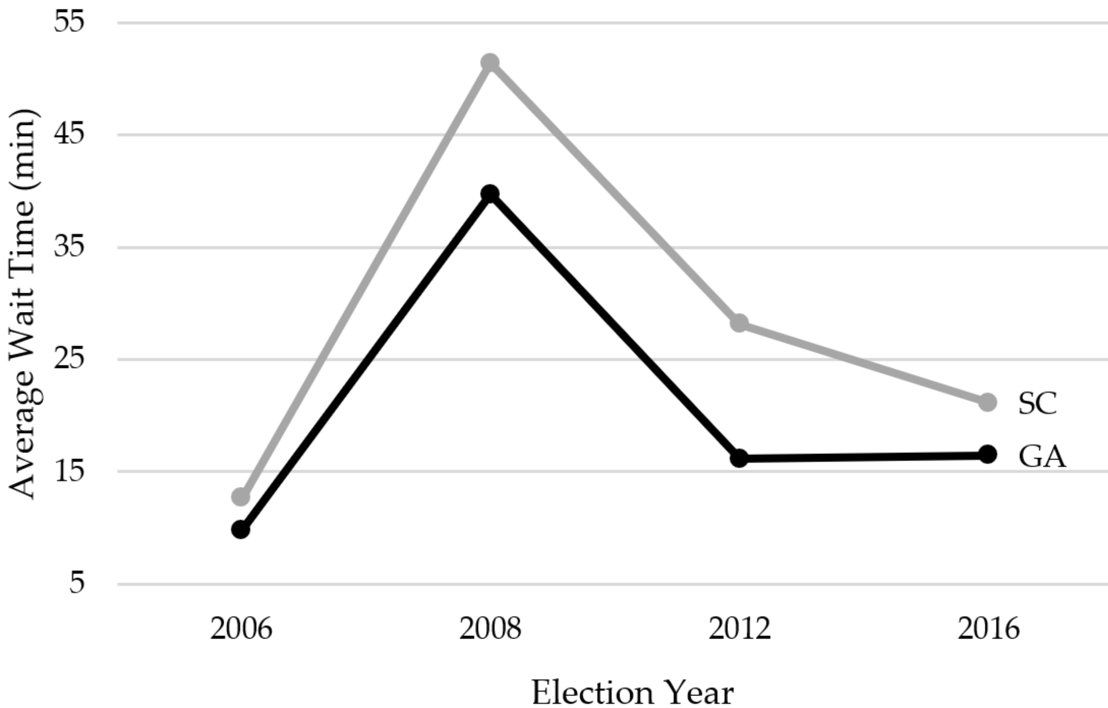

Figure 4 Average wait times (minutes) for Georgia and South Carolina in the 2006, 2008, 2012, and 2016 elections

Registration and Elections). β_7 is therefore our DD estimate of the impact polling place closures had on wait times in Georgia in the 2016 election. Section EC.1.1 has more information on the origin of the data used in this study.

If South Carolina is a valid control for Georgia in the DD estimation, its wait times, conditional on the regressors in Eq.2, should follow a parallel trend from 2006 to 2012 (i.e., before the *Shelby County* v. *Holder* ruling). Unconditional on any other variables, this appears to be visually confirmed in Fig.4. To perform the parallel trend assumption test statistically, however, the estimates for β_5 and β_6 in Eq.2 should not be statistically significant, suggesting there is a constant difference (or parallel trend) between Georgia and South Carolina's conditional wait times before treatment.

We include in Eq.2 several controls related to three main factors that influence wait times in elections: voter arrival variability, polling place capacity, and the overall demand to vote. (See Table EC.2 for a numerical summary of all controls).

Urban polling places may have more consistent voter arrivals throughout the day than rural polling places because residents in rural areas may have less access to their polling places throughout the workday. This could cause an arrival pattern in rural areas with larger spikes in demand throughout Election Day. Due to this potential rural versus urban effect, we include the control *logPplPerSqMi*, which is the log of the number of residents per square mile in voter i's county in the voter's election year.

