Polling Place Location and the Costs of Voting

Gaurav Bagwe
Georgetown University

Juan Margitic*
Georgetown University

Allison Stashko
University of Utah

Job Market Paper

December 14, 2020

Please check here for latest version

Abstract

Surprisingly little is known about the location of polling places across the United States and their effect on turnout. To fill this gap, we acquire voter registration data, voting history data, and polling locations for over 15 million voters from Pennsylvania and Georgia. Using a precinct border discontinuity design, we find small average effects of a voter's distance to the polling place on turnout, but considerable heterogeneity. A one mile increase in distance to polling place decreases the likelihood of voting by up to 1.2 p.p., but by up to 27.6 p.p. in areas where eligible voters rely on public transportation to go to work. The availability of no excuse vote by mail may help to substantially attenuate the reduction in turnout caused by distance to the polling place.

JEL Classification: D72, H70, K16
Keywords: Polling Places, Voting Precincts, Costs of Voting

*Juan Margitic (Job Market Paper), corresponding author at jfm114@georgetown.edu. Department of Economics, Georgetown University, 37th & O Streets NW, Washington, DC 20057.

1 Introduction

The 2020 U.S. elections have set the public's eyes on the influence of electoral design on turnout. State and local government decisions regarding early voting, (Kaplan and Yuan 2020), mail-in voting (Meredith and Endter 2016; Meredith and Malhotra 2011; Lockhart et al. 2020; Thompson et al. 2020), and at-poll voting requirements (Highton 2017; Cantoni and Pons 2019) can each potentially have important consequences for voter participation. Even small changes to the convenience or cost of voting can determine whether or not someone votes, especially in large elections (Gomez et al. 2007; Braconnier et al. 2017).

This paper focuses on a particular cost of voting: the distance from a voter's home to their polling place. Distance to the polling place is an essential determinant of voting behavior to study for three reasons. First, this cost of voting cannot be eliminated, unless we remove polling places altogether. Despite the rise in convenience voting, three-quarters of voters still chose to vote at polls on election day in the 2018.[1] Even during the pandemic of the 2020 election cycle, 34 million voters were not able to vote by mail without a state-approved excuse.[2] Second, the distance to polling place is unevenly distributed among the population of eligible voters. If a particular group faces higher costs of voting such that they are less likely to vote, then politicians may ignore their interests (Avery 2015; Martin 2003). In particular, it is important to understand if the distance to polling place varies systematically by race of eligible voters, given the history of voter suppression in the United States. The locations of polling places may also advantage one political party over another. Third, the distance between voters and their polling place is an outcome of electoral design. State and local lawmakers determine how to divide a state into precincts and where to locate a polling place within precincts. A detailed understanding of how polling place locations affect voter participation would be the first step in determining the optimal number and distribution of polling places.

Existing estimates of the effect of distance to polling places on voting vary widely. Three papers use a causal identification strategy.[3] Most recently, Cantoni (2020) uses a border discontinuity approach, which exploits the fact that residents on either side of a voting precinct border are plausibly similar, but differ in their polling place. Using

[1] Election Administration and Voting Survey: 2018 Comprehensive Report. `https://www.eac.gov/sites/default/files/eac_assets/1/6/2018_EAVS_Report.pdf` Retrieved November 11, 2020.

[2] `https://www.washingtonpost.com/graphics/2020/politics/vote-by-mail-states/` "At least 84% of American voters can cast ballots by mail in the fall", *The Washington Post*. Retrieved September 25, 2020.

[3] Other published studies on the distance to polling place find a negative association with turnout. Dyck and Gimpel (2005) find that distance to polling place is associated with lower turnout and more mail-in voting in a study of Clark County, Nevada. Haspel and Gibbs Knotts (2005) find a negative and non-linear relationship in an Atlanta mayoral election.

data from nine urban municipalities in Massachusetts and Minnesota, Cantoni finds large effects: a mile increase in distance to polling place reduces turnout by 8 to 14.5 percentage points. Clinton et al. (2019) use a panel of voters from North Carolina to study how voting behavior changes as polling places change over time. They find no effect of distance to polling place on turnout: as distance to a polling place increases, voters substitute to early voting such that there is no overall change in turnout. Finally, Brady and McNulty (2011) study precinct consolidations in Los Angeles County using matching methods. They find smaller effects: a mile increase in distance to the polling place reduces turnout by 4 percentage points. Several studies find an additional search cost associated with a change in polling place location (Clinton et al. 2019, Yoder 2018).

These findings underscore the need for a more comprehensive study of polling places in the United States and their effect on turnout. One hypothesis is that the range of results reflect heterogeneous effects, given that each study uses data from a different location. Moreover, we know that there are large location and election-specific effects on voting behavior (Cantoni and Pons 2019). However, there is also no overlap in methodologies used across studies, making comparisons difficult.

To help fill this gap, we collect information about the distance to polling place and turnout for over 15 million voters in two large and diverse states, Pennsylvania and Georgia. Simply regressing the likelihood of voting on distance to the polling place would not credibly allow us to uncover the true causal effect of distance. One possible source of bias could be that voters who choose to live closer to schools or government buildings, which are often used as polling locations, may be systematically different to those who don't. Hence, to credibly estimate the effect of distance to the polling place on voting behavior, we use the border discontinuity approach of Cantoni (2020). We choose to use this methodology because the identifying assumptions are plausible. Additionally, given that the results in Cantoni (2020) are significantly larger than other estimates, using the same methodology allows us to directly compare our the results to the ones in that paper. The border discontinuity approach relies on the assumption that voters who live near to precinct borders are similar, except that they are assigned to different polling places and thus face different distances to the polling place. Any factors possibly correlated with turnout should be continuous across the border, whereas the distance to a polling place is discontinuous at the border. We use a sample of voters who live within 0.05 miles (about 160 feet or 80 meters) of a voting precinct border. We are careful in eliminating all precinct borders that overlap with other important boundaries like those for school districts, towns, or legislative districts. The remaining precinct borders play no role other than determining where people vote on election day.

We supplement the individual-level analysis with block-level analysis by aggregating the data to the Census block level and measuring turnout with respect to the voting age population of the block. Since distance to polling place may affect the likelihood that an individual registers to vote, the aggregation alleviates concerns about potential sample selection bias (Cantoni 2020).

We find that, on average, a one mile increase in the distance to polling place decreases the likelihood of voting at polls by 0.45 to 1.72 percentage points (p.p.). In Georgia, the decrease in voting at polls is matched with an increase in voting by mail of the same magnitude. There, a one mile increase in distance to polling place leads to an increase in the likelihood of voting by mail by up to 1.91 p.p.. Overall, there is a null effect of the distance to polling place on the likelihood of voting in Georgia. Although the effects of distance to polling place on the likelihood of voting at the polls is strikingly similar in Pennsylvania and in Georgia, the substitution to mail-in voting is substantially smaller in Pennsylvania. This is likely due to the different policies about absentee ballots across the two states. In 2018, Pennsylvania required an excuse for a voter to vote by mail, whereas any registered voter could request to vote by mail in Georgia. In Pennsylvania, a one mile increase in distance to polling place increases the likelihood of voting by mail by only 0.23 p.p.. Due to the small effect on mail in voting in Pennsylvania, there is a net negative effect of distance to polling place on the likelihood of voting overall. A one mile increase in distance to polling place decreases the likelihood of voting by 1.23 p.p. in the primary election and 0.99 p.p. in the general election.

Overall, our main estimates are an order of magnitude smaller than those from the urban areas of Massachusetts and Minnesota (Cantoni 2020) and are more in line with those from Los Angeles and North Carolina (Clinton et al. 2019; Brady and McNulty 2011). However, the average effects mask significant heterogeneity. We find significantly different estimates, for instance, when restricting attention to the three largest urban areas in our sample (Atlanta, Philadelphia, and Pittsburgh). In Atlanta, a larger distance to polling place induces a decrease in at-poll voting (and an increase in mail-in voting) that is up to 90% larger than the average statewide estimates suggest. Because our methodology closely follows that of Cantoni (2020), location-specific factors and heterogeneous effects likely explain the wide variance in estimated effect sizes. To demonstrate, we show that point estimates from Georgia and Pennsylvania are similar to those found in Cantoni 2020 when we use propensity score matching to construct a samples that are comparable based on observable characteristics. We then turn to heterogeneous effects analyses to better understand what factors explain the large differences in sensitivity to polling locations across different cities and towns.

The analysis of the two large states allows us to explore heterogeneous effects by de-

mographic characteristics, economic variables, party affiliation, and mobility patterns. Differences in the sensitivity of voting behavior to polling place location are minimal when we compare groups by age, sex, race, or ethnicity. Registered Democrats and Republicans also respond similarly to distance to polling place, though both are more sensitive than registered Independents. In Georgia, voters in areas with higher educational attainment are more likely to substitute from voting at polls to voting by mail than voters in areas with lower educational attainment. Finally, in both states, we find that means of transportation is a particularly important in explaining effect heterogeneity. In areas where a large share of the population relies on public transportation to commute to work, a one mile increase in distance to polling place decreases turnout by up to 28 p.p..

Our findings highlight some important lessons for studies of polling places in the future. First, the importance of polling place locations for voter participation will vary depending on the constituency affected. If the affected population largely owns cars and drives to work, then a one mile increase in distance to a polling place will have no meaningful effect. On the other hand, a small change to a polling place in an area where people rely on public transportation can have significant effects on turnout.

Pennsylvania and Georgia also offer two comparison points for electoral design. Pennsylvania requires an excuse for a registered voter to vote by mail (absentee voting) and offers no early voting, while Georgia does not require any excuse for voting by mail and does have early voting. In Georgia, we find that no-excuse mail-in voting is likely important for mitigating the cost of travelling to a polling place. A longer distance to the polling place makes a voter in Georgia less likely to vote at polls and more likely to vote by mail. In Pennsylvania, by contrast, very few voters appear to substitute to mail-in voting when they are deterred by the distance to the polling place. Importantly, the sensitivity to distance to polling place in each state is very similar, on average. Distance to polling place appears to deter voters from voting at polls, regardless of whether or not there is a convenient alternative method of voting.

In recent years, decisions to close or move polling places have come under increased scrutiny due to concerns over voter suppression.[4] Related to these concerns, recent studies show that Black voters are more likely to experience longer waiting times at polls (Chen et al. 2019) and are more likely to have their mail-in ballots rejected (Enrijeta Shino and Smith 2020). In Georgia, where we have data about the race of registered voters, we find that Black voters tend to live slightly closer to polling places on average. We do not find large differences across racial groups in terms of sensitivity to distance to polling place. Similarly, there does not appear to be a

[4] "The Georgia Governor's Race Has Brought Voter Suppression Into Full View", *The Atlantic*. Retrieved Novermber 6, 2018. "Republican Voter Suppression Efforts Are Targeting Minorities, Journalist Says", *NPR*. Retrieved October 23, 2018.

significant difference in the way that Republicans and Democrats respond to distance to the polling place. Our findings suggest that polling place closures are unlikely to affect vote shares strictly through increasing the cost of travelling to the polling place. However, polling place decisions may be related to other important costs of voting like wait times. Relatedly, some of the media concern over polling place closures in recent years may have been misplaced. Most of the polling place closures in the past decade in Georgia occurred in rural areas where there is likely to be a smaller impact of increasing the distance to the polls among voters.[5] Instead, small changes to the location of urban polling places are likely to have a greater impact on turnout and should be evaluated carefully by election commissions.

2 Institutional Background

We study the 2018 primary and general elections in Pennsylvania and Georgia. From 2012 to 2018, the number of registered voters in Pennsylvania increased from 8.5 to 8.6 million[6] while in Georgia it grew from 6 to 6.9 million [7]. In many states, including Pennsylvania and Georgia, 2018 was a year of historically high turnout for a midterm election (58% and 53 % of registered voters cast ballots compared to 43% and 37% in 2014 respectively). However, turnout was much lower for the primary elections (12% for Pennsylvania and 17% for Georgia).

Pennsylvania and Georgia differ in a number of election policies.[8] In Pennsylvania, voting happened only on election day in 2018; there was no early voting. Voters also required an excuse to vote by absentee ballot at this time in Pennsylvania.[9] In contrast, early voting began in Georgia three-weeks before election day and any voter could request a mail-in ballot up to 180 days before the election.

Both states are divided into voting precincts by local government authorities (either county election commissions or municipal or county heads of government). An accessible location within each precinct, typically a school, library, police station, or church, is chosen as the polling place location by local authorities. Barring emergencies, polling places must be announced no less than 60 days prior to an election in Georgia and 20 days prior to an election in Pennsylvania. This means that voters may register to vote before knowing exactly where their polling place will be located. Neither state uses same-day voter registration, so voters must register several weeks in advance of

[5] "Voting precincts closed across Georgia since election oversight lifted" *Atlanta Journal-Constitution*. Retreived November 11, 2020.

[6] Voter Registration Statistics from Pennsylvania's Department of State

[7] Voter Registration Statistics from Georgia's Secretary if State Office

[8] Election policies were retrieved from Pennsylvania and Georgia Secretary of State websites and from state election law: Pennsylvania Statutes Title 25 and Georgia Title Code 25.

[9] Pennsylvania introduced early voting and no-excuse mail-in voting in 2019 with Act 77.

the election date. Importantly for our identification strategy, if voting in person, each voter may only vote on election day at the polling place for the precinct in which they reside.

Election day polls are open from 7am to 8pm in Pennsylvania and from 7am to 7pm in Georgia. If a registered voter has voted before in Pennsylvania, they do not need to bring identification. On the other hand, Georgia has more strict voter ID laws that require Georgia residents to show photo identification when voting in person.

We do not have the ability to assess the effect of these electoral policies with only two states. However, the policies are potentially important for understanding the substantive differences in our findings for Pennsylvania and Georgia.

3 Data Collection

From the Pennsylvania Department of State and Georgia Secretary of State, we obtain voter registration files, which include a unique voter identification, address, and voting precinct for each registered voter within the state. Through the voter ID, this information can be merged with voter history files, which records whether or not each registered voter voted in each election as well as their method of voting (at polls or absentee).

We obtain the locations of polling places from Georgia's Secretary of State's website and from Pennsylvania's state-run polling place look-up website.[10] Next, we geocode the polling place locations and registered voter addresses using the Address Locator provided by ArcGIS.[11] The distance to polling place for each individual is measured as the Euclidian distance in miles between the voter's address and the polling place address.

It is important to note that we only observe addresses for registered voters. At the individual level, we are only able to estimate the effect of distance to polling place on voting, conditional on an individual already being registered to vote. Since distance to polling place may also affect the likelihood that an individual registers, this may introduce selection bias. Hence, to complement our analysis, we estimate the effect of distance to polling place on the likelihood that an eligible voter votes, by aggregating to the Census block level. Blocks are the smallest statistical area used by the Census, corresponding to roughly the size of a city block. At the block level, we have information on the voting age population, a proxy for voting eligibility, from the 2010 Census. The

[10] `https://www.pavoterservices.pa.gov/Pages/PollingPlaceInfo.aspx.` and `https://sos.ga.gov/index.php/elections`. Retrieved during October 2018 and July 2020.

[11] This address locator uses interpolation to locate addresses, meaning it has the latitude and longitude of the endpoints of every street. It then interpolates the latitude and longitude of the specific address based on the street endpoints.

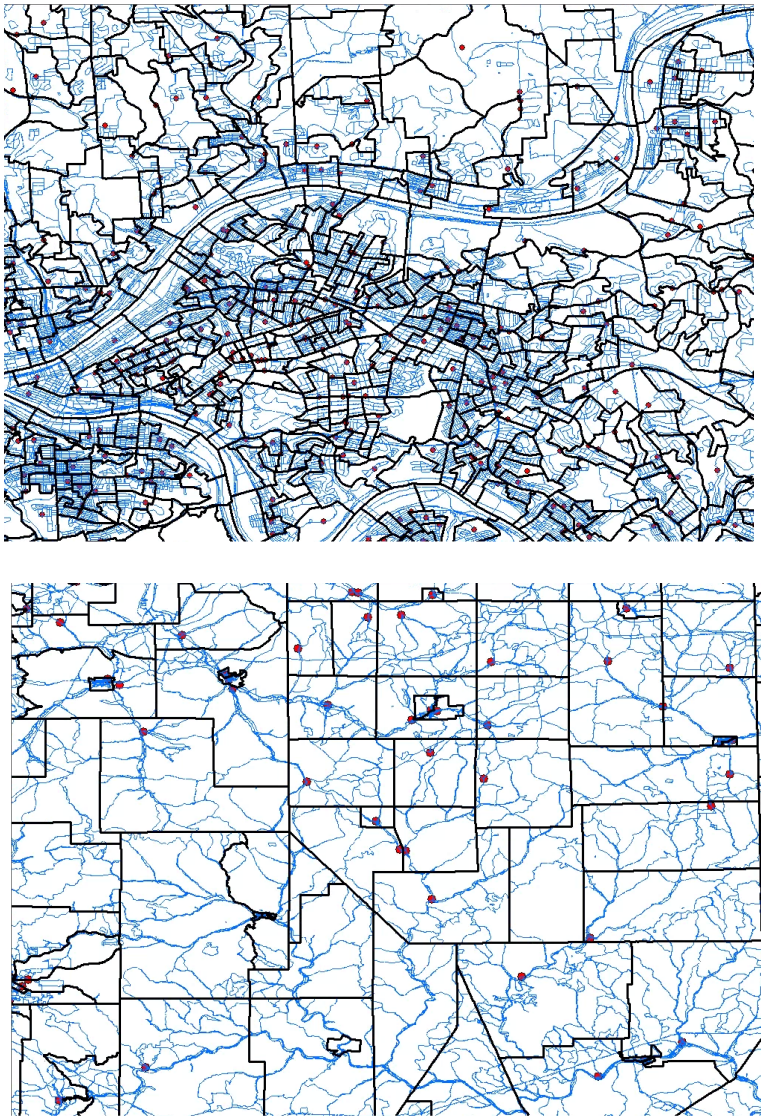
main outcome of interest is turnout: the total votes per voting age population. Cantoni similarly aggregates to the block-level, noting that the benefit of avoiding selection bias comes at the cost of less precise measurement of distance.[12] Here, the loss in precision is not as important, since we have a large number of blocks. Additionally, blocks are small so that there is little variation in distance to polling place within a block (the average standard deviation of distance to polling place within a block is 0.1 miles or 160 meters).

