



Open camera or QR reader and scan code to access this article and other resources online.

Effect of Distance on Dropbox Usage Among Georgia Voters in the 2020 Election

AU2 ▶

Michael and Jason M. Roberts

ABSTRACT

Ballot dropboxes provide voters who fill out mail-in ballots with a secure and convenient method for returning their ballot. During the COVID-19 pandemic, the use of ballot dropboxes increased dramatically as voters sought to cast ballots safely and conveniently. In the wake of the 2020 election, ballot dropboxes have come under considerable scrutiny as many Republican-controlled state legislatures have sought to eliminate them or sharply reduce the number available and/or limit the hours in which they can be used by voters. This article uses novel data on the number of ballots collected in Georgia dropboxes paired with measures of how accessible these dropboxes were to voters in order to analyze how the allocation of dropboxes affected voting behavior in an election where voters could choose to vote in a variety of ways. When controlling for the number of potential users, dropboxes closer in distance to voters are used at higher rates. Individuals located closer to dropboxes are more likely to vote by mail and are less likely to fail to return requested mail-in ballots. Our findings carry important implications for election administrators seeking to make voting accessible by adding additional ballot dropboxes and for administrators seeking to adjust to mandated decreases in the number of dropboxes provided to voters.

AU3 ▶

Keywords: dropbox voting, absentee voting, voting behavior, election administration

INTRODUCTION

THE COVID-19 PANDEMIC upended all aspects of life in the United States beginning in March of 2020. Among those things affected was the process of voting and administering elections throughout

the country. The typical mode of voting in the United States—in person, in often crowded polling places could have not been more inconsistent with the Center for Disease Control’s (CDC) “social distancing” guidelines put in place to help mitigate the spread of COVID-19. Many voters likely feared that going to the voting booth would increase their risk of contracting COVID-19. At the same time, election administrators feared that it would be difficult to convince poll workers to serve given the risks involved in working in tight quarters and interacting with thousands of voters throughout election day. Given the critical importance that poll workers play in administering elections, this issue alone was enough to potentially imperil the smooth administration of the 2020 election (Suttman-Lea 2020; Jones and Stein 2021; King and Barnes 2019).

◀ AU0

Michael Greenberger is with the Department of Political Science at the University of Denver, in Denver, Colorado, USA. Jason M. Roberts is with the Department of Political Science at the University of North Carolina at Chapel Hill, in Chapel Hill, North Carolina, USA.

We thank Lali Madduri, Lia Merivaki, Mara Suttman-Lea, Mitchell Brown, and Martha Kropf for helpful comments and feedback. Thank you also to Brian Brew, Colin Case, and Emily Ommundsen for help in the data collection process. We are also grateful to the Rapoport Family Foundation for their generous support.

Given the difficulties presented by COVID-19, a variety of changes to voting procedures were enacted. Polling places were moved to larger venues, early voting hours were extended, and absentee voting rules were loosened. For voters wishing to minimize their potential exposure to COVID-19, voting via an absentee or mailed ballot was the safest method of voting as it did not require a voter to have an in-person interaction with elections staff or other voters. Absentee voting, however, is also one of the most procedurally difficult methods of voting. Ballots have to be requested in advance of the election by the voter and often have stringent requirements that have to be met for the ballot to be accepted.¹ In addition, if a voter is returning the ballot via mail they must purchase postage in many states and mail the ballot early enough so that it will be received by their state’s deadline.² All the while hoping that the United State Postal Service (USPS) handles their ballot properly.³ As a result of these difficulties and other factors, the rejection rate for absentee ballots is much higher than for other forms of voting (Baringer et al. 2020; Cottrell et al. 2021; Shino et al. 2022).