We include several controls related to polling place capacity. In the United States, elections tend to be funded by counties, and as of 2018, the National Conference of State Legislator suggested that Georgia and South Carolina counties primarily funded general elections in the state (see `http://www.ncsl.org/research/elections-and-campaigns/election-costs.aspx`). We have no reason to believe that this funding model was not the same over the duration of our study. Thus, we include $logIncome$, which is the log of the median income in voter i's county and election year. We include $Pct65Plus$, the percentage of residents in voter i's county and election year who are 65 years or older, because counties with higher percentages of older voters may face different capacity constraints (Glenn and Grimes (1968)). Given the evidence that polling place capacity could be affected by the racial or political party composition of voters within various jurisdictions (Famighetti et al. (2014), Pettigrew (2017), Cachon and Kaaua (2019)), we include two related controls. $PctWhite$ is the percentage of white registered voters in voter i's county and election year. Georgia and South Carolina do not ask voters for political party affiliation on their voter registration forms and both states hold open primaries, but we still control for potential political party bias using a proxy for political party affiliation within a county. $PctDem$ is the percentage of voters in voter i's county who voted for the Democratic gubernatorial or presidential candidate in the previous election (relative to the voter i's election year).

The overall demand to vote is driven by two factors: the number of registered voters and the turnout percent of those registered voters. In Eq.2, we include controls related to the overall demand to vote. $RegVoters$ is the total number of active registered voters in voter i's county and election year. We also include the squared term of this variable (i.e., $RegVoters^2$) to account for the fact that wait times may increase exponentially at higher levels of voter demand. $Turnout$ is the percentage of voters who turned out to vote in voter i's county and election year. $EDTurnout$ is the turnout specifically on Election Day and is the total number of Election Day ballots cast divided by the total number of active registered voters in voter i's county and election year. $RegVoters$, $Turnout$, and $EDTurnout$ also control for key legislative changes that occurred in Georgia and South Carolina over the time of our study which may have impacted the general demand to vote.

Brennan Center for Justice listed the key voting restrictions states have implemented in the recent past (Weiser and Feldman (2018)), and they are shown verbatim for Georgia and South Carolina in Table EC.3. In 2006, the state of Georgia attempted to enact a law that would have required voters to present photo identification to vote. This law was blocked for the 2006 election but was upheld in 2007 (see `https://www.brennancenter.org/legal-work/common-causegeorgia-v-billups`). This legislative change may have reduced voter turnout, so $Turnout$, and $EDTurnout$ should control for its effect.

In 2009, Georgia required voter registration applicants to provide documents proving citizenship. This more stringent voter registration requirement could have reduced the pool of registered voters. Therefore, $RegVoters$ should control for this law's effects.

Before the 2010 election, Georgia implemented a law shortening the number of early voting days. This legislative change may have reduced voter turnout in general and shifted more voting demand to Election Day. $Turnout$ and $EDTurnout$ should control for the effect of this change.

In *South Carolina* v. *Holder*, plaintiffs aimed to block a South Carolina law (proposed to the U.S. Department of Justice for approval in 2011) requiring voters to have photo identification to vote. (See `https://www.brennancenter.org/legal-work/south-carolina-v-holder` for more information on *South Carolina* v. *Holder*.) The law was not implemented in the 2012 election and voters were still able to use a non-photo voter registration card in future elections. Although we believe that this law should not have had a significant impact on voter turnout in the 2016 election, we still control for the change in legislation with $Turnout$, and $EDTurnout$.

From 2013 until two months before the 2016 election, Georgia implemented a "no match, no vote" policy and did not process voter registrations for applicants who did not have information on the application matching information in the state's databases (J.E.F. (2018)). During that time, thousands of voter registration applications were not processed which could have reduced the number of registered voters for the 2016 election. $RegVoters$ should control for this policy's effects.

Fig.4 shows that the average wait time for South Carolina decreased from 2012 to 2016, while the wait time for Georgia slightly increased over the same time period. This suggests that polling place closures in Georgia resulted in an increase in wait times in the 2016 election. However, the figure shows unconditional wait times. More convincing evidence is a positive and statistically significant estimate for β_7 in Eq.2, which would indicate that the increase in wait times in Georgia is associated with polling place closures. An increase (given the controls for turnout and others), would suggest that Georgia did not implement a capacity pooling strategy, i.e., polling place closures occurred with a reduction in overall capacity, either because the freed capacity was redistributed unevenly, or mothballed, or both.