To aggregate the data to the block level, we assign each registered voter to the census block that contains their geolocated address. Distance to polling place at the block level is measured as the average distance to polling place for all registered voters in the block. To give a sense of the the geography and scale of blocks relative to precincts, Figure 1 shows voting precincts, census blocks, and polling places in an urban and rural area.

Finally, the block-level data is merged with census data on race, ethnicity, gender and age using block identifiers. Other covariates of interest that may be correlated to both turnout and distance to polling place include car ownership, mode of travel to work and commute time, income, and unemployment. These variables are available at the block-group-level and tract-level from the American Community Survey (2006-2010 five-year estimates). We assign the block-group or tract average to each block within the statistical area. Variable definitions, units of observations, and data sources are described in more detail in Appendix A.1.

[12]Cantoni also pairs this analysis with analysis at the parcel-level. A parcel is a unit of land, typically containing one household. We don't have parcel data for important parts of Pennsylvania (e.g., Philadelphia) nor Georgia. The benefit of Parcel-level analysis is that the measurement of distance is more precise. The drawback is that there is no data on the voting age population, so parcels are assumed to have roughly the same voting age population.

Figure 1: Maps of Precincts, Census Blocks, and Polling Places



Note: The upper map is in Pittsburgh (population 302,407) and the lower map is in Jefferson County (population 43,804). Bold black lines are precinct boundaries. Thin blue lines are Census block boundaries. Red dots are Poling Place Locations. Both maps are roughly 75 square miles (194 square kilometers).

4 Empirical Framework

4.1 Identification Strategy

We estimate the effect of the distance to polling place on the likelihood of voting at the poll, voting by absentee ballot, and voting by either method. Estimating this causal effect presents several challenges. Simply regressing voting outcomes on distance to polling place could be misleading. Local election officials are supposed to choose convenient and accessible locations for polling places. Schools and other public buildings are most frequently selected as polling places. Voters who live close to polling places may therefore differ systematically from voters who tend to live far away from polling places in ways that are important for voting behavior. For example, adults who choose to live close to the center of town or close to a school may tend to be younger, and therefore belong to a demographic with a relatively low historical turnout rate. We therefore turn to a causal identification strategy that exploits discontinuities at the borders of voting precincts (called Voting Tabulation Districts by the Census). Intuitively, two neighbors who live on opposite sides of a voting precinct border should be comparable in dimensions related to voting, but differ in where they go to vote.

We first apply this methodology using the individual-level dataset to estimate the effect of distance to polling place on the likelihood of voting, conditional on being a registered voter. Each individual is assigned to the nearest voting precinct border and is only included in the sample if they reside within 0.05 miles (161 feet or 81 meters) of the voting precinct border. Additionally, we restrict attention to segments of voting precinct borders that to do not overlap with other important boundaries that would cause residents to sort on either side of the border. Voting precinct boundaries included in our sample do not overlap with school district boundaries, town or county boundaries, nor boundaries for state or federal congressional districts. Figures 2 and 3 show the voting precinct border segments that are included and excluded in the samples for Georgia and Pennsylvania.

We use a similar estimation strategy with the block-level dataset to estimate the effect of the distance to polling place on turnout, unconditional on registration. Each block is assigned to the nearest voting precinct border and is only included in the sample if it's centroid is within 0.2 miles (1056 feet or 322 meters) of the voting precinct border. Conditioning on the distance from the block centroid to the border allow us to only consider those blocks where most of the population lives close to the border.

To limit noise due to imprecise geocoding,we only consider blocks where the average distance to polling place is less than 10 miles. Finally, we discard borders where the nearest blocks include both rural and urban areas since these blocks are unlikely to satisfy identifying assumptions. This selection leaves us with $1,787,734$ voters,

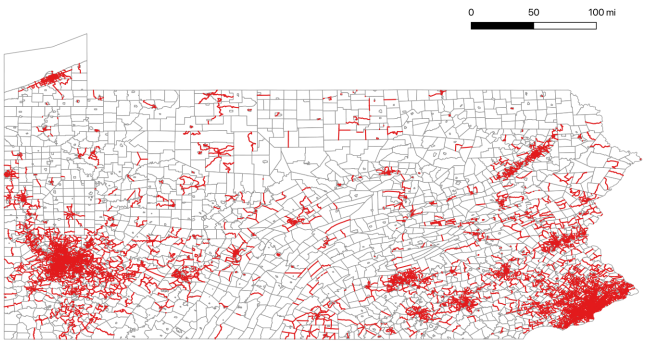


Figure 2: Pennsylvania

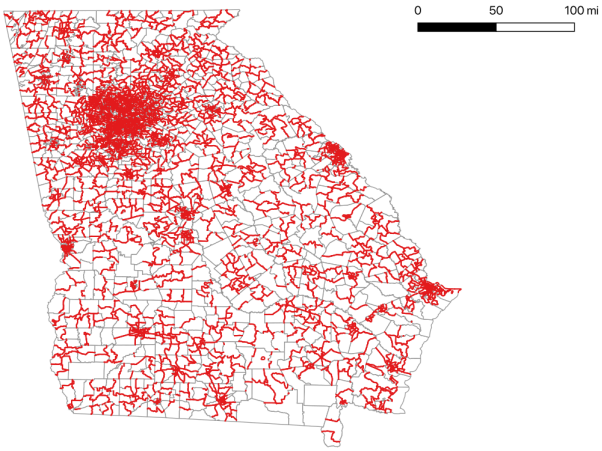


Figure 3: Georgia

111,782 blocks and 9,921 borders in Pennsylvania and 524,675 voters, 35,137 blocks and 3,945 borders in Georgia. On average, each border has 355 voters and 27 blocks in Pennsylvania and 358 voters and 22 blocks in Georgia.

The main empirical specification can be written as follows:

$$vote_i = \delta_{s(i)} + \beta distance_i + \mathcal{P}_i'\rho + \mathcal{X}_{b(i)}'\iota + \epsilon_i \tag{1.A}$$

where $vote_i$ indicates whether or not registered voter i voted. For ease of interpreting small coefficients, we have $vote_i$=100 if voter i votes and $vote_i = 0$ if voter i does not vote. $\delta_{s(i)}$ is a fixed effect for a segment of a precinct border, where each voter i is assigned to a unique segment $s(i)$. $distance_i$ is the distance (measured in miles) between a voter's residence and polling place. The specification includes individual-level controls ($\mathcal{P}_i$) and block-level controls ($\mathcal{X}_b(i)$).

At the block-level, the estimating equation is:

$$turnout_b = \delta_{s(b)} + \beta distance_b + \mathcal{X}_b'\iota + \epsilon_b \tag{1.B}$$

where $turnout_b$ is the percent of voting-age population in block b that votes.

The identifying assumption in both of our specifications is that all unobservable factors affecting voting behavior are uncorrelated with distance across and along border lines, conditional on observables.

Following Cantoni (2020), we relax this identifying assumption with a second set of estimating equations that include county-specific controls for latitude and longitude:

$$vote_i = \delta_{s(i)} + \beta distance_i + \alpha_{c(i)} lat_i + \gamma_{c(i)} lon_i + \mathcal{P}_i'\rho + \mathcal{X}_{b(i)}'\iota + \epsilon_i \tag{2.A}$$

$$turnout_b = \delta_{s(b)} + \beta distance_b + \alpha_{c(b)} lat_b + \gamma_{c(b)} lon_b + \mathcal{X}'_{b(i)}\iota + \epsilon_b \qquad (2.B)$$

This less parsimonious model means that the effect is identified using only the discontinuities in distance to polling place at the border. The identifying assumption is that any variables that affect turnout, apart from distance, are continuous at all points of the precinct border. Because voters on either side of the border are assigned to different polling places, there is a discontinuity in $distance_i$ at the border.

At the block level we separately estimate equations 1.B and 2.B with the following covariates: percent voting age population, percent Democrat, percent Republican, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent who walk to work, and indicators for travel time to work being less than 5 minutes and travel time to work is more than 60 minutes). At the individual level we estimate equations 1.A and 2.A with the the same block-level covariates and include the following individual-level covariates from voter registration files: age, and indicators for the voter being a registered Democrat, registered Republican, and female.

4.2 Summary Statistics and Balance Tests

In 2018, there were 7,014 polling places in Pennsylvania and 2,340 polling places in Georgia. Voters on average live 0.93 miles away from their polling place in Pennsylvania and 1.66 miles in Georgia. For the 2018 general election, the turnout was is 59% of registered voters in Pennsylvania and 55% of registered voters in Georgia. Voting by mail in Georgia is much higher than in Pennsylvania, where an excuse is required for an absentee ballot. In Georgia, 29.76 percent of those registered to vote chose to vote by mail whereas only 2.23 did the same in Pennsylvania.

Comparing our regression samples with that of the whole state, we find some important differences. Urban areas are over-represented in our sample: 87% of the sample is urban in Georgia and 98% in Pennsylvania, versus 75% and 80% for the whole sample, respectively. This is mainly because small towns are more likely to have only one voting precinct, and we remove voting precinct border segments that overlap with town borders. However, there are sufficient segments in rural areas within each state sample in order to detect differences between urban and rural areas (210 segments (5%) in Pennsylvania and 1380 segments (34 %) in Georgia). Our sample also contains more Black registered voters, and poorer voters than the state. Full summary statistics are reported in Appendix A.2

Investigating how distance to polling place varies for voters within each state, we regress distance to polling place on political, demographic, and socioeconomic variables in Appendix A.3. In both states, polling places tend to be farther away from

Republicans, white individuals, and individuals without a high school diploma. To test for balance within each border segment, we include border fixed effects and county-latitude/longitude controls. After including border-fixed effects, most of the correlations between distance to polling place and covariates are statistically insignificant. However, two variables at the individual level are statistically significantly correlated with distance to polling plae (indicators for age 30 to 49 and age 50 to 64) in Pennsylvania and one in Georgia (indicator for voter being a registered Democrat). Considering covariates that are aggregated at the block, block-group, and tract level, there is one statistically significant correlation with distance to polling place in Georgia (percent Hispanic) and no statistically significant correlations in Pennsylvania.

5 The Effect of Distance to Polling Place

We begin with a discussion on the average effect of distance to polling place on likelihood of voting in Pennsylvania (Table 1) and in Georgia (Table 2). We report the coefficient on distance to polling place for several outcomes: likelihood of voting at polling places, likelihood of voting by absentee ballot, and overall likelihood of voting for both primary and general elections in 2018. In each table, Panel A reports coefficients from estimating the outcomes with controls and precinct fixed effects only, Panel B reports coefficients from estimating equation 1.A, and Panel C reports coefficients from estimating equation (2.A).

In Panel A of each table, we observe small but statistically significant correlations between distance to polling place and the likelihood of voting at polls. Comparing these point estimates to those in Panels B and C, we see that estimates based on correlations between voting and distance to polling place using within-precinct variation are likely *understate* the effects of distance to polling place on voting behavior.

In Panel B of Tables 1 and 2, including border fixed effects yields coefficients that are larger in magnitude. In Pennsylvania, a one mile increase in distance to polling place is associated with a decrease in at poll voting of 1.35 p.p. in primary elections and 1.23 p.p. in general elections. In Georgia, a one mile increase in distance to polling place is associated with a decrease in at poll voting of 0.46 p.p. in the primary election and 1.71 p.p. in the general election. Compared to Panel A, these estimates have increased in magnitude from 50% to 75%.

In Georgia, the negative effect of distance to polling place on voting at polls is largely compensated for by a positive effect on the likelihood of absentee voting. A one mile increase in distance to polling place is associated with a 0.44 p.p. increase in absentee voting in primary elections and a 1.87 p.p. increase in absentee voting in general elections (Table 2, Panel B). The effect of distance to polling place on the

Table 1: The effect of distance to polling place on likelihood of voting: Pennsylvania

	Panel A: OLS with Precinct FE and Controls					
	Primary Election			General Election		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-0.9691***	-0.0051	-0.9742***	-0.4393***	0.0986***	-0.3407***
	(0.0536)	(0.0082)	(0.0548)	(0.0648)	(0.0168)	(0.0666)
N	6922990	6922990	6922990	6949983	6949983	6949983
y variable mean	18.31	0.38	18.69	56.43	2.15	58.58
R^2	0.059	0.007	0.061	0.057	0.011	0.065
	Panel B: Border FE with Controls					
	Primary Election			General Election		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-1.3523***	0.1177*	-1.2346***	-1.2255***	0.2326***	-0.9929***
	(0.2261)	(0.0611)	(0.2190)	(0.2786)	(0.0808)	(0.2669)
N	1529592	1529592	1529592	1534873	1534873	1534873
y variable mean	16.15	0.33	16.48	51.57	1.60	53.17
R^2	0.072	0.028	0.074	0.075	0.027	0.083
	Panel C: Border FE with Controls and County-Lat./Lon.					
	Primary Election			General Election		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-1.3476***	0.1201*	-1.2274***	-1.1533***	0.2322***	-0.9211***
	(0.2325)	(0.0623)	(0.2247)	(0.2766)	(0.0816)	(0.2640)
N	1529592	1529592	1529592	1534873	1534873	1534873
y variable mean	16.15	0.33	16.48	51.57	1.60	53.17
R^2	0.072	0.029	0.074	0.075	0.028	0.083

Note: Distance to polling place is measured in miles. The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. All regressions include Border Fixed Effects (Border FE). County-Lat./Lon. refers to latitude and longitude controls, interacted with county fixed effects. The additional controls are: Democrat indicator, Republican indicator, age 30-49 indicator, age 50-64 indicator, age 65 and up indicator, female indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors clustered at the border level are reported in parentheses.

Table 2: The effect of distance to polling place on likelihood of voting: Georgia

	Panel A: OLS with Precinct FE and Controls					
	Primary Election			General Election		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-0.2614***	0.2403***	-0.0211***	-1.1373***	1.4199***	0.2826***
	(0.0229)	(0.0227)	(0.0030)	(0.0572)	(0.0665)	(0.0556)
N	5999708	5999708	5999708	5999708	5999708	5999708
y variable mean	12.14	4.55	16.70	25.52	29.52	55.05
R^2	0.677	0.243	0.980	0.033	0.135	0.161
	Panel B: Border FE with Controls					
	Primary Election			General Election		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-0.4572***	0.4379***	-0.0193	-1.7106***	1.8681***	0.1575
	(0.0753)	(0.0755)	(0.0156)	(0.1794)	(0.1935)	(0.1939)
N	445881	445881	445881	445881	445881	445881
y variable mean	11.45	4.12	15.57	24.61	27.36	51.97
R^2	0.694	0.249	0.979	0.049	0.156	0.188
	Panel C: Border FE with Controls and County-Lat./Lon.					
	Primary Election			General Election		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-0.4677***	0.4458***	-0.0219	-1.7159***	1.9143***	0.1984
	(0.0773)	(0.0770)	(0.0155)	(0.1836)	(0.2018)	(0.2020)
N	445881	445881	445881	445881	445881	445881
y variable mean	11.45	4.12	15.57	24.61	27.36	51.97
R^2	0.694	0.250	0.979	0.050	0.158	0.189

Note: Distance to polling place measured in miles. Turnout is measured as the number of votes per voting-age population (separately for votes cast at polling places, through absentee ballots, and total). All regressions include Border Fixed Effects (Border FE). County-Lat./Lon. refers to latitude and longitude controls, interacted with county fixed effects. The additional controls are: Democrat indicator, Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors clustered at the border level are reported in parentheses.

likelihood of voting ranges from -0.97 to -0.34 p.p. for primary and general elections in Pennsylvania and from -0.02 to 0.28 p.p. for primary and general elections in Georgia. These effects are 3.7 to 8 times larger in magnitude than the effect of distance on absentee voting in Pennsylvania (for the primary and general election, respectively, Table 1, Panel B). It is important to remember that Pennsylvania and Georgia differed in their requirements for voting by mail in the 2018 election. Pennsylvania required voters who request absentee ballots to provide an excuse while Georgia does not. In Georgia, the estimates are consistent with a larger share of voters substituting to mail-in voting when at poll voting becomes too inconvenient, compared to Pennsylvania.

Overall, there is a negative effect of distance to polling place on the likelihood of voting (either at polls or by mail) in Pennsylvania, whereas the combined effect is small and statistically insignificant in Georgia. The effect of distance to polling place on the total likelihood of voting in Pennsylvania ranges from negative 1.23 p.p. in the primary election to negative 0.99 p.p. in the general election. In Georgia,the same point estimates range from 0.02 for the primary election and 0.16 for the general election; neither is statistically significant.

The addition of individual's latitude and longitude interacted with county-fixed effects in Panel C does little to change point estimates compared to those in Panel B. The estimates in Panel C suggest that the effect of a mile increase in distance to polling place on the likelihood of voting in a general election is negative 0.92 p.p. in Pennsylvania with no statistically significant effect in Georgia. For remaining analyses, we will largely focus on the more parsimonious estimating equation without county-specific latitude and longitude controls, as in Panel B.

Next, we estimate the effect of distance to polling place on turnout, unconditional on voter registration, using the block-level analyses. We follow the same structure as for Tables 1 and 2 in Tables A.4 and A.5. We find similar patterns to those found in the individual level regressions, with one meaningful difference. At the block-level, the estimated effect of distance to polling place on overall turnout in general elections in Georgia is negative and statistically significant (-0.86 p.p.). This suggests that while registered voters in Georgia are able to effectively substitute toward mail-in voting, the inconvenience of reaching a polling place may deter some eligible voters from registering in the first place. However, there is no strong evidence that this is the case for primary elections. Overall, the similarity in results from individual-level and block-level analyses in Pennsylvania suggests that the selection of registered voters in the individual-level analysis does not affect estimates. Put differently, it is unlikely that distance to polling place has a large effect on a voter's decision of whether or not to register to vote. This may be because registering to vote is an infrequent and relatively low-cost action that largely takes place before polling places are known.