AU4 ▶

AU0 ▶

One step that many jurisdictions took to mitigate the costs of absentee voting was to install ballot “dropboxes.” These dropboxes provided a secure place for a voter to return their ballot at a time that was convenient to them without having to rely on or incur the costs of using the USPS. In the wake of the 2020 election, however, ballot dropboxes have come under considerable scrutiny as many Republican-controlled state legislatures have sought to sharply reduce the number available and/or the hours in which they can be used by voters. One of the states where dropboxes have been the most controversial is Georgia. Now President Joe Biden narrowly won Georgia in 2020, which was the first time a Democratic candidate for president had won the peach state since Bill Clinton’s victory in 1992. In addition, Democratic candidates won both U.S. Senate races in Georgia in 2020.⁴ Republicans in the Georgia legislature responded to their electoral shortfalls in 2020 by enacting a sweeping reform measure *Senate Bill 202* that among other things sharply reduced the number of dropboxes that can be deployed in Georgia, the hours in which the dropboxes can be used, and enhanced the security requirements for dropboxes.

AU0 ▶

Georgia voters did not lose total access to ballot dropboxes for future elections, but many, especially

those in urban counties, are likely to have fewer dropboxes to choose from and will in many cases have to travel much farther to access a dropbox. Our goal in this article is to assess how the accessibility of dropboxes affected dropbox use in Georgia in 2020 in order to understand how election administrators in any State might place dropboxes to most efficiently serve voters in the future (assuming the election administrators do have some autonomy over the placement of dropboxes). To do this we estimate the effect of dropbox placement on the propensity for voters to cast an absentee by-mail ballot. We also estimate the effect of proximity on dropbox usage at the dropbox-level; that is, how many ballots can election administrators expect a dropbox to receive based on how close voters are to the dropbox. Given the costs associated with dropbox implementation and maintenance, this is an important question for election administrators.

◀ AU0

We find that proximity to dropboxes is very important for voters—dropboxes geographically close to voters were used at higher rates than those farther away from voters. Voters closer to dropboxes were more likely to vote by mail and less likely to fail to deliver their requested by-mail ballots. Our findings suggest that limiting the number of dropboxes will likely decrease their use in subsequent elections, especially in areas where dropboxes were placed extremely closely to voters. These tend to be urban areas that have large numbers of non-white voters and voters who are more apt to vote for Democratic party candidates. Although these results are intuitive, they are meaningful for election administrators across the United States responding to new guidelines on dropbox usage. This article

¹Some states require an excuse to vote via mail. Other states have photo identification requirements, witness signature requirements, and/or signature verification requirements.

²Some states require that absentee ballots be received by the close of business on election day, while others allowed a ballot that is postmarked by election day to arrive in the days following an election.

³The USPS loses some ballots. A much larger problem is that many ballots do not receive postmarks and thus their mail date cannot be verified by elections staff.

⁴Georgia had a special election for the Senate and a regular Senate election on the ballot at the same time. In neither race did a candidate gain a majority of the votes cast, so under a Georgia law a runoff between the top two vote getting candidate ensued.

AU1 ► EFFECT OF DISTANCE ON DROPBOX USAGE

3

adds to the preexisting literature on distance and dropboxes by demonstrating the effect of proximity in an election in which vote-by-mail is *not* the standard of voting and by considering the utility of dropbox placement from a resource-limited election administrators perspective.

AU0 ►

DROPBOXES AND THE COST OF VOTING

Voting is a costly act for citizens. It takes time and physical effort to register to vote and the voting process itself takes time and effort. These costs vary based on the method of voting one chooses and the voting rules in a voter's state. The costs of voting are not exceedingly high for most voters, but they can be consequential to individual voting decisions, in part because the direct benefits of voting are also not high (Aldrich 1993). In almost all cases, one individual's vote is not outcome consequential. The existing literature has consistently demonstrated that even small increases in the costs of voting have a deterrent effect on turnout and ballot completion (McNulty et al. 2009; Aldrich 1993; Engstrom 2012; Engstrom and Roberts 2020). For example, factors such as rain on election day, long lines at the polling place, and a change in voting location have all been shown to decrease voter turnout (Joslyn et al. 2020; Walker et al. 2019; Brady and McNulty 2011). Similarly, policies that decrease the cost of voting such as allowing voters to register to vote and cast a ballot at the same time are associated with higher levels of turnout (Haspel and Knotts 2005).