3. Results and Robustness Checks

Using ordinary least squares regression, we estimated the DD specification in Eq.2, and the results are displayed in Fig.5 and Table EC.4. We first note that there is evidence that the parallel trends assumption is satisfied in our regression with insignificant, small coefficients on ($Treated \times Election2006$) and ($Treated \times Election2008$). In Fig.5, we see that the difference in $logWait$ for Georgia and South Carolina (i.e., the treatment effect), conditional on all other regressors, looks

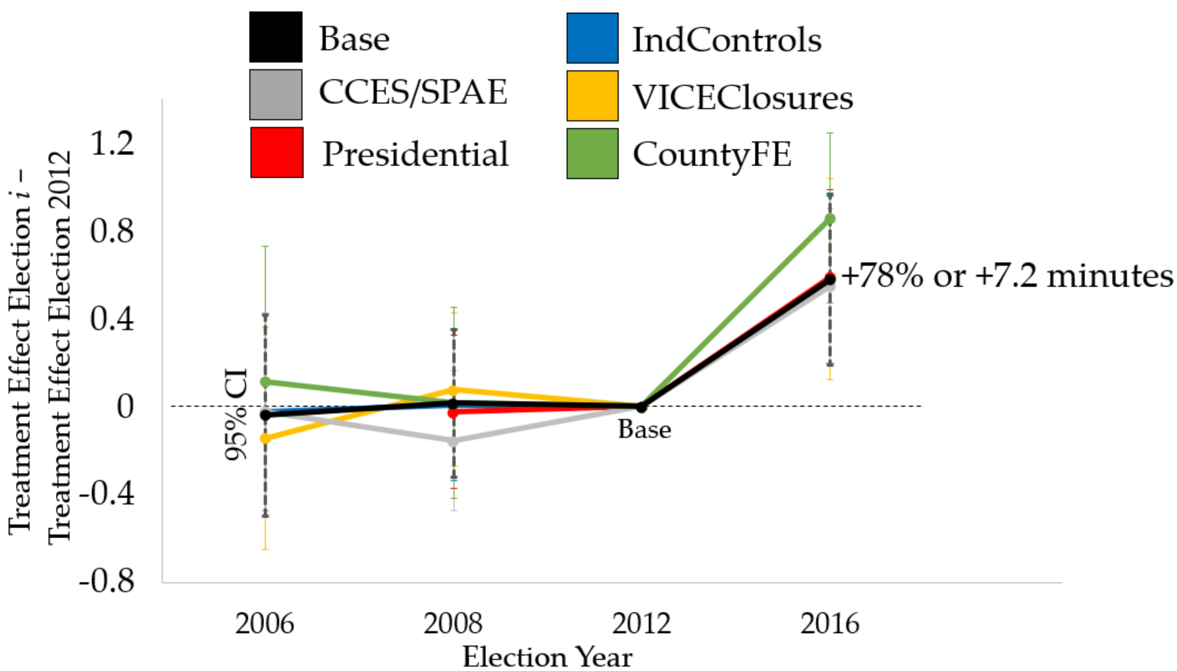

Figure 5 **Treatment effect in election i (where $i = 2006, 2008, 2016$) minus the treatment effect in the 2012 election**

statistically identical in 2006, 2008, and 2012, suggesting a parallel trend. We therefore assume that South Carolina is a good control for Georgia.

Our results show a statistically significant DD estimate of $\beta_7 = 0.578$, and Fig.5 displays the confidence interval around the treatment effect. According to this estimate, the average wait time in Georgia in 2016 was $1 - e^{0.578} = 78\%$ higher due to polling place closures. From the CCES data, the average wait time in Georgia in 2016 was 16.5 minutes, suggesting that the increase in wait time resulting from polling place closures was about 7.2 minutes $(16.5 - 16.5/1.78)$. In addition, we believe that this result may be a conservative estimate given that we include in our analysis all counties in Georgia rather than focusing only on counties that closed polling places (due to limitations in the data discussed above to identify these counties).

An increase in average wait time in the 2016 election is not consistent with the implementation of a capacity pooling strategy, which would predict a reduction in average wait times. Instead, the increase in the time to vote in Georgia is consistent with administrators who either reallocated the capacity and resources from closed polling locations to a limited set of the maintained locations, or more likely, a reduction in the overall voting resources in the state. Therefore, polling place closures in Georgia in the 2016 election may have not only disenfranchised voters due to the longer average distances needed to travel to vote, but also due to the longer wait times once at the polling places.