Across all specifications, the estimates of the average effect of distance to polling place on overall turnout in Georgia and Pennsylvania are an order of magnitude smaller than those estimated in Cantoni (2020). The estimates from Pennsylvania are closer to those in Brady and McNulty (2011), whereas the null estimates in Georgia coincide with findings in Clinton et al. (2019). In order to reconcile these differences, we check to see if estimates vary within Pennsylvania and Georgia, depending on the context. We first estimate effects in cities and counties separately, and then explore heterogeneous effects.

First, we construct a sample of blocks in Georgia and Pennsylvania that are more similar to the urban census blocks studied in Cantoni. Cantoni analyzes the Boston, Massachusetts area and Minneapolis, Minnesota. Compared to the statewide Pennsylvania and Georgia samples, the census blocks in these areas are higher in population, income, and education. We pool all census-block level data and estimate a propensity score for the likelihood of being in Massachusetts or Minnesota. We use a logit specification and the covariates used in Cantoni (population, income, race, car ownership, and education). Then, we construct a matched sample by selecting the blocks with the highest propensity score so that we have a sample size roughly equivalent to that of Cantoni. For comparability, we consider voting for general elections in midterm years (2018 in Georgia and Pennsylvania, 2014 in Massachusetts and Minneapolis).

Table 3 reports the border fixed effects estimates for full state samples (columns 1 and 2), for the matched samples (column 3) and for the urban areas in Massachusetts and Minnesota (column 4). Point estimates in the matched sample in the full samples. Although the point estimates in the matched sample are still smaller than those estimated in the Boston area and in Minneapolis, the standard errors are larger such that we can not reject the point estimate from the MA sample based in estimates in either matched sample. Overall, this analysis suggests that the effects of distance on turnout are specific to both the setting and electoral design, such that estimates based on small areas are unlikely to generalize to larger areas or to other states.

Next, in Table 4, we estimate equation 1.A separately for the three largest cities in our data: Philadelphia, Pittsburgh, and Atlanta. Voters in these urban areas are significantly more sensitive than the statewide average estimates would indicate. A mile increase in distance to polling place is associated with a decrease in the likelihood of voting in the general election of 2.62 p.p. in Philadelphia and 0.614 p.p. in Pittsburgh. As in the rest of Pennsylvania, there is no evidence of substitution into absentee voting to moderate these negative effects on turnout. In Atlanta, Georgia, the effects of distance to polling place are similarly amplified compared to the rest of the state. A mile increase in distance leads to a decrease in turnout of 3.16 p.p. and an increase in absentee voting of 3.28 p.p., such that the overall effect on turnout is null. These

Table 3: Comparing state samples to urban areas: Border fixed effects regressions

	State Samples		Matched Sample	Urban Areas
	(1) GA	(2) PA	(3) GA and PA	(4) MA and MN
Distance to polling place (mi)	-0.733***	-0.562***	-4.494	-5.435**
	(0.135)	(0.122)	(3.504)	(2.484)
N	84171	165082	1538	1694
y variable mean	54.002	47.584	60.253	38.229
R^2	0.250	0.294	0.478	0.595

Note: The Urban Areas sample is provided by Cantoni (2020) and include data from the Boston, Massachusetts area (MA) and Minneapolis, Minnesota area (MN). The dependent variable is turnout in the 2018 midterm election for Georgia (GA) and Pennsylvania (PA), and the dependent variable is turnout in the 2014 midterm election for MA and MN. All regressions include border fixed effects and covariates. Standard errors clustered at the segment level are reported in parentheses.

findings underscore the fact that sensitivity to distance to the polling place and the effect on overall turnout depend greatly on contextual factors, likely including aspects of electoral design (i.e., access to mail-in ballots).

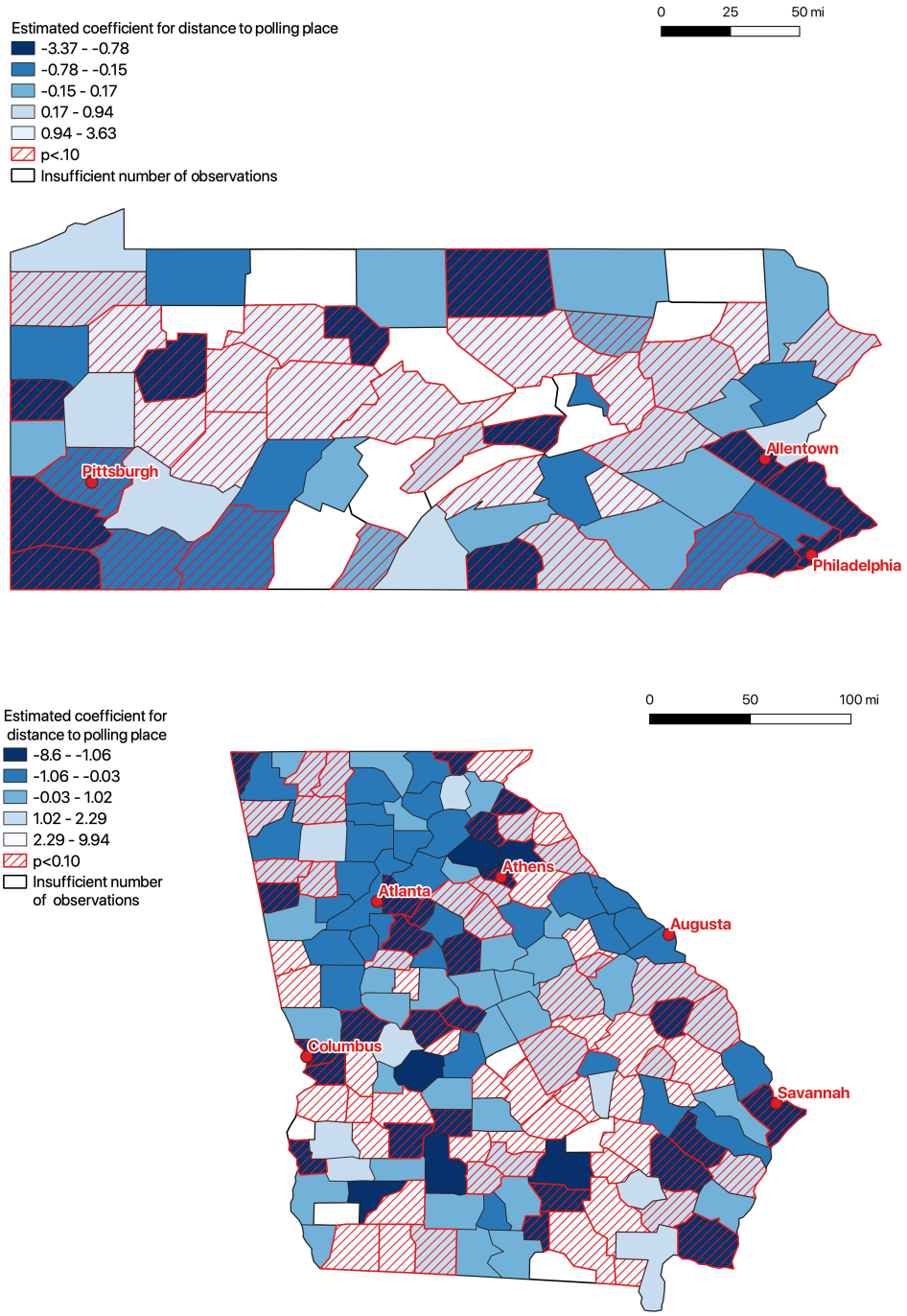
To explore the role of location further, we estimate the effect of distance to polling place separately for each county. We regress whether or not a registered voter voted (either at polls or absentee) on distance to polling place and border fixed effects. Due to limited power within some counties, we do not include additional covariates in each regression. Figure 4 shows maps of Pennsylvania and Georgia, indicating the point estimate for each county and whether or not the coefficient is precisely estimated. Cities with over 100,000 population are also indicated. A first observation from these maps is that urban areas and surrounding suburbs do tend to generate larger point estimates than the statewide averages, consistent with the more detailed results for the three largest cities in Table 4. However, there is also large variance in point estimates within rural areas of each state, suggesting that there is no straightforward urban-rural divide in terms of how voters respond to polling place locations. Next, we turn to understand which factors contribute to the variation in estimated effects across geographic areas with heterogeneous effects analyses.

Table 4: Comparing city samples: Philadelphia, Pittsburgh, and Atlanta

	Panel A: Philadelphia					
	Primary Election			General Election		
	(1) At Poll	(2) Absentee	(3) Total	(4) At Poll	(5) Absentee	(6) Total
Distance (miles)	-2.163***	-0.014	-2.177***	-2.728***	0.113	-2.615***
	(0.520)	(0.026)	(0.521)	(0.645)	(0.070)	(0.638)
N	658435	658435	658435	661231	661231	661231
y variable mean	16.26	0.19	16.45	52.61	1.13	53.74
R^2	0.119	0.016	0.122	0.090	0.021	0.098
	Panel B: Pittsburgh					
	Primary Election			General Election		
	(1) At Poll	(2) Absentee	(3) Total	(4) At Poll	(5) Absentee	(6) Total
Distance (miles)	-0.780***	0.035	-0.745***	-0.736***	0.122*	-0.614**
	(0.203)	(0.029)	(0.196)	(0.269)	(0.068)	(0.277)
N	587367	587367	587367	588804	588804	588804
y variable mean	20.22	0.58	20.79	58.38	2.52	60.90
R^2	0.100	0.019	0.105	0.074	0.022	0.086
	Panel C: Atlanta					
	Primary Election			General Election		
	(1) At Poll	(2) Absentee	(3) Total	(4) At Poll	(5) Absentee	(6) Total
Distance (miles)	-0.894***	0.876***	-0.017	-3.163***	3.284***	0.121
	(0.142)	(0.141)	(0.023)	(0.361)	(0.392)	(0.375)
N	587402	587402	587402	587402	587402	587402
y variable mean	11.55	4.58	16.13	23.30	29.83	53.12
R^2	0.676	0.251	0.975	0.023	0.181	0.188

Note: The Philadelphia sample includes all of Philadelphia county. The Pittsburgh sample includes all of Allegheny county. The Atlanta sample includes all of Fulton county. Distance to polling place measured in miles. Turnout is measured as the number of votes per voting-age population (separately for votes cast at polling places, through absentee ballots, and total). All regressions include Border Fixed Effects (Border FE). County-Lat./Lon. refers to latitude and longitude controls, interacted with county fixed effects. The additional controls are: Democrat indicator, Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors clustered at the border level are reported in parentheses.

Figure 4: County-level estimates of the effect of distance to polling place on the likelihood of voting in Pennsylvania and Georgia



Note: The shaded areas indicate the estimated coefficient for distance to polling place. These coefficients are estimated using individual-level data within each county. The dependent variable is an indicator for whether or not a registered voter voted (either at polls or by absentee ballot). Regressions include border fixed effects. Standard errors are clustered at the border level, and counties with coefficients that are statistically significant at at the 10% level are indicated with red lines. The maps are shaded by quantiles of point estimates within each state. All cities with population greater than 100,000 are indicated with red circles.

6 Heterogeneous Effects

In this section we investigate differences in the responses to distance to polling place by demographic, economic, and political factors. When available, we use individual-level variables from voter registration files to estimate heterogeneous effects. We study differences by age, gender, race and ethnicity (available for Georgia only), and party affiliation using this approach. For each of these covariates of interest, we estimate equation 1.A using sub-samples defined by a set of mutually exclusive categories. Some other variables are likely to affect the relationship between polling place location and voting behavior, but are only available at the block, block-group, or tract level. This is true for education, income, and mode of transportation. For these variables, we use block-level data to estimate equation 1.B, with distance to polling place interacted with the categorical variable of interest.

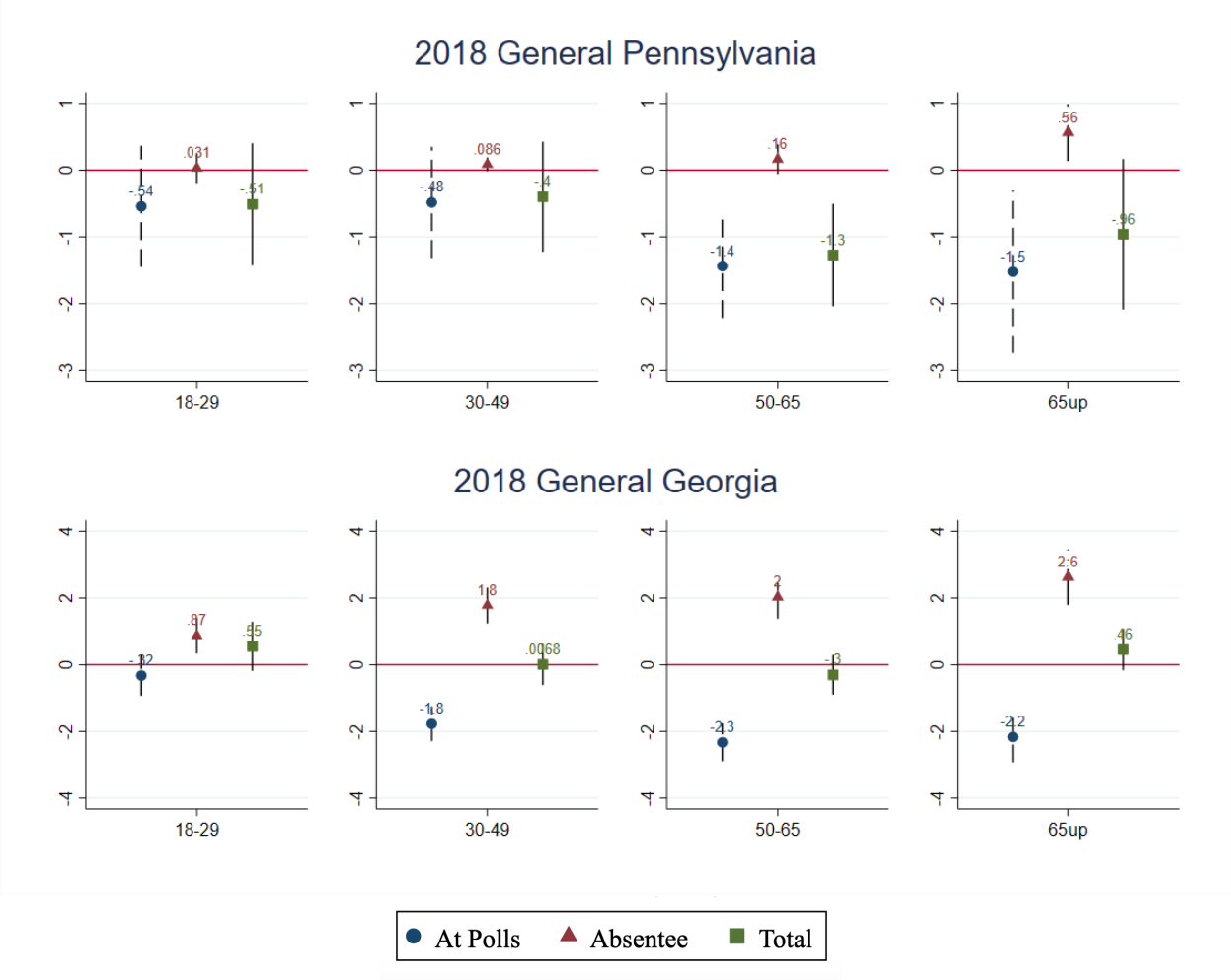
6.1 Individual Level Heterogeneous Effects

Age. One might expect that individuals in the 18 to 29 age category are more sensitive to costs of voting, like distance to polling place, due to habit formation (Fujiwara et al. 2016; Plutzer 2002). Newly eligible voters may carefully evaluate the costs of traveling to a polling place or voting by mail, whereas older voters are more likely to continue voting or not voting using the same method as in the past. On the other hand, voters ages sixty five and above may be more likely to have difficulty traveling to a polling place on their own. Moreover, the oldest voters may be more likely to have to vote by mail due to health limitations. In Figure 5, we see that older voters are indeed more sensitive to distance to polling place than younger voters. In both Pennsylvania and Georgia, there is a pattern of increasing magnitude of point estimates from younger age groups to older age groups. Although estimates for each age group are not statistically different from each other in Pennsylvania, in Georgia, voters ages 65 and up are significantly more sensitive to distance to polling place than the youngest voters, ages 18 to 29. Among voters ages 65 and up, a one mile increase in distance to polling place is associated with a 2.2 p.p. decrease in voting at polls and a 2.6 p.p. increase in voting by mail. In Pennsylvania, voters ages 65 and up are the only age group in which there is a statistically significant increase in absentee voting, consistent with the idea that voters are more likely to be eligible for absentee voting in Pennsylvania in this age group.

Gender. Women have turned out to vote at a higher rate than men since 1980[13]. However, we find neither large differences in distance to polling place between male and

[13]Center for American Women and Politics (CAWP), "Gender Differences in Voter Turnout." Eagleton Institute of Politics, Rutgers University https://cawp.rutgers.edu/sites/default/files/resources/genderdiff.pdf. 2017. Retrieved September 5, 2020.