We performed five robustness checks to support our results, and they are described below. The results in Fig.5 and Table EC.4 show that all passed the parallel trends test and had similar results to the base regression's DD estimator.

(1) CCES/SPAE: We combine the CCES wait data with data from the Survey of the Performance of American Elections (SPAE). Each survey requests voters to estimate their wait times using the same question (although the sampling methodology differs). Initiated in 2008, SPAE samples 200 registered voters in each state of which a fraction vote, and it is distributed within states proportional to the population (see `https://dataverse.harvard.edu/dataverse/SPAE`). See Table EC.5 for the number of wait time observations in the CCES and SPAE surveys in each election.

(2) Presidential: In Eq.2, we calculate the DD estimate for a presidential election year (2016) using a midterm election (2006) in the pre-treatment period. Presidential elections tend to have higher turnout relative to midterm elections (see Fig.2), and states have more of an incentive to maximize voter capacity in presidential elections. Therefore, voter wait times across Georgia and South Carolina may follow more uniform pre-treatment trends across presidential elections and provide a more accurate estimate of the treatment effect in the 2016 election. We therefore remove Election2006 and ($Treated \times Election2006$) from Eq.2 and perform our DD estimation on observations from the 2008, 2012, and 2016 elections.

(3) IndControls: In the base regression, all controls are at the county level. We therefore add additional controls to Eq.2 specific to each respondent in the CCES survey. The controls are as follows: whether the respondent identified as white ($White$); whether the respondent identified as male ($Male$); age of the respondent at the time of the Election (Age); whether the respondent identified as a Democrat (Dem); whether the respondent identified as an Independent (Ind); whether the respondent's family income was $100,000 or more ($HighInc$); whether the respondent had some college education but not necessarily a college degree ($College$). See Table EC.6 for summary statistics on all the individual-level controls.

(4) VICEClosures: Because Georgia did not report any polling place counts for EAVS in 2012, we conduct a robustness check only on those counties which *VICE News* (Arthur and McCann (2018)) found to have closed polling places between 2012 and 2016. We therefore exclude all observations from Georgia counties that did not meet this criteria.

(5) CountyFE: To control for any potential county fixed effects, we add dummy variables for each voter's county to Eq.2.

4. Discussion and Conclusion

We find that polling place closures substantially increased wait times in Georgia in the 2016 election. In addition, our result suggests that the state did not pursue a capacity pooling strategy and probably had a significant amount of voting resources that were idle or reduced during the election. When this result is coupled with the fact that voters in Georgia may have needed to travel longer distances to vote due to polling place closures, voter disenfranchisement becomes a twofold concern. Moreover, the poor service experience voters may have had in the 2016 election due to polling place closures could have discouraged them from voting in the 2018 election (e.g. Cottrell et al. (2017))

Evidence suggests that the Georgia Secretary of State's office (which was under Republican leadership at the time) promoted "consolidation" to all local election officials, and counties with specific demographics (e.g., those with more minority voters) were not explicitly targeted. However, polling place closure strategies are likely to be more attractive in poorer counties where election budgets may be tighter and voters may be less likely to protest such changes (Mohai and Saha (2015)). In addition, following polling place closures, poorer counties may find a non-pooling strategy attractive given that a pooling strategy incurs larger administrative costs associated with finding new polling places (that can accommodate more voting machines) and larger labor costs (i.e., more poll workers).

We conducted a county-level analysis (see Section EC.1.2 and Table EC.8) to identify the characteristics of the counties we were able to confirm closed polling locations before the 2016 election (relative to the 2008 presidential election). Racial composition of voters and political party measures do not predict the counties with closures. Instead, we find that a county's average income is the only significant ($p<0.05$) predictor of closures between the two elections (see Table EC.8). If Democrats tend to be over-represented among lower income voters (Pew Research Center (2016)), then promoting polling place closures without encouraging capacity pooling could help Republicans overall. Furthermore, if Democrats are more sensitive than Republicans to voting costs (Brady and McNulty (2011)) such as wait times at the polls (e.g., due to the lost income associated with voting relative to overall wealth), then Republicans could gain an advantage through longer wait times to vote even if polling place closures occurred randomly across the state. In other words, a party could gain an advantage from a policy that encourages fewer polling places even if such a policy does not focus on areas with a higher concentration of voters from the opposition.