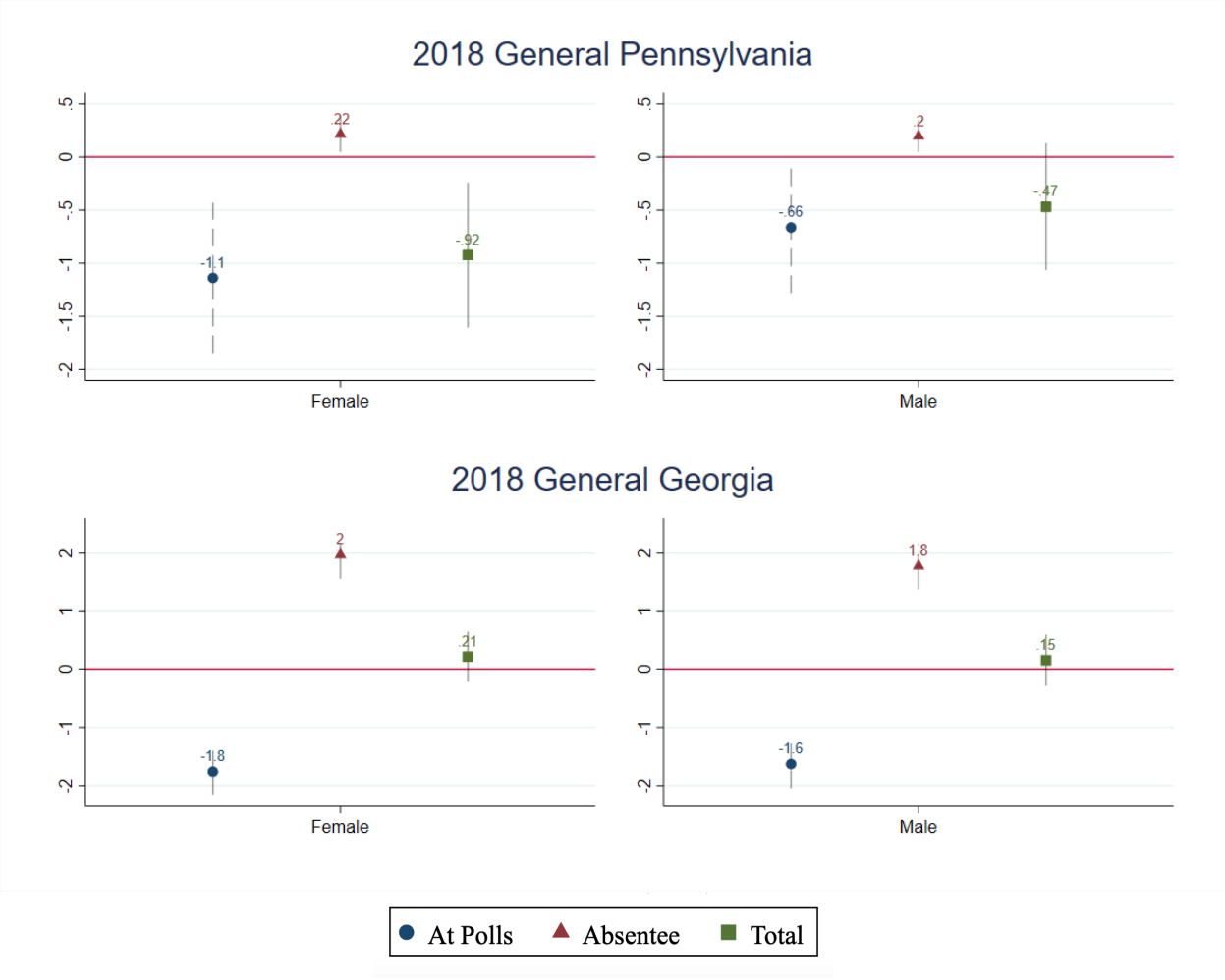
Figure 5: The effect of distance to polling place on likelihood of voting: by Age



Note: The y-axis measures the coefficient on distance to polling place (measured in miles) interacted with the variable on the x-axis. The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. Each symbol represents a point estimate in a separate regression, and the lines indicate 95% confidence intervals. All regressions include border fixed effects and additional individual-level and block-level covariates: registered Democrat indicator, registered Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors allow for clustering at the border level.

female registered voters (A.3) nor differences in sensitivity to an increase in distance to polling place (Figure 6). This suggests that differential responses to the costs of getting to the polling place do not help to explain differences in voting behavior by gender.

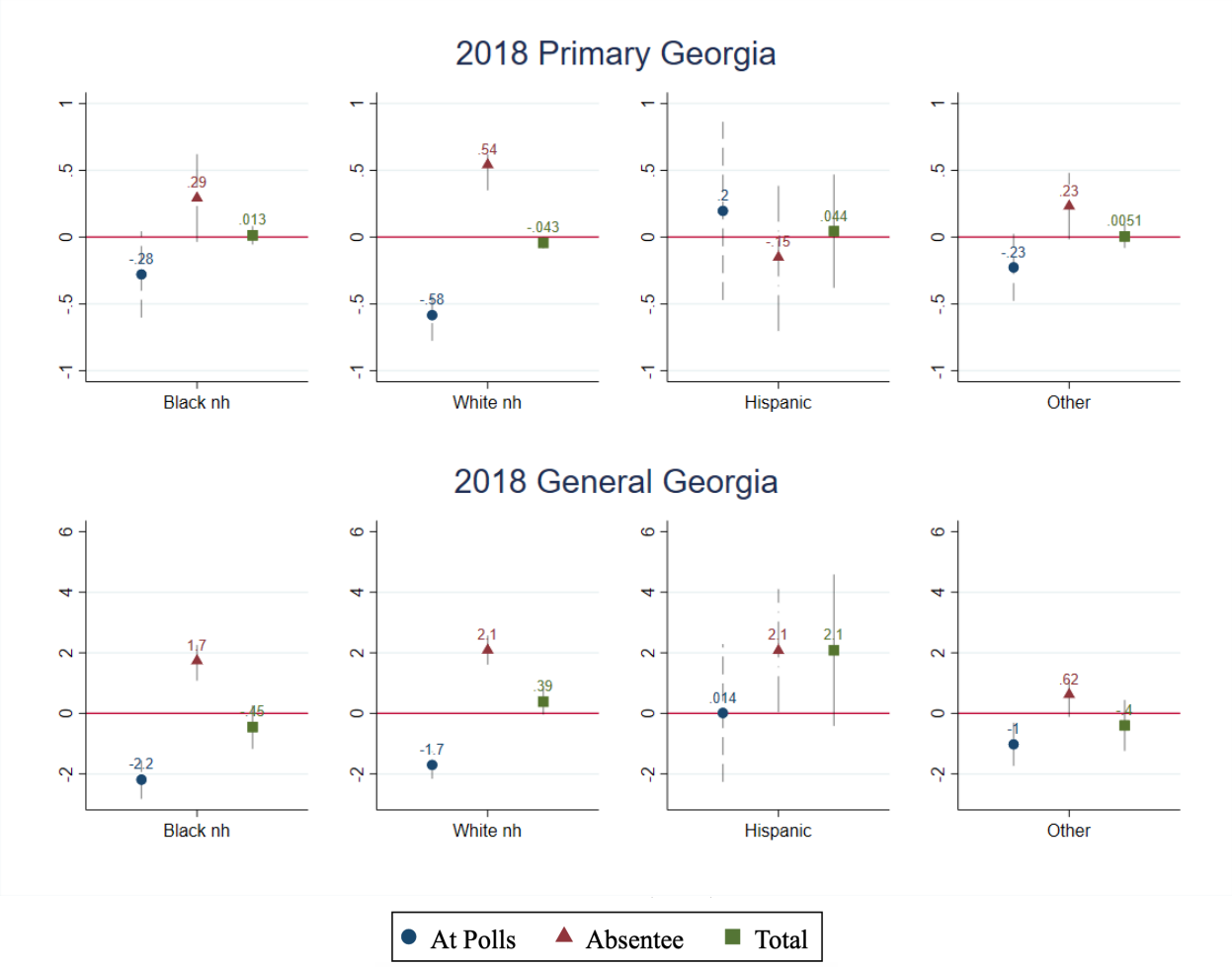
Figure 6: The effect of distance to polling place on likelihood of voting: by Gender



Note: The y-axis measures the coefficient on distance to polling place (measured in miles) interacted with the variable on the x-axis. The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. Each symbol represents a point estimate in a separate regression, and the lines indicate 95% confidence intervals. All regressions include border fixed effects and additional individual-level and block-level covariates: registered Democrat indicator, registered Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors allow for clustering at the border level.

Race and Ethnicity. Race and ethnicity are important to consider in the context

Figure 7: The effect of distance to polling place on likelihood of voting: by Race



Note: Voter-level race and ethnicity data is available in Georgia but not in Pennsylvania. The y-axis measures the coefficient on distance to polling place (measured in miles) interacted with the variable on the x-axis. The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. Each symbol represents a point estimate in a separate regression, and the lines indicate 95% confidence intervals. All regressions include border fixed effects and additional individual-level and block-level covariates: registered Democrat indicator, registered Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors allow for clustering at the border level.

of the cost of voting due to both a persistent turnout gap between white and non-white voters (Fraga 2018; Ansolabehere et al. 2020) and long-standing concerns of voter disenfranchisement. Fraga (2018) finds that the differential turnout rates by race and ethnicity can not be explained well by economic or demographic factors like income and education. Thus, it is important to see whether the costs associated with distance to polling place affect voters differently depending on racial and ethnic identity.

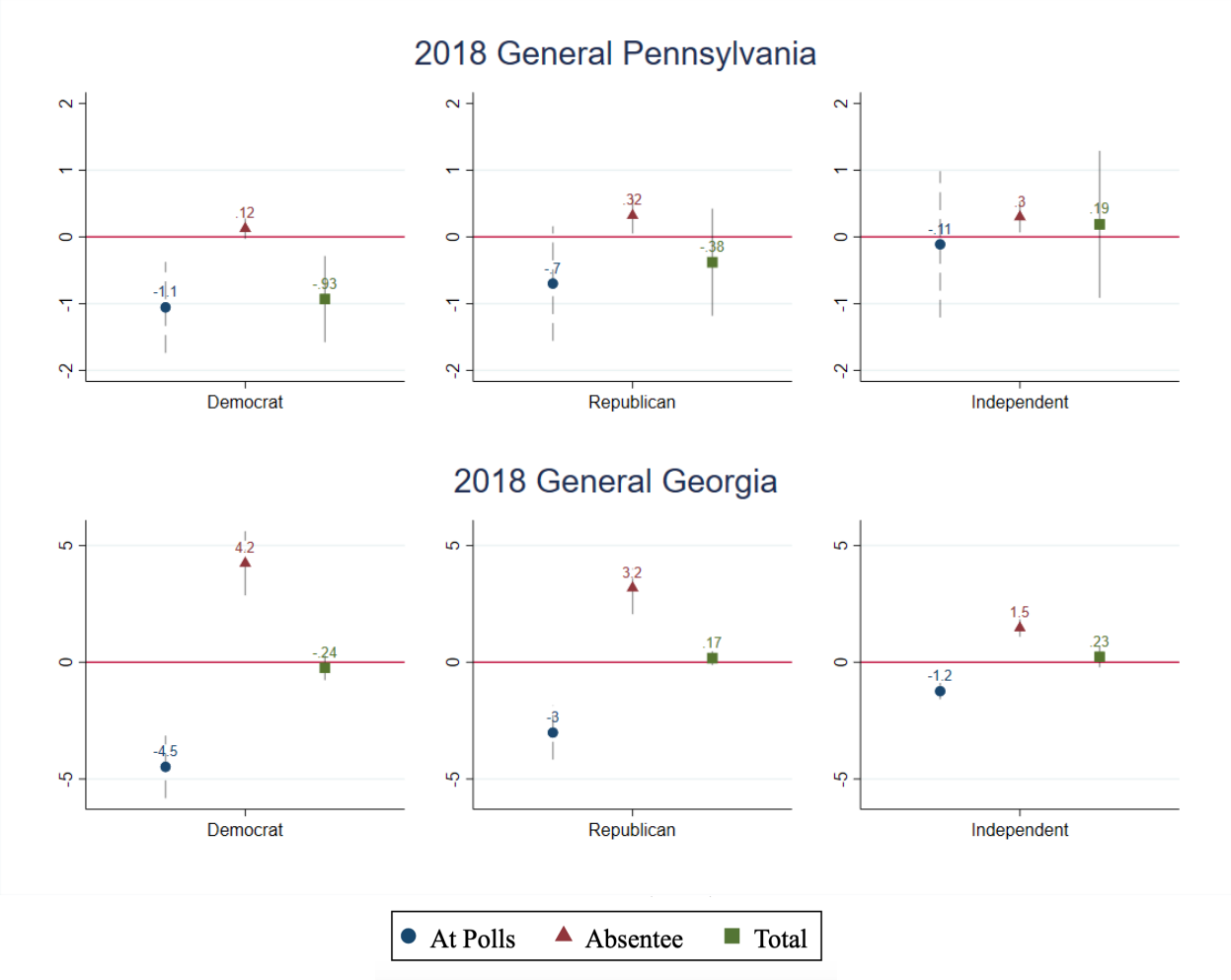
We use the information about race and ethnicity provided in the voter registration data from Georgia. Pennsylvania does not report race or ethnicity in their voter data. In Figure 7, we find no significant differences in how Black non-Hispanic, White non-Hispanic, and Hispanic voters react to distance to polling place. However, it is important to note that the absence of heterogeneous effects by race does not mean that changes to polling places would be race-neutral, in theory. Correlations between race and ethnicity and other important factors, like availability of public transportation in a residential area, could lead to disparate affects of polling place location decisions among historically disenfranchised populations.

The existing evidence of differential effects of distance to polling place by race is mixed. Cantoni (2020) finds that areas with a larger non-White population are more sensitive to distance to polling place, while Clinton et al. (2019) find that non-White voters are less likely to substitute to early voting in response to polling place changes than white voters. In studying recent poling place and precincting decisions in North Carolina, Shepherd et al. (2020) find no evidence of manipulation of polling place choices that would systematically affect voters differently by race. The mixed findings and subtle average differences across racial and ethnic groups in our data suggest that context-specific factors and electoral design are important to take into account when considering whether or not polling place locations and changes will have disparate racial impacts.

Political Party. Differences in the effects of an increase in the cost of voting by political affiliation could create incentives for officials to modify polling locations in order to manipulate vote shares in elections. In particular, a disproportionately negative effect to an increase of a mile in distance on turnout among voters registered for one party could motivate the opposition to reallocate polling places if the effects on their own voters were small to null effects.

Making use of the party registration information we explore the effects of an increase of distance to the polls on the likelihood of voting. In both Pennsylvania and Georgia we find the point estimates at polls to be for voters registered as democrats (4.5 p.p.) while the smallest ones are for those registered as independents (1.2 p.p.). Although we can't reject the null that the effects in overall likelihood of voting are the same for voters registered as republicans and democrats, we observe that in Pennsylvania and Georgia

Figure 8: The effect of distance to polling place on likelihood of voting: by Party Affiliation



Note: The y-axis measures the coefficient on distance to polling place (measured in miles) interacted with the variable on the x-axis. The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. Each symbol represents a point estimate in a separate regression, and the lines indicate 95% confidence intervals. All regressions include border fixed effects and additional individual-level and block-level covariates: registered Democrat indicator, registered Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors allow for clustering at the border level.

the point estimate for democrats is roughly 50% larger than that of republicans. In Georgia, we find that those registered as democrats or republicans are more likely to respond to changes in distance at polls and in mail-in ballots take up by more than 1.5 p.p. than those registered as independents.

6.2 Block Level Heterogeneous Effects

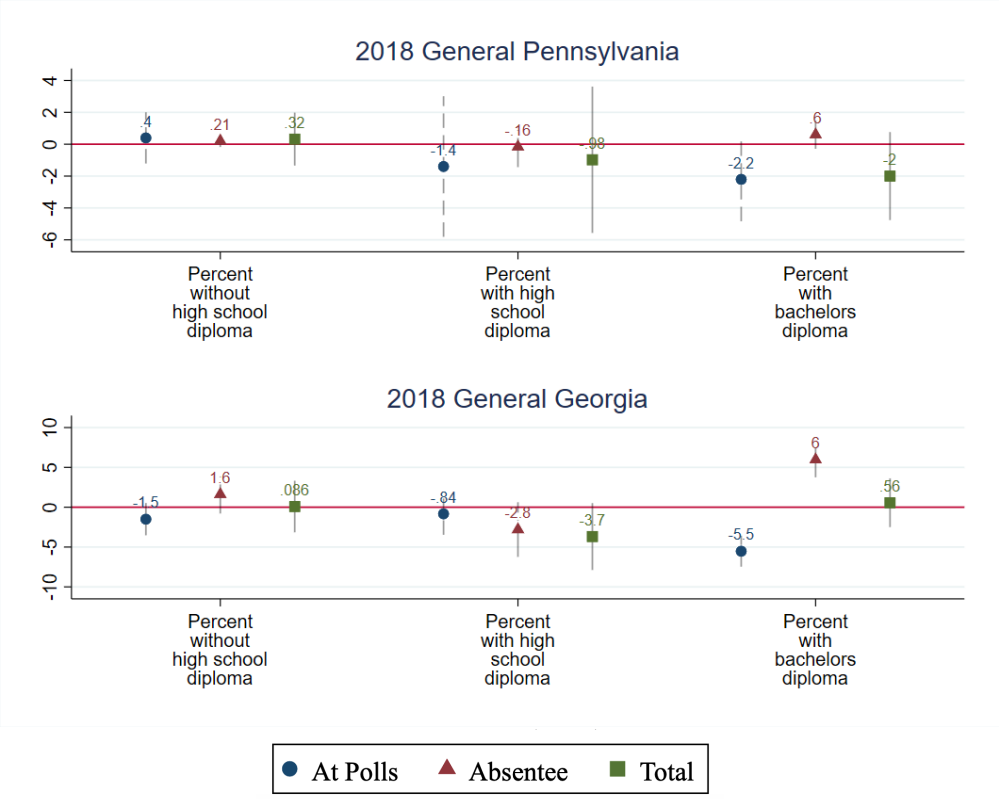
Using data from census blocks and block-groups, we determine if other factors that affect turnout, education and income, also affect sensitivity to distance to polling place. We also use information about mode of transportation to work, since the cost of travelling to a polling place will certainly vary depending on the mode of transportation available. We use block-level data to assess these characteristics that are not available in individual voter registration files. At the block level, we estimate the following specification:

$$turnout_b = \delta_{s(b)} + \mathcal{C}_b'\gamma + distance_b \cdot \mathcal{C}_b'\beta + \mathcal{X}_b'\iota + \epsilon_b \tag{1}$$

where $\mathcal{C}_i$ refers to a set interacting variables. We look at blocks with a higher percentage of voters at different income groups, education levels, mode of transportation to work, and length of time to work. We report each coefficient on $distance_i$ using coefficient plots. Detailed results from these regressions are reported in the appendix. For each interaction effect, we report estimated coefficients for Pennsylvania and Georgia general elections. Results for primary elections show similar patterns and are reported in Appendix A.4.

Education. We report how educational attainment interacts with changes in distance to the polling location in Figure 9. Voters with different educational backgrounds have historically responded differently to costs of voting (Milligan et al. 2004, Sondheimer and Green 2010). In Pennsylvania, we don't find any significant interaction effects on turnout at polls, absentee or total. In contrast, we find that in Georgia, the percent of the adult population with a bachelors degree or higher is associated with greater sensitivity to the distance to the polling place. When faced with a higher cost of voting at polls, voters in areas with a high percent of bachelors degrees are more likely to substitute to voting absentee instead of at polls. The differences in the effects at polls and absentee voting could indicate that there is a higher burden of switching into voting by mail among those with a lower educational attainment. This pattern is consistent with the finding that convenience voting can widen turnout gaps by making it easier to vote for those who are already more likely to vote (Leighley and Nagler 2014).

Figure 9: The effect of distance to polling place on turnout: by Educational Attainment

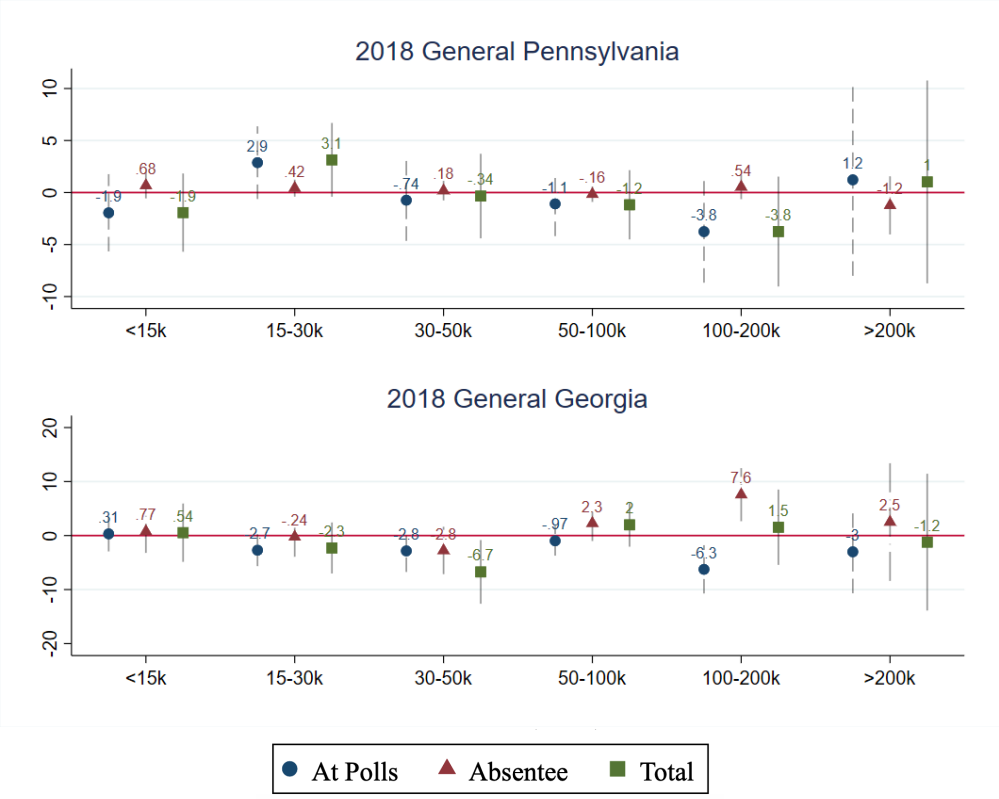


Note: The y-axis measures the coefficient on distance to polling place (measured in miles) interacted with the variable on the x-axis. The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. Each symbol represents a point estimate in a separate regression, and the lines indicate 95% confidence intervals. All regressions include border fixed effects and additional individual-level and block-level covariates: registered Democrat indicator, registered Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors allow for clustering at the border level.

Income. Unevenly distributed costs of voting could potentially contribute to unequal political representation by income. Historically, low-income voters are underrepresented in U.S. elections (Leighley and Nagler 2014) and elected politicians are less responsive to their preferences (Gilens 2012). Without being able to voice their votes, low-income voters could lose access to crucial government programs which offer relief and opportunities (Jolliffe et al. 2019; Neumark and Wascher 2001). However, We find no evidence that voters react differently to changes in the distance to the polling place based on the average income of the Census block in which they reside. Moreover, there is only a weak correlation with distance to polling place and income within precincts (Table A.3). As with gender, polling place location does not appear to explain variation in turnout by income.

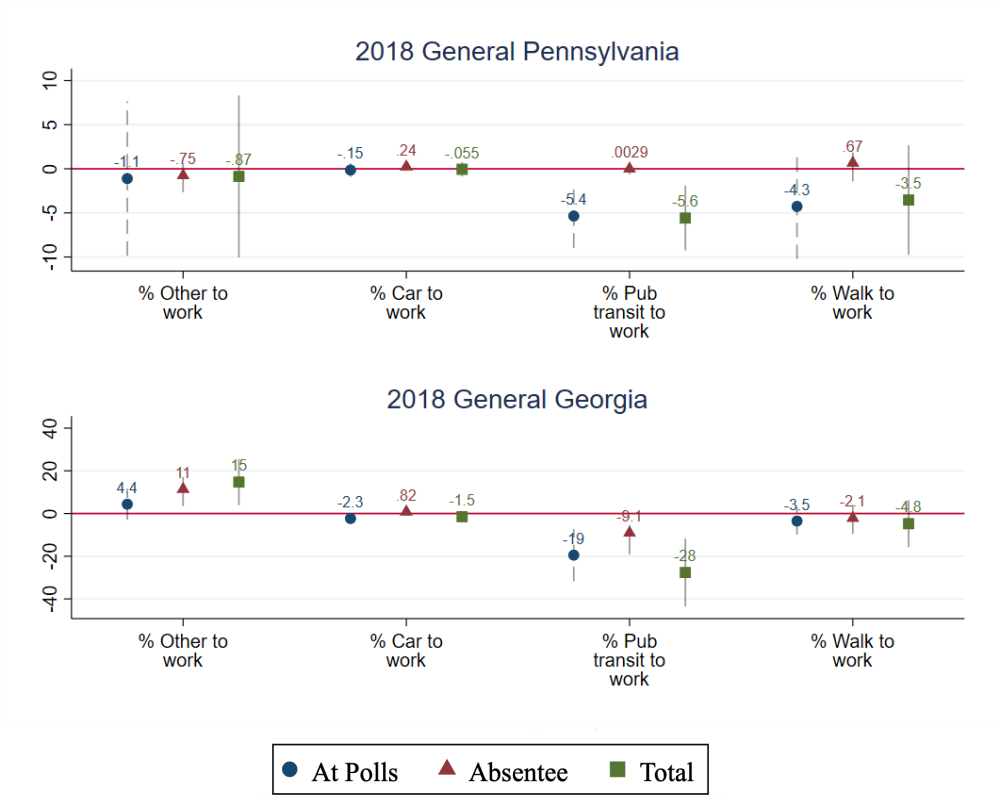
Transportation. Naturally, the cost of distance to the polling place will vary by mode of transportation. We use information about the ways adults commute to work from the American Community Survey. Results in Figure 11 show that mode of transportation is a particularly important interacting variable. In both Pennsylvania and Georgia, we find that the largest effects on on voting behavior are found in blocks that have a higher percentage of voters who take public transport to work. These estimates are 8 to 10 times larger than the average effect found in section 4. We find that an increase of a mile of distance to the polling place would decrease at polls turnout by 5.4 p.p. in Pennsylvania and 19 p.p. in Georgia if the percentage of those who take public transport would grow from 0 to 100 percent. To grasp the magnitude of these effects, if all the blocks would go from having zero of its residents to 100 percent of its residents using public transit to work, we would observe a drop in turnout that is at least twice as large as the vote margins of Maine, Nevada, Minnesota, New Hampshire, Michigan, Pennsylvania, Wisconsin and, Florida in the 2016 election.

Figure 10: The effect of distance to polling place on turnout: by Income Categories



Note: The y-axis measures the coefficient on distance to polling place (measured in miles) interacted with the variable on the x-axis. The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. Each symbol represents a point estimate in a separate regression, and the lines indicate 95% confidence intervals. All regressions include border fixed effects and additional individual-level and block-level covariates: registered Democrat indicator, registered Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors allow for clustering at the border level.

Figure 11: The effect of distance to polling place on turnout: by Way of Transportation to Work



Note: The y-axis measures the coefficient on distance to polling place (measured in miles) interacted with the variable on the x-axis. The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. Each symbol represents a point estimate in a separate regression, and the lines indicate 95% confidence intervals. All regressions include border fixed effects and additional individual-level and block-level covariates: registered Democrat indicator, registered Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors allow for clustering at the border level.

7 Robustness Checks

In this section we consider alternative restrictions to the construction of our samples as well as the role of non-linear effects. The sample used to estimate the main results is constructed conservatively to increase the likelihood that identifying assumptions hold. We find balance across observable characteristics in our fixed effects specifications, but do sacrifice in terms of power and representativeness of the overall sample. With this in mind, we loosen some sample restrictions and re-estimate average effects at the individual-level in Appendix A.6. First, we incrementally include voters that live further away from the precinct border (up to 0.5 miles). Changing the distance from the border does not meaningfully change the results reported in Tables 1 and 2. In the main sample, we exclude individuals who live further than ten miles away from the polling place, to avoid geocoding errors. However, this may unintentionally remove some voters who live unusually far from their polling place, which could bias estimates in rural areas. We show that the inclusion of voters who live more than ten miles away from the polling place also does not substantially change estimates.

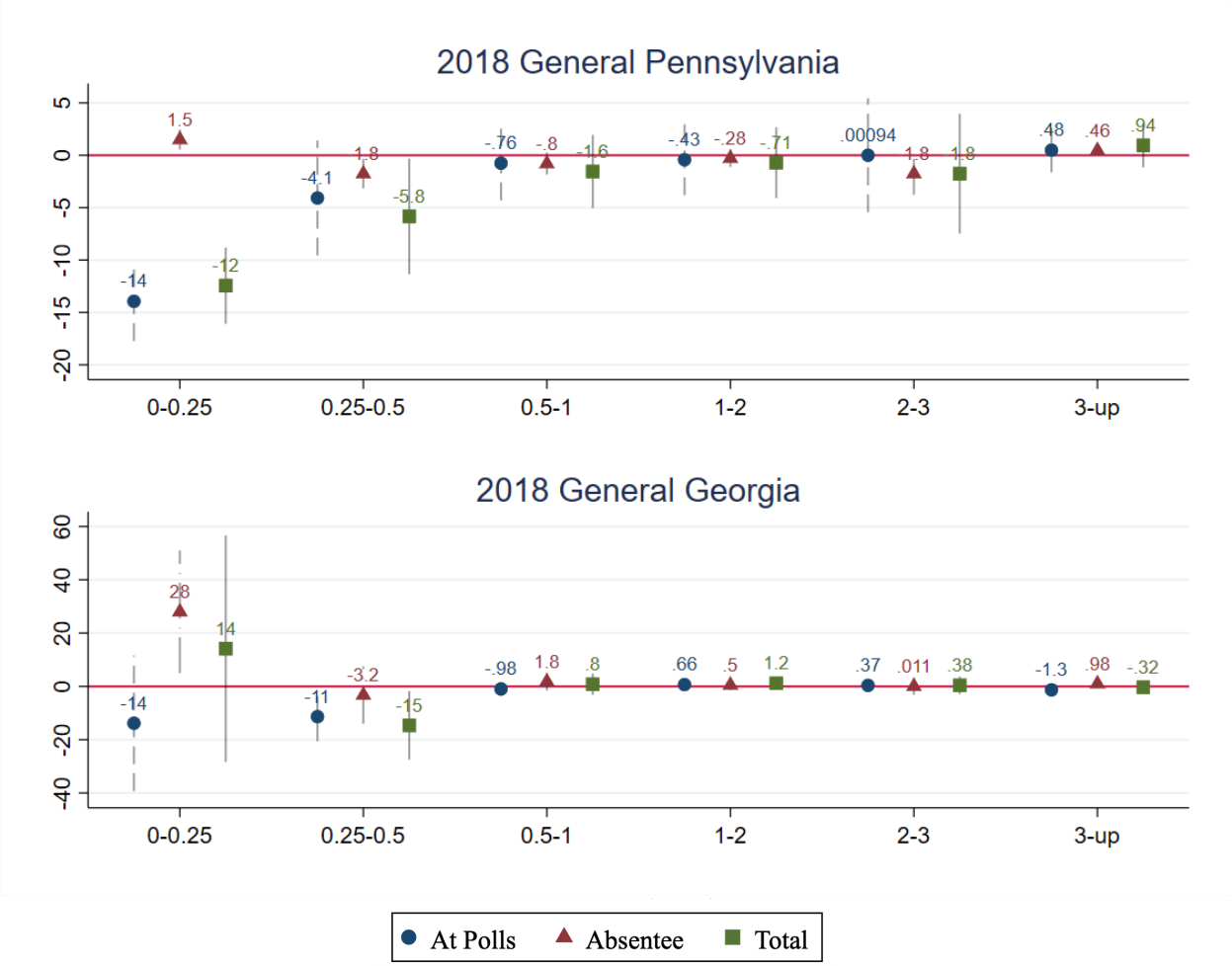
Non-linear effects. Last, we consider the potential non-linearity of the effect of distance to polling place on voting. We estimate the following specification to isolate the effect of distance to polling place across different intervals:

$$vote_i = \delta_{s(i)} + \gamma\ D_i + \beta\ D_i \cdot dist_i + \rho \mathcal{P}_i + \iota\ \mathcal{X}_b(i) + \epsilon_i \tag{2}$$

The variable D_i refers to a vector of indicator variables that take value 1 when the average distance to polling place in block i is within a particular range of miles and 0 otherwise. The distance ranges are: [0,0.25), [0.25,0.5), [0.5,1), [1,2), [2,3), and [3,10]. We report in Figure 12 the vector of coefficients, β for general elections. These coefficients can be interpreted as the effect of distance to polling place on the likelihood of voting within each distance category.

In both Pennsylvania and Georgia, the average effects are driven by voters that are a short distance away from polling places. We find that voters who face distances up to half a mile are most sensitive to distance to polling place, with decreases in turnout at polls of 14 p.p. in both Pennsylvania and Georgia. Although the average effects we find in our main results are small, they mask non-linearity in the responses to changes in distance to the polling place.

Figure 12: The effect of distance to polling place on likelihood of voting in General elections: Non-linear effects



Note: Distance to polling place is measured in miles. The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. All regressions include border fixed effects and additional individual-level and block-level covariates: registered Democrat indicator, registered Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors clustered at the border level are reported in parentheses.

8 Conclusion

Among the many costs of voting, some are easy to control or ban (polling taxes) and others are impossible to control (bad weather). The distance to the polling place is both inherent to the voting process and is subject to regulation. However, we know relatively little about how distance to polling place affects voter participation. This paper is another step toward informing the policy debate on the distributional effects of changes to polling places.

We study the causal effect of distance to polling place on voter participation and voting method (at polls or by mail) in two large swing states, Georgia and Pennsylvania. On average, there is a small negative effect of distance to polling place on the likelihood that a registered voter goes to the poll to vote (0.45 p.p. to 1.72 p.p. per mile). In Georgia, voters substitute to voting by mail by the same order of magnitude, such that there is no net effect on turnout. In Pennsylvania, substitution to mail-in voting is limited and there is a negative net effect of distance to polling place on the likelihood of voting. Although we use the same geographical border discontinuity approach as in Cantoni (2020), we find substantially smaller average effects. We reconcile these differences through extensive analysis of heterogeneous effects and by considering variations in electoral policies across states.

The results highlight some important lessons for studies of polling places in the future. First, it is important to use large datasets to study costs of voting in large elections, where power is needed to detect very small effects. Although we estimate small effects of distance to polling place, change to polling places could still lead to meaningful changes in aggregate. In the 2020 presidential election, the margin of victory for Joe Biden was less than one percentage point in both Georgia and Pennsylvania. A mile change (slightly less than one standard deviation in distance) for all voters would decrease turnout by up to 0.99 p.p. in Pennsylvania and would shift voting from in-person to mail-in voting in Georgia. Having a statewide dataset also allows for meaningful descriptive statistics of the distribution of polling places and allows us to explore the effects by different characteristics of the population.

We find that the sensitivity to distance to polling palace varies across settings and for different demographic groups. Although our average effect sizes in Pennsylvania and Georgia are an order of magnitude smaller than those found in a previous comparable study in urban areas, we find that heterogeneous effects can explain these discrepancies. In particular, in areas where people rely on public transportation for commuting, voters are most sensitive to polling place location. A one mile increase in distance to polling places is associated with an 5.6 to 28 p.p. decrease in total turnout. These findings may point to the need of facilitating easier access to polling places for those that rely on public transport. Older voters are also more sensitive and more likely to substitute

to mail-in voting. In Georgia, male voters seem to be more sensitive to changes in distance while we don't observe the same pattern in Pennsylvania. We do not find any statistically significant differences in the sensitivity to polling place location by race or ethnicity.