Given our research findings, Georgia policymakers may be interested to determine whether voting resources, such as DREs, were idle in the 2016 election, and if so, why they were idle. Operational transparency can increase trust in government (Buell et al. (2018)), so Georgia policymakers could consider implementing laws promoting transparency in how voting resources are being utilized in elections. Furthermore, Georgia policymakers may also consider implementing legislation requiring the redistribution of all functioning voting machines from closed polling places to reduce the chances of voter disenfranchisement from waiting times at the polls.

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Supplementary Information

EC.1. Supporting Information Text

EC.1.1. Data Sources

logWait

Cooperative Congressional Election Study (CCES) publishes its survey results in each election (see `https://cces.gov.harvard.edu/`). Note, there was one respondent in the 2008 CCES survey who reported a wait time greater than an hour but then wrote "got early in the morning at 6am" when specifying his wait time. We excluded this observation from the analysis. Survey of the Performance of the Performance of American Elections (SPAE) publishes its survey results in each election (see `https://dataverse.harvard.edu/dataverse/SPAE`). One respondent in the 2008 SPAE survey reported a wait time greater than an hour but wrote "I got to there an hour before they opened but once the polls opened I waited und" when specifying his wait time. We excluded this observation from the analysis.

PctWhite

Georgia's Secretary of State publishes information by county on the number of white registered voters and the number of total registered voters in each election (see `http://sos.ga.gov/index.php/Elections/voter_turn_out_by_demographics`). South Carolina Election Commission provided voter registration tallies by race as of the following dates: January 1, 2006; October 25, 2008; October 26, 2012; and October 28, 2016.

PctDem

Georgia's Secretary of State publishes information on current and past election results (see `http://sos.ga.gov/index.php/Elections/current_and_past_elections_results`). South Carolina Election Commission publishes information on current and past election results (see `https://www.scvotes.org/election-returns-primaries-and-general-elections-statewide`).

RegVoters

Election Administration Voting Survey (EAVS) provides county-level information on the number of active registered voters from question A3 or equivalent (see `https://www.eac.gov/research-and-data/election-administration-voting-survey/`).

Turnout, Voters

Georgia's Secretary of State publishes information by county on the number of registered voters and the number who voted in each election (see `http://sos.ga.gov/index.php/Elections/voter_turn_out_by_demographics`). South Carolina Election Commission publishes information by county on the number of registered voters and the number who voted in each election (see `https://www.scvotes.org/data/voter-history.html`).

EDTurnout

EAVS provides county-level information on the number of ballots cast on Election Day from question F1 or equivalent (see `https://www.eac.gov/research-and-data/election-administration-voting-survey/`). (Note, for Georgia, the 2016 EAVS survey data for section F listed McDuffie County and McIntosh County twice and did not list Meriwether County or Miller County. However, the responses to the questions in the survey for the second instances of McDuffie and McIntosh counties are different from the first instances. Based on data from other years in the survey, we determined that the second instance of McDuffie County was Meriwether County and the second instance of McIntosh County was Miller County.) EAVS also provides county-level information on the number of active registered voters from question A3 or equivalent (see `https://www.eac.gov/research-and-data/election-administration-voting-survey/`).

logPplPerSqMile

U.S. Census Bureau publishes information by county on the intercensal estimates of the resident population (see `https://www.census.gov/data/tables/time-series/demo/popest/intercensal-2000-2010-counties.html` for 2000 to 2010 estimates and report ID PEPANNRES at `https://www.census.gov/programs-surveys/acs/` for 2010 to 2016 estimates). U.S. Census Bureau also publishes information on the total square mileage in a county in 2010 (see `https://www.census.gov/quickfacts/fact/note/US/LND110210`).

logMedInc

U.S. Census Bureau collects county-level information on median household income in its Small Area Income and Poverty Estimates (see `https://www.census.gov/programs-surveys/saipe.html`).

Pct65Plus

U.S. Census Bureau collects county-level information on age and publishes its estimates in report ID S0101 (see `https://www.census.gov/programs-surveys/acs/`). For all counties which an estimate was not available in 2006, the 2008 estimate was used.

PollPlaces

EAVS provides county-level information on the number of polling places in an election from question D2 or equivalent (see `https://www.eac.gov/research-and-data/election-administration-voting-survey/`).