The findings in this paper can help election commissions that face costly tradeoffs in choosing how many polling places to open and where to place them. For instance, closing or moving polling places in areas where voters have access to car transportation is less costly than closing or moving polling places in areas with heavy reliance on public transportation. Every ten years, following the U.S. Census, state and local officials determine the boundaries of voting precincts, a process known as "reprecincting". This paper suggests that these decisions are not without consequences. Currently, precincts are designed to have equal population size so that polling places each serve a similarly sized constituency. With the more nuanced understanding of when voters choose mail-in ballots over voting in person or choose to abstain from voting, election commissions may have an opportunity to reduce costs of voting or make costs of voting more equal across the population.

References

Stephen Ansolabehere, Bernard L. Fraga, and Brian F. Schaffner. The CPS Voting and Registration Supplement Overstates Minority Turnout, 2020.

James M. Avery. Does Who Votes Matter? Income Bias in Voter Turnout and Economic Inequality in the American States from 1980 to 2010. *Political Behavior*, 37 (4):955–976, 2015. ISSN 01909320. doi: 10.1007/s11109-015-9302-z.

Céline Braconnier, Jean Yves Dormagen, and Vincent Pons. Voter registration costs and disenfranchisement: Experimental evidence from France. *American Political Science Review*, 111(3):584–604, 2017. ISSN 15375943. doi: 10.1017/S000305541700003X.

Henry E. Brady and John E. McNulty. Turning out to vote: The costs of finding and getting to the polling place. *American Political Science Review*, 105(1):115–134, 2011. ISSN 00030554. doi: 10.1017/S0003055410000596.

Enrico Cantoni. A Precinct Too Far: Turnout and Voting Costs. *American Economic Journal: Applied Economics*, 12(1):61–85, 2020. ISSN 1945-7782. doi: 10.1257/app.20180306.

Enrico Cantoni and Vincent Pons. Does Context Trump Individual Drivers of Voting Behavior? Evidence from U.S. Movers. *Working Paper*, (July): 1–43, 2019. URL `https://www.hbs.edu/faculty/PublicationFiles/19-025_85938b2f-de86-43a4-b725-460810843ba6.pdf`.

M. Keith Chen, Kareem Haggag, Devin G. Pope, and Ryne Rohla. Racial Disparities in Voting Wait Times: Evidence from Smartphone Data. *NBER Working Paper Series*, 53(9):1689–1699, 8 2019. ISSN 1098-6596. URL `http://arxiv.org/abs/1909.00024`.

Joshua D Clinton, Nick Eubank, Adriane Fresh, and Michael E Shepherd. Polling Place Changes and Political Participation: Evidence from North Carolina Presidential Elections, 2008-2016 *. pages 2008–2016, 2019.

Joshua J. Dyck and James G. Gimpel. Distance, turnout, and the convenience of voting. *Social Science Quarterly*, 86(3):531–548, 2005. ISSN 00384941. doi: 10.1111/j.0038-4941.2005.00316.x.

Mara Suttmann-Lea Enrijeta Shino and Daniel A. Smith. Voting by mail in a venmo world: Assessing rejected absentee ballots in georgia. 2020. URL `https://electionscience.clas.ufl.edu/files/2020/05/GA_Venmo.pdf`.

Bernard L. Fraga. *The Turnout Gap*. Cambridge University Press, 2018.

Thomas Fujiwara, Kyle Meng, and Tom Vogl. Habit formation in voting: Evidence from rainy elections. *American Economic Journal: Applied Economics*, 8(4):160–188, 2016. ISSN 19457790. doi: 10.1257/app.20140533.

Martin Gilens. *Affluence and Influence*. Princeton University Press, 2012.

Brad T. Gomez, Thomas G. Hansford, and George A. Krause. The pepublicans should pray for rain: Weather, turnout, and voting in U.S. presidential elections. *Journal of Politics*, 69(3):649–663, 2007. ISSN 00223816. doi: 10.1111/j.1468-2508.2007.00565.x.

Moshe Haspel and H. Gibbs Knotts. Location, location, location: Precinct placement and the costs of voting. *Journal of Politics*, 67(2):560–573, 2005. ISSN 00223816. doi: 10.1111/j.1468-2508.2005.00329.x.

Benjamin Highton. Voter identification laws and turnout in the united states. *Annual Review of Political Science*, 20(1):149–167, 2017. doi: 10.1146/annurev-polisci-051215-022822. URL `https://doi.org/10.1146/annurev-polisci-051215-022822`.

Dean Jolliffe, Juan Margitic, and Martin Ravallion. Food Stamps and America's Poorest. Technical Report 9, National Bureau of Economic Research, Cambridge, MA, 6 2019. URL `http://www.nber.org/papers/w26025.pdf`.

Ethan Kaplan and Haishan Yuan. Early voting laws, voter turnout, and Partisan vote composition: Evidence from Ohio. *American Economic Journal: Applied Economics*, 12(1):32–60, 2020. ISSN 19457790. doi: 10.1257/app.20180192.

Jan E. Leighley and Jonathan Nagler. *Who votes now?* Princeton University Press, 2014.

Mackenzie Lockhart, Seth J. Hill, Jennifer Merolla, Mindy Romero, and Thad Kousser. America's electorate is increasingly polarized along partisan lines about voting by mail during the covid-19 crisis. *Proceedings of the National Academy of Sciences*, 117(40):24640–24642, 2020. ISSN 0027-8424. doi: 10.1073/pnas.2008023117. URL `https://www.pnas.org/content/117/40/24640`.

Paul S. Martin. Voting's rewards: Voter turnout, attentive publics, and congressional allocation of federal money. *American Journal of Political Science*, 47(1):110–127, 2003. ISSN 00925853. doi: 10.1111/1540-5907.00008.

Marc Meredith and Zac Endter. Aging into absentee voting: Evidence from texas. 2016. URL https://www.sas.upenn.edu/~marcmere/workingpapers/AgingIntoAbsentee.pdf.

Marc Meredith and Neil Malhotra. Convenience voting can affect election outcomes. *Election Law Journal*, 10(3), 2011.

Kevin Milligan, Enrico Moretti, and Philip Oreopoulos. Does education improve citizenship? evidence from the united states and the united kingdom. *Journal of Public Economics*, 88(9):1667 – 1695, 2004. ISSN 0047-2727. doi: https://doi.org/10.1016/j.jpubeco.2003.10.005. URL http://www.sciencedirect.com/science/article/pii/S0047272703002056.

David Neumark and William Wascher. Using the eitc to help poor families: New evidence and a comparison with the minimum wage. *National Tax Journal*, 54(2): 281–317, 2001. ISSN 00280283, 19447477. URL http://www.jstor.org/stable/41789549.

Eric Plutzer. Becoming a Habitual Voter: Inertia, Resources, and Growth in Young Adulthood. *The American Political Science Review*, 96(1):41–56, 2002.

Michael E. Shepherd, Adriane Fresh, Nick Eubank, and Joshua D. Clinton. The Politics of Locating Polling Places: Race and Partisanship in North Carolina Election Administration, 2008–2016. *Election Law Journal: Rules, Politics, and Policy*, pages 2008–2016, 2020. ISSN 1533-1296. doi: 10.1089/elj.2019.0602.

Rachel Milstein Sondheimer and Donald P. Green. Using experiments to estimate the effects of education on voter turnout. *American Journal of Political Science*, 54(1): 174–189, 2010. doi: https://doi.org/10.1111/j.1540-5907.2009.00425.x. URL https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-5907.2009.00425.x.

Daniel M. Thompson, Jennifer A. Wu, Jesse Yoder, and Andrew B. Hall. Universal vote-by-mail has no impact on partisan turnout or vote share. *Proceedings of the National Academy of Sciences of the United States of America*, 117(25):14052–14056, 2020. ISSN 10916490. doi: 10.1073/pnas.2007249117.

Jesse Yoder. How Polling Place Changes Reduce Turnout: Evidence from Administrative Data in North Carolina. *SSRN Electronic Journal*, 2018. ISSN 1556-5068. doi: 10.2139/ssrn.3178184.

A Appendix

A.1 Data

Table A.1: Variable Definitions, Units of Observation, and Data Sources

Variable	Definition	Unit of Observation	Source
Turnout	Votes per voting age population	Block	PA Secretary of State
Distance to Polling Place	Miles from block interior centroid to polling place	Block	Computed value
Race, Ethnicity, Gender, Age	Percent of population in demographic group	Block	2010 Census
Car Ownership	Number of cars per housing units	Block-group	2006-2010 ACS
Way to Work	Percent of workers 16 and older using mode of transportation to work	Block-group	2006-2010 ACS
Time to Work	Time to work among workers 16 and older who do not work from home	Block-group	2006-2010 ACS
Median Income	Median household income for the past 12 months	Block-group	2006-2010 ACS
Home Ownership	Percent of households owning home	Block-group	2006-2010 ACS
Education	Percent of population older than 25 belonging to education group	Block-group	2006-2010 ACS

A.2 Summary Statistics

Table A.2: Summary Statistics

	Pennsylvania				Georgia			
	All		Regression sample		All		Regression sample	
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Voting History								
Primary election, at polls	18.41	38.75	16.30	36.94	12.30	32.85	11.50	31.91
Primary election, absentee	0.38	6.16	0.33	5.73	4.60	20.95	4.12	19.87
Primary election, total	18.79	39.06	16.63	37.24	16.90	37.48	15.62	36.31
General election, at polls	56.79	49.54	51.91	49.96	25.79	43.75	24.91	43.25
General election, absentee	2.23	14.78	1.65	12.72	29.76	45.72	27.34	44.57
General election, total	59.03	49.18	53.56	49.87	55.55	49.69	52.25	49.95
Distance to polling place (mi)	0.93	3.72	0.38	0.50	1.66	2.70	1.32	1.28
Democrat	0.48	0.50	0.64	0.48	0.08	0.27	0.09	0.28
Republican	0.38	0.49	0.22	0.41	0.09	0.28	0.06	0.25
Independent	0.14	0.35	0.14	0.35	0.83	0.37	0.85	0.36
Demographics								
Population	145.70	220.38	149.02	200.29	337.02	465.12	298.92	421.26
Voting Age Population	115.55	190.53	120.02	178.01	244.13	332.47	223.55	309.17
Percent urban	0.80	0.40	0.98	0.13	0.75	0.43	0.87	0.34
Percent Black	0.11	0.23	0.27	0.35	0.30	0.33	0.37	0.35
Percent Hispanic	0.05	0.11	0.08	0.16	0.07	0.11	0.07	0.11
Poverty Rate	0.12	0.13	0.19	0.18	0.14	0.13	0.17	0.16
Median hh Income (10k USD)	5.86	2.89	4.75	2.68	5.85	2.89	5.69	3.14
Way to work								
% Car to work	0.85	0.17	0.71	0.23	0.90	0.09	0.87	0.12
% Walk to work	0.04	0.09	0.07	0.12	0.01	0.04	0.02	0.06
% Pub transit to work	0.06	0.12	0.16	0.18	0.02	0.06	0.04	0.08
% Bike to work	0.00	0.02	0.01	0.03	0.00	0.01	0.00	0.02
Time to work								
% time to work 0-5min	0.04	0.05	0.03	0.05	0.03	0.04	0.02	0.04
% time to work 5-60min	0.88	0.08	0.88	0.10	0.88	0.08	0.89	0.08
% time to work 60min plus	0.08	0.08	0.09	0.09	0.10	0.08	0.09	0.08
N	8,245,003		1,704,797		6,980,226		495,641	

Note: For each voting history variable, we observe whether or not a registered voter votes, by method of voting. Each indicator variable is multiplied by 100 to make coefficients easier to interpret. Demographic variables are measured at the block, or block-group level and assigned to each individual voter that resides in the geographic area.

Table A.3: Correlates of Distance to Polling Place

	Pennsylvania			Georgia		
	(1) All Individual	(2) Blocks in Border FE Sample	(3) Blocks in Border FE Sample	(4) All Individuals	(5) Blocks in Border FE Sample	(6) Blocks in Border FE Sample
Democrat	-0.049***	0.000	0.000	-0.089***	-0.015***	-0.017***
	(0.008)	(0.001)	(0.001)	(0.017)	(0.004)	(0.004)
Republican	0.047***	0.001	0.002	-0.074**	-0.011*	-0.012*
	(0.011)	(0.001)	(0.001)	(0.034)	(0.007)	(0.006)
Population	-0.001	-0.000	-0.000	0.000	0.000	0.000
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age 18 to 29	-0.042***	0.005**	0.005**	0.008	0.004	0.002
	(0.010)	(0.002)	(0.002)	(0.014)	(0.008)	(0.007)
Age 30 to 49	-0.039***	0.005**	0.005**	0.024	-0.003	-0.003
	(0.008)	(0.002)	(0.002)	(0.017)	(0.007)	(0.007)
Age 50 to 64	0.002	0.003	0.003	0.040***	0.001	0.000
	(0.006)	(0.002)	(0.002)	(0.012)	(0.006)	(0.006)
Female	-0.015**	0.000	0.000	-0.016***	-0.002	-0.002
	(0.006)	(0.001)	(0.001)	(0.004)	(0.001)	(0.001)
Voting Age Population	0.001	0.000	0.000	-0.000	0.000	0.000
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Percent Black	-0.091	-0.004	-0.004	-0.450***	-0.070	-0.081*
	(0.065)	(0.026)	(0.026)	(0.111)	(0.045)	(0.041)
Percent Hispanic	1.416	0.020	0.024	-0.594***	-0.183**	-0.127**
	(1.110)	(0.026)	(0.026)	(0.144)	(0.072)	(0.063)
Median hh Income (10k USD)	-0.006	0.003	0.001	-0.053***	0.008	0.011
	(0.013)	(0.003)	(0.003)	(0.012)	(0.010)	(0.009)
Poverty Rate	-0.098	-0.004	-0.008	-0.457**	0.073	0.076
	(0.203)	(0.037)	(0.036)	(0.214)	(0.114)	(0.103)
Cars per Household	0.804***	0.005	0.017	0.880***	0.124**	0.088*
	(0.177)	(0.021)	(0.016)	(0.183)	(0.060)	(0.047)
Percent without high school diploma	0.365***	-0.016	-0.017	1.540*	-0.106	-0.084
	(0.096)	(0.026)	(0.026)	(0.900)	(0.122)	(0.112)
% Walk to work	-0.230*	-0.027	-0.019	-0.729	-0.199	-0.363
	(0.131)	(0.036)	(0.035)	(0.724)	(0.343)	(0.296)
% time to work 0-5min	-1.677***	-0.103	-0.096	-2.580***	-0.118	0.122
	(0.401)	(0.090)	(0.085)	(0.715)	(0.293)	(0.260)
Black nh				-0.028*	-0.004	-0.003
				(0.016)	(0.004)	(0.004)
Hispanic				-0.022***	-0.002	-0.002
				(0.008)	(0.006)	(0.006)
White nh				0.028**	-0.003	0.000
				(0.013)	(0.005)	(0.004)
County FE	X			X		
Border FE		X	X		X	X
County-Lat/Long			X			X
N	4924711	1101629	1101629	6015607	445077	445077
y variable mean	0.91	0.37	0.37	1.66	1.34	1.34
R^2	0.019	0.748	0.758	0.099	0.830	0.847

A.3 Block-level estimates

Table A.4: The effect of distance to polling place on turnout: Pennsylvania

	Panel A: OLS with Precinct FE and Controls					
	Primary Election			General Election		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance to polling place	-0.6460***	-0.0043	-0.6505***	-0.5936***	0.2250***	-0.4380**
	(0.1389)	(0.0209)	(0.1424)	(0.1977)	(0.0549)	(0.2052)
N	173573	174702	173567	165936	174604	165913
y variable mean	16.34	0.35	16.67	45.87	1.94	47.57
R^2	0.177	0.053	0.179	0.255	0.112	0.270
	Panel B: Border FE with Controls					
	Primary Election			General Election		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance to polling place	-0.4864***	0.0350	-0.4731***	-0.6016**	0.2078***	-0.4731*
	(0.1732)	(0.0325)	(0.1788)	(0.2550)	(0.0590)	(0.2618)
N	108708	109338	108706	104530	109279	104518
y variable mean	15.72	0.34	16.04	44.55	1.73	46.08
R^2	0.280	0.102	0.281	0.355	0.177	0.371
	Panel C: Border FE with Controls and County-Lat./Lon.					
	Primary Election			General Election		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance to polling place	-0.4791***	0.0477	-0.4524**	-0.6058**	0.2323***	-0.4741*
	(0.1747)	(0.0294)	(0.1779)	(0.2584)	(0.0582)	(0.2653)
N	108708	109338	108706	104530	109279	104518
y variable mean	15.72	0.34	16.04	44.55	1.73	46.08
R^2	0.283	0.103	0.283	0.357	0.179	0.373

Note: Distance to polling place measured in miles. Turnout is measured as the number of votes per voting-age population (separately for votes cast at polling places, through absentee ballots, and total). All regressions include Border Fixed Effects (Border FE). County-Lat./Lon. refers to latitude and longitude controls, interacted with county fixed effects. The additional controls in Panels B and C are: population, voting age population, percent registered Democrat, percent registered Republican, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors clustered at the border level are reported in parentheses.

Table A.5: The effect of distance to polling place on turnout: Georgia

	Panel A: OLS with Precinct FE and Controls					
	Primary Election			General Election		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance to polling place	-0.4316***	0.1555***	-0.2701***	-0.8066***	1.0935***	0.2472
	(0.0757)	(0.0548)	(0.0990)	(0.0949)	(0.1170)	(0.1569)
N	87852	88332	87718	86499	85553	84538
y variable mean	13.60	5.66	19.09	25.36	29.11	54.00
R^2	0.143	0.101	0.144	0.193	0.184	0.178
	Panel B: Border FE with Controls					
	Primary Election			General Election		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance to polling place	-0.5935***	0.4661***	-0.1389	-2.0821***	1.2319***	-0.8558**
	(0.1772)	(0.1363)	(0.1981)	(0.2735)	(0.3058)	(0.4035)
N	32752	32933	32708	32269	32005	31655
y variable mean	13.51	5.23	18.55	25.52	27.45	52.56
R^2	0.524	0.335	0.607	0.320	0.370	0.377
	Panel C: Border FE with Controls and County-Lat./Lon.					
	Primary Election			General Election		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance to polling place	-0.5911***	0.4878***	-0.1225	-2.2828***	1.5376***	-0.8430**
	(0.1869)	(0.1382)	(0.2084)	(0.2799)	(0.3100)	(0.4215)
N	32752	32933	32708	32269	32005	31655
y variable mean	13.51	5.23	18.55	25.52	27.45	52.56
R^2	0.533	0.349	0.614	0.331	0.384	0.386

Note: Distance to polling place measured in miles. Turnout is measured as the number of votes per voting-age population (separately for votes cast at polling places, through absentee ballots, and total). All regressions include Border Fixed Effects (Border FE). County-Lat./Lon. refers to latitude and longitude controls, interacted with county fixed effects. The additional controls in Panels B and C are: population, voting age population, percent registered Democrat, percent registered Republican, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors clustered at the border level are reported in parentheses.

A.4 Heterogeneous Effects: Individual Level

Table A.6: The effect of distance to polling place on likelihood of voting: by Age

	Age 18-29					
	General Pennsylvania			General Georgia		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-0.5428	0.0309	-0.5120	-0.3240	0.8727***	0.5487
	(0.4629)	(0.1155)	(0.4673)	(0.3094)	(0.2758)	(0.3747)
N	246636	246636	246636	114752	114752	114752
y variable mean	41.06	1.48	42.53	20.31	14.71	35.02
R^2	0.105	0.077	0.116	0.061	0.124	0.139
	Age 30-49					
	General Pennsylvania			General Georgia		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-0.4848	0.0862	-0.3986	-1.7721***	1.7789***	0.0068
	(0.4242)	(0.0535)	(0.4210)	(0.2663)	(0.2762)	(0.3129)
N	396102	396102	396102	156859	156859	156859
y variable mean	49.42	0.88	50.29	27.28	22.62	49.90
R^2	0.102	0.032	0.107	0.071	0.140	0.178
	Age 50-64					
	General Pennsylvania			General Georgia		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-1.4366***	0.1636	-1.2730***	-2.3287***	2.0268***	-0.3019
	(0.3975)	(0.1139)	(0.3914)	(0.2884)	(0.3300)	(0.3038)
N	256849	256849	256849	103039	103039	103039
y variable mean	62.43	1.36	63.80	27.03	36.01	63.04
R^2	0.101	0.057	0.108	0.094	0.176	0.220
	Age 65 up					
	General Pennsylvania			General Georgia		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-1.5232**	0.5613***	-0.9619*	-2.1668***	2.6221***	0.4552
	(0.6215)	(0.2175)	(0.5749)	(0.3892)	(0.4242)	(0.3166)
N	200687	200687	200687	70427	70427	70427
y variable mean	64.42	3.68	68.10	22.18	45.94	68.12
R^2	0.104	0.082	0.103	0.134	0.203	0.265

Note: Distance to polling place is measured in miles. The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. All regressions include border fixed effects and additional individual-level and block-level covariates: registered Democrat indicator, registered Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors clustered at the border level are reported in parentheses.

Table A.7: The effect of distance to polling place on likelihood of voting: by Gender

	Female					
	General Pennsylvania			General Georgia		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-1.1381***	0.2151**	-0.9230***	-1.7630***	1.9728***	0.2098
	(0.3612)	(0.0857)	(0.3480)	(0.2068)	(0.2173)	(0.2193)
N	600505	600505	600505	240919	240919	240919
y variable mean	55.07	1.74	56.81	25.44	29.32	54.76
R^2	0.098	0.044	0.107	0.057	0.184	0.196
	Male					
	General Pennsylvania			General Georgia		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-0.6636**	0.1960**	-0.4676	-1.6324***	1.7829***	0.1505
	(0.3146)	(0.0765)	(0.3042)	(0.2103)	(0.2127)	(0.2246)
N	499769	499769	499769	204158	204158	204158
y variable mean	51.21	1.51	52.72	23.64	25.07	48.71
R^2	0.121	0.036	0.133	0.071	0.189	0.236

Note: Distance to polling place is measured in miles. The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. All regressions include border fixed effects and additional individual-level and block-level covariates: registered Democrat indicator, registered Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors clustered at the border level are reported in parentheses.

Table A.8: The effect of distance to polling place on likelihood of voting: by Party Affiliation

	Democrat					
	General Pennsylvania			General Georgia		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-1.0557***	0.1237	-0.9320***	-4.4799***	4.2396***	-0.2402
	(0.3479)	(0.0782)	(0.3295)	(0.6845)	(0.7004)	(0.2679)
N	733063	733063	733063	40212	40212	40212
y variable mean	55.23	1.63	56.87	31.30	65.24	96.54
R^2	0.093	0.041	0.104	0.151	0.155	0.101
	Republican					
	General Pennsylvania			General Georgia		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-0.6993	0.3194**	-0.3798	-3.0107***	3.1848***	0.1741
	(0.4383)	(0.1367)	(0.4096)	(0.5906)	(0.5735)	(0.1516)
N	228128	228128	228128	27928	27928	27928
y variable mean	56.29	2.00	58.29	39.18	57.88	97.06
R^2	0.131	0.060	0.142	0.243	0.253	0.150
	Independent					
	General Pennsylvania			General Georgia		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-0.1119	0.2999**	0.1880	-1.2394***	1.4690***	0.2296
	(0.5591)	(0.1191)	(0.5624)	(0.1791)	(0.1912)	(0.2258)
N	139083	139083	139083	376937	376937	376937
y variable mean	38.33	1.06	39.39	22.82	21.07	43.90
R^2	0.138	0.079	0.147	0.043	0.082	0.084

Note: Distance to polling place is measured in miles. The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. All regressions include border fixed effects and additional individual-level and block-level covariates: registered Democrat indicator, registered Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors clustered at the border level are reported in parentheses.

Table A.9: The effect of distance to polling place on likelihood of voting: by Race

	Black nh					
	Primary Georgia			General Georgia		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-0.2795*	0.2926*	0.0130	-2.1880***	1.7390***	-0.4490
	(0.1648)	(0.1674)	(0.0353)	(0.3236)	(0.3365)	(0.3675)
N	165509	165509	165509	165509	165509	165509
y variable mean	10.93	3.83	14.76	22.35	27.46	49.81
R^2	0.710	0.264	0.984	0.050	0.225	0.233
	White nh					
	Primary Georgia			General Georgia		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-0.5845***	0.5419***	-0.0426**	-1.7016***	2.0909***	0.3893*
	(0.0983)	(0.0979)	(0.0209)	(0.2330)	(0.2444)	(0.2181)
N	201672	201672	201672	201672	201672	201672
y variable mean	13.93	5.24	19.18	28.23	30.58	58.82
R^2	0.682	0.267	0.979	0.078	0.181	0.212
	Hispanic					
	Primary Georgia			General Georgia		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	0.1960	-0.1517	0.0442	0.0137	2.0739**	2.0876
	(0.3400)	(0.2810)	(0.2163)	(1.1593)	(1.0348)	(1.2753)
N	13927	13927	13927	13927	13927	13927
y variable mean	5.03	1.11	6.14	24.93	16.97	41.90
R^2	0.826	0.330	0.970	0.194	0.260	0.262
	Other					
	Primary Georgia			General Georgia		
	At Poll	Absentee	Total	At Poll	Absentee	Total
Distance (miles)	-0.2269*	0.2320*	0.0051	-1.0211***	0.6228*	-0.3983
	(0.1280)	(0.1270)	(0.0443)	(0.3633)	(0.3777)	(0.4281)
N	63969	63969	63969	63969	63969	63969
y variable mean	6.43	2.02	8.45	19.01	19.27	38.28
R^2	0.740	0.265	0.965	0.091	0.190	0.217

Note: Distance to polling place is measured in miles. The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. All regressions include border fixed effects and additional individual-level and block-level covariates: registered Democrat indicator, registered Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors clustered at the border level are reported in parentheses.

A.5 Heterogeneous Effects: Block Level

Table A.10: The effect of distance to polling place on turnout: by Educational Attainment

	Pennsylvania			Georgia		
	(1) GE AP	(2) GE AB	(3) GE Total	(4) GE AP	(5) GE AB	(6) GE Total
Percent without high school diploma	-10.339***	-1.554***	-11.629***	-13.491***	-3.050	-16.845***
	(1.472)	(0.369)	(1.532)	(2.474)	(2.380)	(3.497)
Percent with high school diploma	-9.930***	-1.380*	-11.772***	-13.501***	-0.212	-13.723***
	(2.464)	(0.750)	(2.573)	(2.513)	(2.774)	(3.918)
Percent with bachelors diploma	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
Mean Distance to Polling Place × % without high school diploma	0.397	0.213	0.321	-1.503	1.618	0.086
	(0.820)	(0.198)	(0.848)	(1.033)	(1.227)	(1.651)
Mean Distance to Polling Place × % with high school diploma	-1.399	-0.160	-0.976	-0.837	-2.804	-3.681*
	(2.252)	(0.651)	(2.342)	(1.341)	(1.750)	(2.141)
Mean Distance to Polling Place × % with bachelors diploma	-2.206	0.600	-1.999	-5.526***	5.970***	0.560
	(1.342)	(0.453)	(1.409)	(0.991)	(1.131)	(1.560)
N	101036	105618	101025	30392	30162	29830
y variable mean	44.60	1.73	46.13	25.88	27.51	52.98
R^2	0.359	0.180	0.375	0.326	0.379	0.384

Note: Distance to polling place is measured in miles. The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. All regressions include border fixed effects and additional block-level covariates: population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors clustered at the border level are reported in parentheses.

Table A.11: The effect of distance to polling place on turnout: by by Income Categories

	Pennsylvania			Georgia		
	(1) GE AP	(2) GE AB	(3) GE Total	(4) GE AP	(5) GE AB	(6) GE Total
Mean Distance to Polling Place	-1.949	0.676	-1.930	0.312	0.766	0.537
× <15k	(1.894)	(0.631)	(1.919)	(1.655)	(2.024)	(2.753)
Mean Distance to Polling Place	2.872	0.420	3.142*	-2.708*	-0.238	-2.297
× 15-30k	(1.784)	(0.416)	(1.810)	(1.505)	(1.878)	(2.408)
Mean Distance to Polling Place	-0.739	0.182	-0.342	-2.839	-2.760	-6.732**
× 30-50k	(1.993)	(0.480)	(2.074)	(1.991)	(2.236)	(3.006)
Mean Distance to Polling Place	-1.088	-0.163	-1.180	-0.967	2.276	1.984
× 50-100k	(1.581)	(0.374)	(1.699)	(1.402)	(1.672)	(2.062)
Mean Distance to Polling Place	-3.763	0.537	-3.753	-6.254***	7.575***	1.545
× 100-200k	(2.504)	(0.597)	(2.695)	(2.281)	(2.506)	(3.554)
Mean Distance to Polling Place	1.220	-1.233	1.021	-3.006	2.504	-1.217
× >200k	(4.706)	(1.427)	(4.975)	(3.914)	(5.561)	(6.458)
N	101036	105618	101025	30392	30162	29830
y variable mean	44.60	1.73	46.13	25.88	27.51	52.98
R^2	0.360	0.180	0.375	0.326	0.379	0.384

Note: Distance to polling place is measured in miles. The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. All regressions include border fixed effects and additional block-level covariates: population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors clustered at the border level are reported in parentheses.

Table A.12: The effect of distance to polling place on turnout: by Way to Work

	Pennsylvania			Georgia		
	(1) GE AP	(2) GE AB	(3) GE Total	(4) GE AP	(5) GE AB	(6) GE Total
% Other to work	2.684	0.330	3.282	1.704	-6.362	-2.627
	(3.623)	(0.827)	(3.771)	(6.788)	(6.398)	(9.832)
% Car to work	6.119***	-0.251	6.317***	6.549	1.635	9.251
	(2.252)	(0.558)	(2.351)	(4.635)	(4.225)	(6.952)
% Pub transit to work	7.055***	0.502	7.735***	17.158**	1.359	19.009*
	(2.646)	(0.627)	(2.764)	(7.461)	(5.804)	(10.114)
% Walk to work	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
Mean Distance to Polling Place	-1.107	-0.752	-0.869	4.359	11.451***	14.708***
× % Other to work	(4.470)	(0.971)	(4.684)	(3.722)	(4.060)	(5.517)
Mean Distance to Polling Place	-0.148	0.238**	-0.055	-2.319***	0.816*	-1.457***
× % Car to work	(0.397)	(0.096)	(0.411)	(0.349)	(0.418)	(0.534)
Mean Distance to Polling Place	-5.355***	0.003	-5.591***	-19.485***	-9.077*	-27.673***
× % Pub transit to work	(1.837)	(0.321)	(1.867)	(6.212)	(5.088)	(8.125)
Mean Distance to Polling Place	-4.268	0.667	-3.539	-3.524	-2.146	-4.787
× % Walk to work	(3.045)	(1.075)	(3.173)	(3.251)	(3.777)	(5.590)
N	101036	105618	101025	30392	30162	29830
y variable mean	44.60	1.73	46.13	25.88	27.51	52.98
R^2	0.359	0.180	0.374	0.326	0.378	0.383

Note: Distance to polling place is measured in miles. The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. All regressions include border fixed effects and additional block-level covariates: population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors clustered at the border level are reported in parentheses.

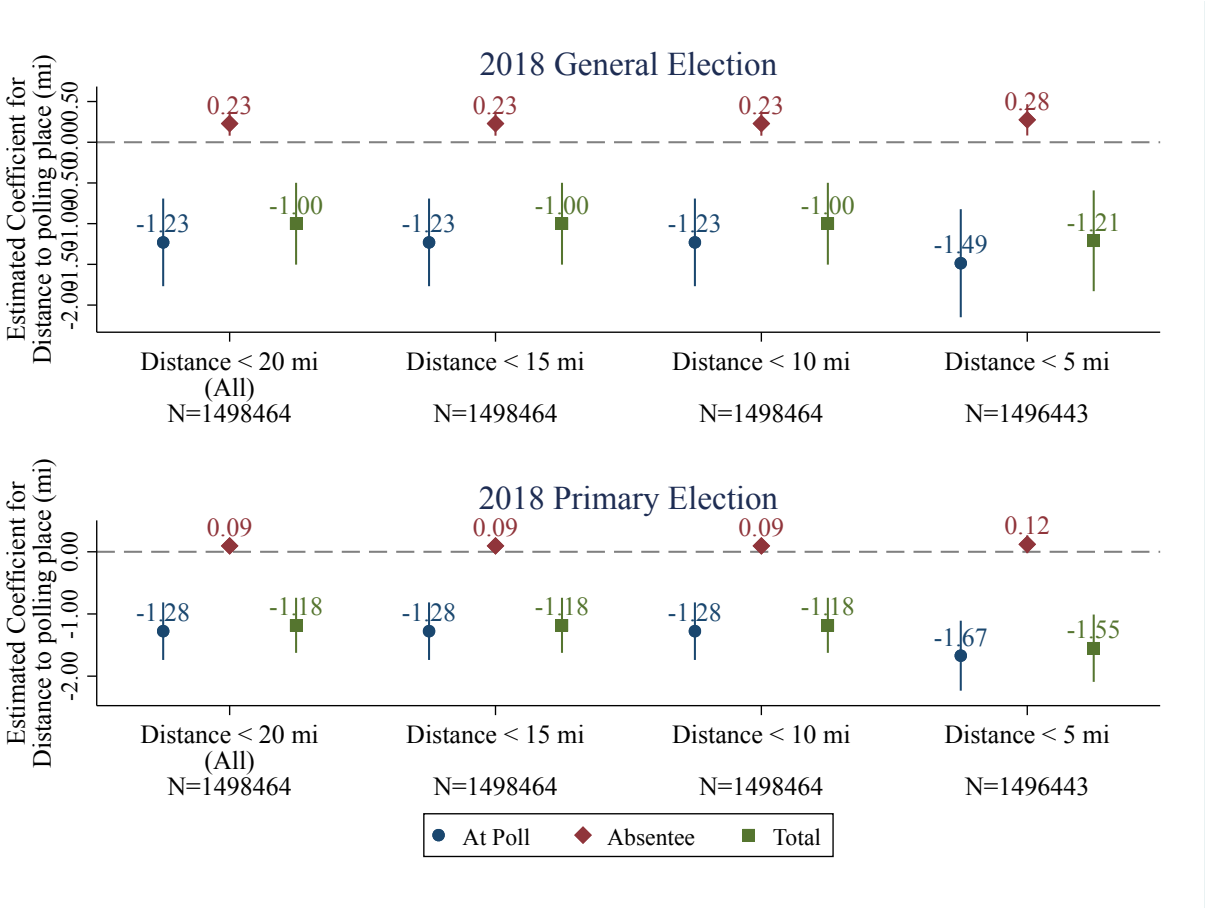
Table A.13: The effect of distance to polling place on turnout: by Time to Work

	Pennsylvania			Georgia		
	(1) GE AP	(2) GE AB	(3) GE Total	(4) GE AP	(5) GE AB	(6) GE Total
% time to work 0-5min	-3.093	-0.852	-3.876	3.023	7.223	10.273
	(3.934)	(0.807)	(4.173)	(5.815)	(6.022)	(8.785)
% time to work 5-15min	-5.206**	-0.302	-5.122**	-0.892	2.831	1.151
	(2.248)	(0.446)	(2.320)	(4.207)	(4.261)	(6.465)
% time to work 15-30min	-6.743***	-0.156	-6.843***	-2.430	-1.889	-3.960
	(2.081)	(0.454)	(2.145)	(4.114)	(3.976)	(6.109)
% time to work 30-60min	-3.506	-0.087	-3.440	-4.382	1.063	-3.920
	(2.169)	(0.412)	(2.220)	(4.380)	(4.520)	(6.690)
% time to work 60min plus	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
Mean Distance to Polling Place	-2.221	1.681	0.106	-2.983	-2.968	-5.393
× % time to work 0-5min	(5.600)	(1.163)	(6.024)	(3.724)	(3.937)	(4.980)
Mean Distance to Polling Place	1.026	0.129	0.620	-0.643	0.870	-0.010
× % time to work 5-15min	(1.455)	(0.276)	(1.510)	(1.170)	(1.358)	(1.796)
Mean Distance to Polling Place	0.904	0.432*	1.209	-3.471***	1.825	-1.489
× % time to work 15-30min	(1.037)	(0.247)	(1.083)	(1.098)	(1.390)	(1.704)
Mean Distance to Polling Place	-3.036**	0.122	-2.850**	-1.089	1.573	0.428
× % time to work 30-60min	(1.268)	(0.255)	(1.302)	(1.234)	(1.428)	(1.880)
Mean Distance to Polling Place	-4.840*	-1.115	-5.243*	-5.127*	-0.004	-4.988
× % time to work 60min plus	(2.608)	(0.771)	(2.707)	(3.010)	(3.303)	(4.449)
N	101036	105618	101025	30392	30162	29830
y variable mean	44.60	1.73	46.13	25.88	27.51	52.98
R^2	0.359	0.180	0.374	0.326	0.377	0.383

Note: Distance to polling place is measured in miles. The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. All regressions include border fixed effects and additional block-level covariates: population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors clustered at the border level are reported in parentheses.