White, Male, Age, Dem, Ind, HighInc, College

CCES provides demographic information on survey respondents (see `https://cces.gov.harvard.edu/`).

PctDriveAlone

U.S. Census Bureau collects county-level information on the percent of the population that drives to work alone and publishes its estimates in report ID S0801 (see `https://www.census.gov/programs-surveys/acs/`). Data was not available in 2008, so 2009 data was used as a proxy.

EC.1.2. County-Level Analysis of Predictors of Polling Place Closures

To analyze the predictors of polling place closures in Georgia, we first defined a closure as occurring in a county if the number of polling places declined in the 2016 presidential election relative to the 2008 presidential election according to the EAVS data. We created a dependent variable, *Closure*, which equaled 1 if county i experienced closures in the 2016 election (relative to 2008) and 0 otherwise. See Fig.EC.1 for all counties that experienced closures according to our definition.

We then ran a cross-sectional logistic regression (see Eq.EC.1) using predictors of closures in 2016 (relative to 2008) specified in Table EC.7 based on data election managers could reasonably observe prior to the 2016 election. Note that we introduce a new variable, *PctDriveAlone*, as a predictor which is the percentage of the population which drives to work alone. We believe that public transportation accessibility could play a role in whether counties close polling places.

The results of our analysis can be seen in Table EC.8.

$$
\begin{aligned}
Closure_i = & \gamma_0 + \gamma_1 logMedInc16_i + \gamma_2 Pct\Delta MedInc0816_i + \gamma_3 PctWhite12_i + \gamma_4 Pct\Delta PctWhite0812_i + \\
& \gamma_5 PctDem12_i + \gamma_6 Pct\Delta PctDem0812_i + \gamma_7 logRegVoters16_i + \gamma_8 Pct\Delta RegVoters0816_i + \\
& \gamma_9 Turnout12_i + \gamma_{10} Pct\Delta Turnout0812_i + \gamma_{11} EDTurnout12_i + \gamma_{12} Pct\Delta EDTurnout0812_i + \\
& \gamma_{13} logPplPerSqMile_i + \gamma_{14} Pct\Delta PplPerSqMile0816_i + \gamma_{15} Pct65Plus16_i + \\
& \gamma_{16} Pct\Delta Pct65Plus0816_i + \gamma_{17} PctDriveAlone16_i + \gamma_{18} Pct\Delta PctDriveAlone0916_i + \epsilon_i
\end{aligned}
\tag{EC.1}
$$

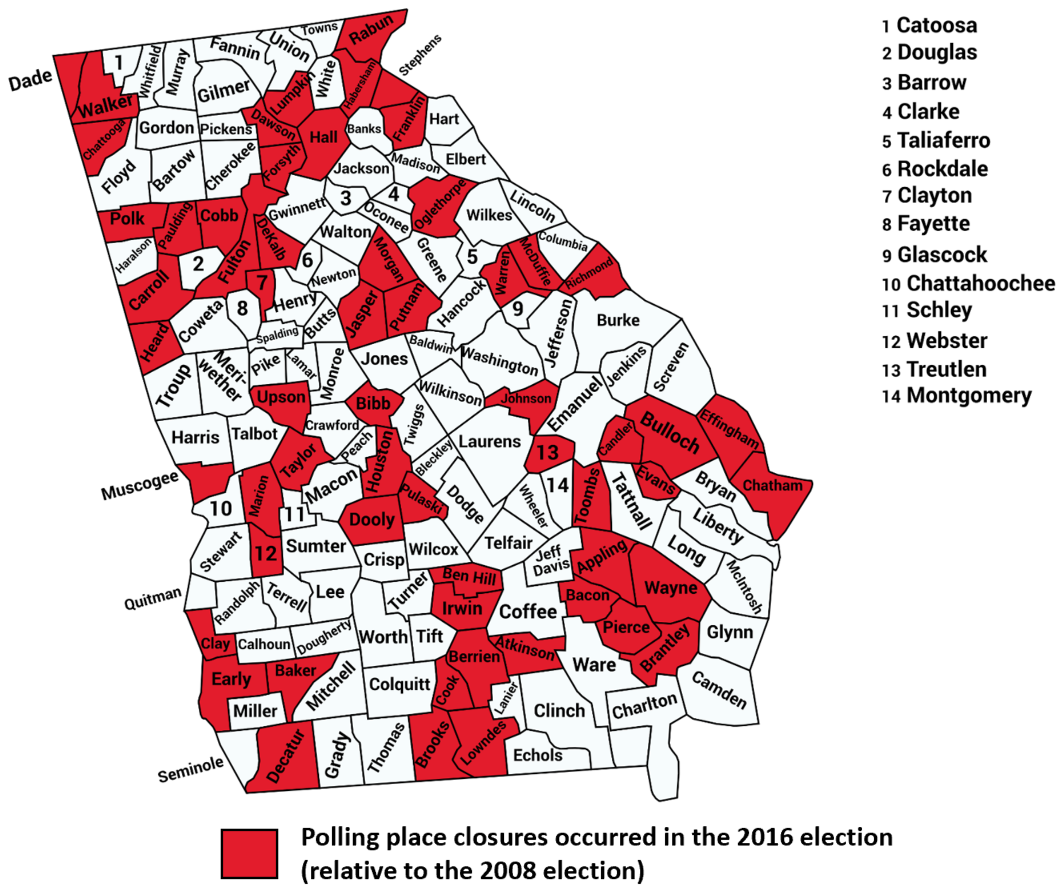

Figure EC.1 **Where polling place closures occurred in Georgia counties in the 2016 election (relative to the 2008 election) (figure created courtesy of** `https://mapchart.net/`**)**

EC.2. Tables

Table EC.1 Total number of polling places in Georgia and South Carolina for the 2006 to 2016 elections as reported in the EAVS

Election Year	Polling Places GA	Polling Places SC
2006	3003	2044
2008	3064	2094
2010	2831	2191
2012	n.a.	2191
2014	3096	1929
2016	2720	2211

Table EC.2 Summary of the dependent variable and controls across elections 2006, 2008, 2012, and 2016

Statistic	Wait	PctWhite	PctDem	RegVoters	Turnout	EDTurnout	PplPerSqMi	Income	Pct65Plus
Mean	21.78	64.01	42.68	185610	68.25	40.51	798.05	51306	11.91
Std. Dev.	34.18	18.15	15.97	171402	10.44	10.87	830.67	11878	3.58
Minimum	1	12.69	12.21	1743	34.77	14.27	9.67	25633	2.60
Maximum	360	99.44	82.70	595979	85.48	68.90	2753.89	101804	33.10
25th%ile	5	48.41	31.76	49861	65.84	32.74	172.26	41543	9.10
50th%ile	5	68.23	39.37	112696	71.66	39.49	403.74	50427	11.50
75th%ile	20	77.90	53.16	316917	75.05	46.63	1694.83	58167	13.90

Table EC.3 Voting restrictions implemented in Georgia and South Carolina in the recent past according to Brennan Center for Justice (Weiser and Feldman (2018))

State	Voting Restrictions
GA	“No match, no vote” limit on access to voter registration (2017 law)
	Reduced early voting period (2010 law)
	Documentary proof of citizenship to register (2009 law)
	Strict voter ID requirement (2006 law)
SC	Voter ID requirement (2011 law, mitigated after lawsuit)

Table EC.4 Regression results

DV: logWait	Base	CCES/SPAE	Presidential	IndControls	VICEClosures	CountyFE
Treated	-0.280	-0.332	-0.195	-0.286	-0.179	0.038
	(0.221)	(0.214)	(0.218)	(0.218)	(0.245)	(0.373)
Election2006	-1.206***	-1.268***		-1.255***	-1.527***	-0.232
	(0.322)	(0.292)		(0.323)	(0.407)	(0.459)
Election2008	0.970***	1.006***	1.030***	0.956***	1.109***	0.983***
	(0.145)	(0.140)	(0.146)	(0.145)	(0.152)	(0.207)
Election2016	-0.423**	-0.403**	-0.434**	-0.452**	-0.534***	-0.738***
	(0.178)	(0.157)	(0.184)	(0.178)	(0.178)	(0.204)
Treated x Election2006	-0.039	-0.022		-0.023	-0.144	0.116
	(0.232)	(0.229)		(0.229)	(0.256)	(0.313)
Treated x Election2008	0.016	-0.154	-0.023	0.008	0.078	0.018
	(0.171)	(0.162)	(0.178)	(0.175)	(0.177)	(0.221)
Treated x Election2016	0.578***	0.552***	0.593***	0.588***	0.583**	0.862***
	(0.197)	(0.178)	(0.203)	(0.198)	(0.231)	(0.197)
County-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Individual-level controls	No	No	No	Yes	No	No
County fixed effects	No	No	No	No	No	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.145	0.149	0.164	0.150	0.152	0.210
Number of observations	5091	6235	4195	5091	4459	5091