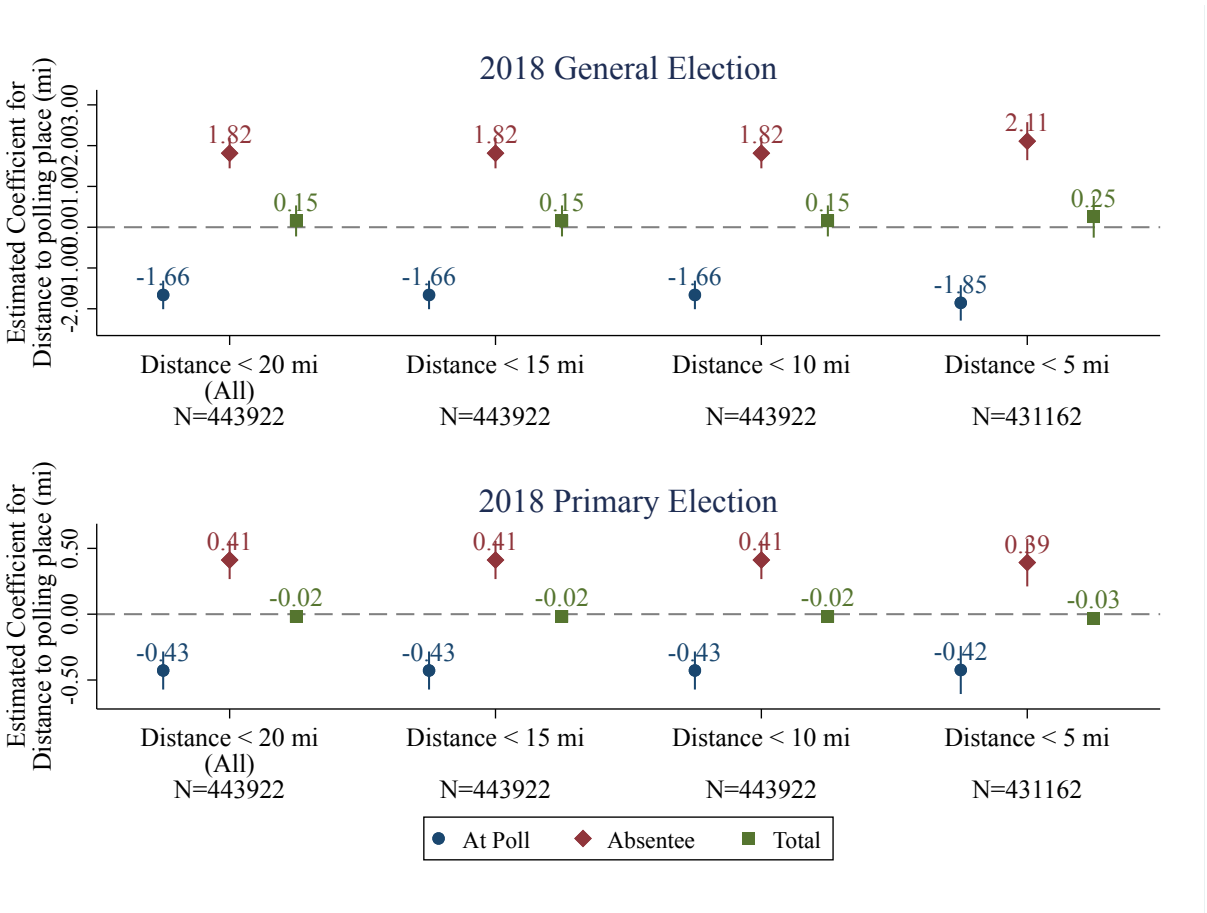
A.6 Robustness Checks

Figure A.1: Individual-level Border Fixed Effects estimates: Vary maximum distance to polling place, Pennsylvania



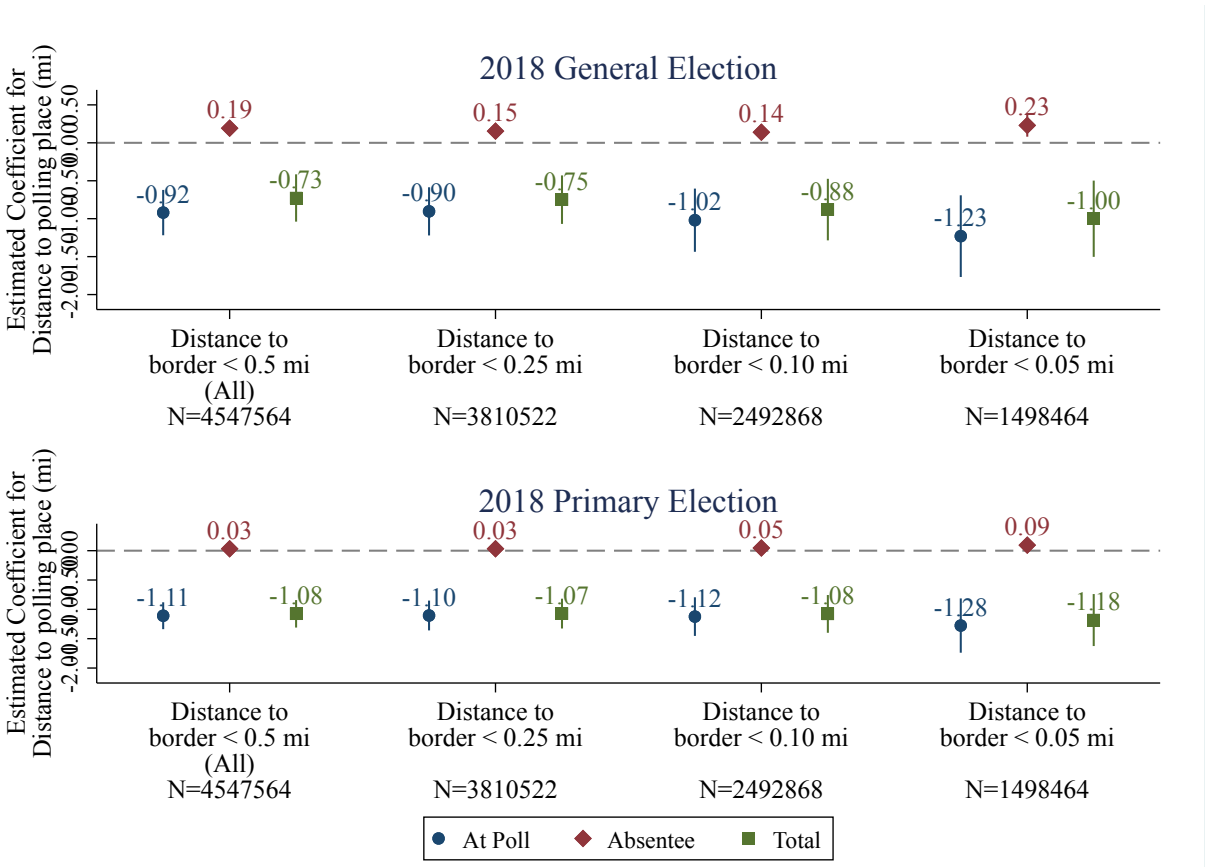
Note: The y-axis measures the coefficient on distance to polling place (measured in miles). The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. Each symbol represents a point estimate in a separate regression, and the lines indicate 95% confidence intervals. Regressions differ by the maximum distance between a voter and the polling place (to correct for potential geocoding errors). All regressions include border fixed effects and additional individual-level and block-level covariates: registered Democrat indicator, registered Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors allow for clustering at the border level.

Figure A.2: Individual-level Border Fixed Effects estimates: Vary maximum distance to polling place, Georgia



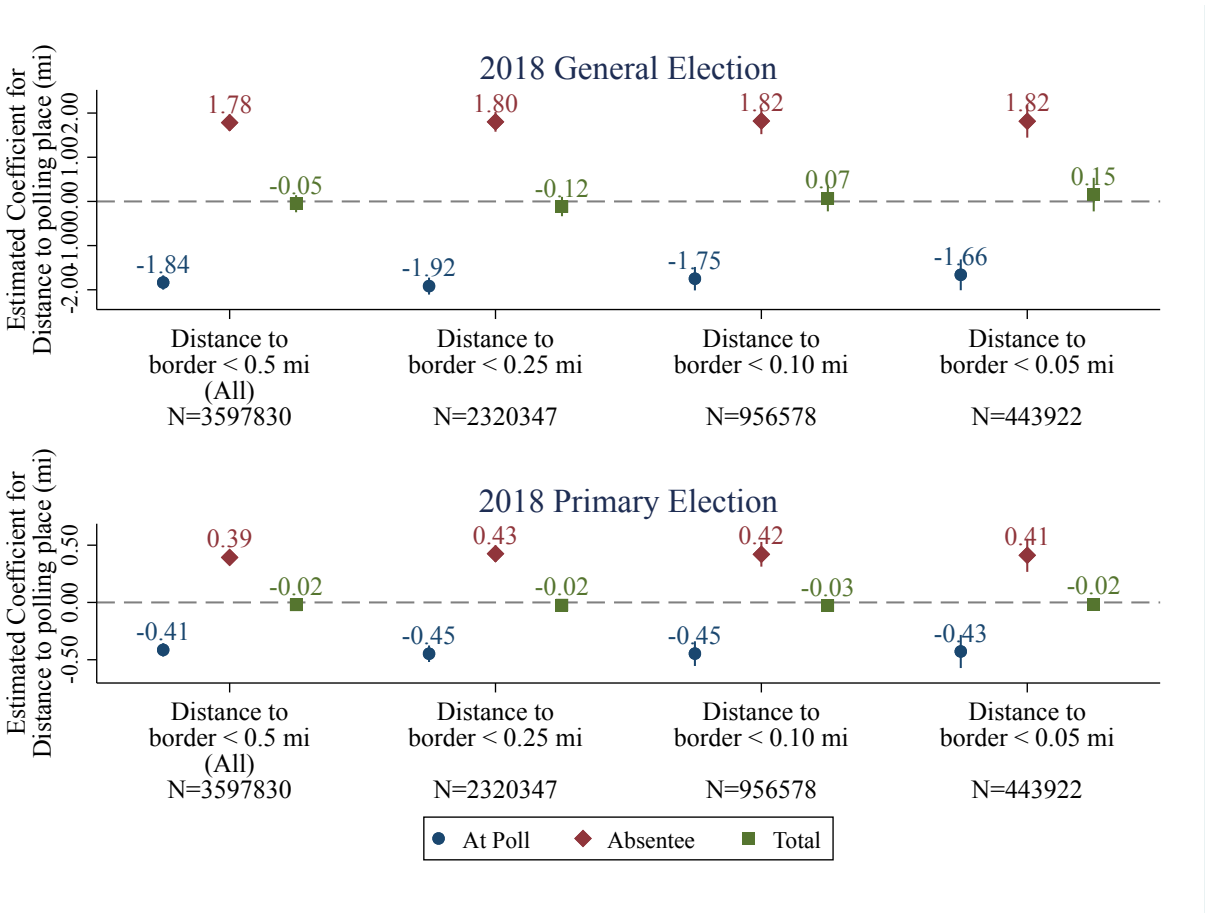
Note: The y-axis measures the coefficient on distance to polling place (measured in miles). The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. Each symbol represents a point estimate in a separate regression, and the lines indicate 95% confidence intervals. Regressions differ by the maximum distance between a voter and the polling place (to correct for potential geocoding errors). All regressions include border fixed effects and additional individual-level and block-level covariates: registered Democrat indicator, registered Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors allow for clustering at the border level.

Figure A.3: Individual-level Border Fixed Effects estimates: Vary maximum distance to border segment, Pennsylvania



Note: The y-axis measures the coefficient on distance to polling place (measured in miles). The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. Each symbol represents a point estimate in a separate regression, and the lines indicate 95% confidence intervals. Regressions differ by the maximum distance between a voter and the border. All regressions include border fixed effects and additional individual-level and block-level covariates: registered Democrat indicator, registered Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors allow for clustering at the border level.

Figure A.4: Individual-level Border Fixed Effects estimates: Vary maximum distance to border segment, Georgia



Note: The y-axis measures the coefficient on distance to polling place (measured in miles). The dependent variables are indicators for whether or not a registered voter has voted at the polling place, through absentee ballot, or through either voting method. Each symbol represents a point estimate in a separate regression, and the lines indicate 95% confidence intervals. Regressions differ by the maximum distance between a voter and the border. All regressions include border fixed effects and additional individual-level and block-level covariates: registered Democrat indicator, registered Republican indicator, population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors allow for clustering at the border level.

A.7 Nonlinear Effects

Table A.14: The effect of distance to polling place on likelihood of voting: Nonlinear effects

	Border FE and additional Controls - PA						Border FE and additional Controls - GA					
	Pri AP	Pri AB	Pri Tot	GE AP	GE AP	GE Tot	Pri AP	Pri AB	Pri Tot	GE AP	GE AB	GE Tot
Distance (miles) × 0-0.25	-19.1311***	0.3360	-18.7950***	-13.9391***	1.4960***	-12.4431***	-7.6937	4.3408	-3.3529	-13.8364	27.9785**	14.1421
	(1.6261)	(0.3582)	(1.5760)	(1.9338)	(0.4887)	(1.8546)	(7.6584)	(2.8965)	(9.2750)	(12.9771)	(11.7451)	(21.6592)
Distance (miles) × 0.25-0.5	-6.0887***	-0.4566	-6.5453***	-4.0775	-1.7584**	-5.8359**	-10.7280***	-0.7928	-11.5208**	-11.3745**	-3.2485	-14.6230**
	(2.0439)	(0.3618)	(2.0592)	(2.7990)	(0.7133)	(2.8152)	(4.0542)	(2.1163)	(4.7229)	(4.6832)	(5.4733)	(6.5545)
Distance (miles) × 0.5-1	-2.5651**	-0.2704	-2.8355**	-0.7594	-0.7965	-1.5558	-1.2078	1.3792**	0.1714	-0.9777	1.7752	0.7975
	(1.2537)	(0.2564)	(1.2575)	(1.8066)	(0.5352)	(1.7793)	(1.0928)	(0.6656)	(1.3819)	(1.3752)	(1.6695)	(2.0275)
Distance (miles) × 1-2	-2.0384*	-0.1095	-2.1479*	-0.4281	-0.2829	-0.7110	-0.2019	-0.2829	-0.4849	0.6564	0.5040	1.1604
	(1.1727)	(0.2160)	(1.1767)	(1.7273)	(0.4272)	(1.7241)	(0.5826)	(0.4131)	(0.7441)	(0.7521)	(0.9944)	(1.0600)
Distance (miles) × 2-3	-3.0072	-0.3569	-3.3640	0.0009	-1.7612*	-1.7603	-0.1934	-0.7349	-0.9283	0.3731	0.0108	0.3839
	(1.9372)	(0.8912)	(2.3086)	(2.7730)	(1.0220)	(2.9168)	(0.9269)	(0.6228)	(1.1237)	(1.1092)	(1.6316)	(1.6838)
Distance (miles) × 3-up	0.9093	0.1772*	1.0865*	0.4814	0.4583**	0.9397	-0.5265**	0.3157*	-0.2108	-1.3087***	0.9842***	-0.3245
	(0.6087)	(0.0921)	(0.5964)	(1.0776)	(0.2070)	(1.0654)	(0.2400)	(0.1691)	(0.2770)	(0.3268)	(0.3598)	(0.3638)
N	1765507	1765507	1765507	1772498	1772498	1772498	523065	523065	523065	523065	523065	523065
y variable mean	16.32	0.33	16.65	52.00	1.66	53.66	11.44	4.13	15.57	24.72	27.40	52.12
R^2	0.049	0.030	0.050	0.062	0.027	0.069	0.039	0.033	0.050	0.042	0.060	0.069

Note: Distance to polling place is measured in miles. The dependent variables are indicators for whether or not a registered voter has voted at the polling place (AP), through absentee ballot (AB), or through either voting method (Tot) for the Primary election (Pri) or General election (GE). All regressions include border fixed effects and additional block-level covariates: population, voting age population, percent Black, percent Hispanic, median household income, percent without a high school diploma, percent that walk to work, and indicators for whether travel time to work is less than 5 minutes or greater than 60 minutes. Standard errors clustered at the border level are reported in parentheses.