*p<0.1, **p<0.05, ***p<0.01
Standard errors clustered by county in parentheses

Table EC.5 Number of logWait observations by state and election year for the CCES and SPAE surveys

State	Survey	2006	2008*	2010†	2012	2014‡	2016
Georgia	CCES	617	541	0	1093	n.a.	1201
	SPAE	n.a.	344	0	170	n.a.	163
South Carolina	CCES	279	279	0	559	n.a.	522
	SPAE	n.a.	156	0	160	n.a.	161

*In 2008, SPAE sampled an additional 200 registered voters in Georgia by phone
†CCES did not collect wait time observations in 2010 and SPAE was not conducted
‡2014 election was not applicable to our study

Table EC.6 Summary of the individual-level controls across elections 2006, 2008, 2012, and 2016

Statistic	White	Male	Age	Dem	Ind	HighInc	College
Mean	0.72	0.47	51.28	0.31	0.28	0.18	0.73
Std. Dev.	0.45	0.5	15.19	0.46	0.45	0.39	0.44
Minimum	0	0	18	0	0	0	0
Maximum	1	1	92	1	1	1	1

Table EC.7 Predictors of polling place closures between 2008 and 2016

Predictors	**Description**
logMedInc16	logMedInc in 2016
Pct∆MedInc0816	Percentage change in non-logged MedInc between 2008 and 2016
PctWhite12	PctWhite in 2012
Pct∆PctWhite0812	Percentage change in PctWhite between 2008 and 2012
PctDem12	Contemporaneous values of PctDem in 2012
Pct∆PctDem0812	Percentage change in contemporaneous values of PctDem between 2008 and 2012
logRegVoters16	Log of RegVoters in 2016
Pct∆RegVoters0816	Percentage change in RegVoters between 2008 and 2016
Turnout12	Turnout in 2012
Pct∆Turnout0812	Percentage change in Turnout between 2008 and 2012
EDTurnout12	EDTurnout in 2012
Pct∆EDTurnout0812	Percentage change in EDTurnout between 2008 and 2012
logPplPerSqMile16	logPplPerSqMile in 2016
Pct∆PplPerSqMile0816	Percentage change in non-logged PplPerSqMile between 2008 and 2016
Pct65Plus16	Pct65Plus in 2016
Pct∆Pct65Plus0816	Percentage change in Pct65Plus between 2008 and 2016
PctDriveAlone16	PctDriveAlone in 2016
Pct∆PctDriveAlone0916	Percentage change in PctDriveAlone between 2009 and 2016

Table EC.8 County-level analysis of predictors of polling place closures in the 2016 presidential election (relative to the 2008 presidential election)

DV: Closure	Estimates
logMedInc16	-4.307**
	(2.052)
PctΔMedInc0816	-0.006
	(0.032)
PctWhite12	0.063
	(0.057)
PctΔPctWhite0812	0.054
	(0.089)
PctDem12	0.041
	(0.057)
PctΔPctDem0812	0.002
	(0.046)
logRegVoters16	0.237
	(0.473)
PctΔRegVoters0816	0.007
	(0.019)
Turnout12	0.128*
	(0.073)
PctΔTurnout0812	-0.010
	(0.052)
EDTurnout12	-0.009
	(0.029)
PctΔEDTurnout0812	-0.022
	(0.015)
logPplPerSqMile16	0.416
	(0.490)
PctΔPplPerSqMile0816	-0.001
	(0.042)
Pct65Plus16	-0.121
	(0.080)
PctΔPct65Plus0816	0.010
	(0.018)
PctDriveAlone16	0.011
	(0.049)
PctΔPctDriveAlone0916	-0.021
	(0.026)
Constant	Yes
Pseudo R^2	0.083
Number of observations	159

*p<0.1, **p<0.05, ***p<0.01
Standard errors in parentheses

References

Weiser W, Feldman M (2018) The state of voting 2018. *Brennan Center for Justice* at New York University, https://www.brennancenter.org/publication/state-voting-2018.