AU0 ►

Ballot dropboxes have the potential to sharply decrease the cost of voting for some voters. For voters who wish to cast an absentee ballot in Georgia, dropboxes have two clear advantages for the voter: (1) the voter does not have to pay postage if depositing a ballot in a dropbox and (2) the voter has more time to complete their ballot given that they do not need to mail the ballot in time for it to reach the county elections office by election day.⁵ In addition, the usage of a dropbox minimizes that chances that the ballot will be lost, damaged, or delayed by removing the USPS from the chain of custody for the ballot. Evidence from vote-by-mail states such as Oregon and Washington suggest that voters strongly prefer dropboxes to the USPS for ballot return as the overwhelming majority of voters use dropboxes to return their ballots.⁶

Prior to the 2020 general election, dropbox voting was rare in states not using universal vote-by-mail elections. As a result, very little scholarship exists that details the relationship between geographic distance and dropbox use. To the best of our knowledge, two studies have addressed this question before. Collingwood et al. (2018) found that the addition of over 30 new drop boxes in King County, Washington, increased turnout. In this study, proximity to dropboxes was associated with a greater likelihood of turnout. In a follow-up study that used a natural experiment to identify an average treatment effect, McGuire et al. (2020) estimate that a one mile decrease in distance to nearest dropbox increased the probability of voting by 0.64 percent. Both of these studies focus on the effect of proximity on turnout in a state with a robust universal vote-by-mail program.

Our study builds on this prior work by expanding our geographic scope from single, mostly urban counties, to the entire state of Georgia. Here, we compare dropbox use-rates across urban, suburban, and rural counties. Like prior studies of dropbox use, we have no direct knowledge of whether or not specific voters actually used a particular dropbox.⁷ However, we do have data on the total number of ballots cast in each dropbox. In addition to individual level effects, we focus on use-rates for dropboxes themselves. We believe this outcome variable is especially important for legislators, scholars, and election administrators interested in how many voters use dropboxes, and in what circumstances dropboxes will prove most effective. As McGuire et al. (2020) point out, dropboxes are expensive—if no one uses them, they may not be a worthwhile investment for election administrators.

Our theoretical expectations are straightforward. We expect that, like prior studies have shown, voters closer to dropboxes will be more likely to vote by mail and that mail-in ballots will be less likely to

⁵Georgia requires absentee ballots to reach the county elections office by election day. To insure timely arrival voter would need to complete their ballot several days before election day.

⁶“Voting by Mail and Absentee Voting,” MIT Election Data and Science Lab. <<https://electionlab.mit.edu/research/voting-mail-and-absentee-voting>>.

⁷An important exception to this is recent work demonstrating that most voters use the dropbox nearest to them (Collingwood and Gonzalez O'Brien 2021). However, this data linking voters to their nearest dropbox has not been used in any analysis of turnout or voting behavior.

go undelivered by voters.⁸ We expect that dropboxes placed proximate to more voters will be used at higher rates, and that this association will be magnified among voters within the closest distances to dropboxes. We also expect that as election day nears and voters worry that ballots mailed via USPS would not be counted on time dropboxes will be used more frequently. Given these expectations, we expect that election administrators can place dropboxes most efficiently (defined as maximizing use for voters) by placing boxes to maximize the number of voters within a very close distance to a box rather than a location that attempts to minimize distance to dropbox for all voters.

DATA COLLECTION

Data on ballot dropbox usage were accessed via a records request made to the *Open Records Request Officer* housed in the Georgia Secretary of State's office. The records were provided for free and contained all ballot transfer forms for the 109 counties (out of 159 counties) that used at least one ballot drop box. Counties using dropboxes filed "ballot transfer forms" to track ballots being retrieved from dropboxes throughout the state. Demographic and political characteristics of counties with and without dropboxes are reported in Table 4 in Supplementary Appendix A. Counties with and without dropboxes are similar in two-party vote share, though counties with dropboxes tend to have larger population, more urban residents, and higher incomes.

Each transfer form listed the county name, the location of the ballot dropbox, the date of pickup, and the number of ballots retrieved. This means that for each dropbox in the state of Georgia (275 unique boxes), there was at least one form for each day for each box. Given that many counties began collecting ballots from dropboxes on the first of September (09/01/2020), the 109 counties produced thousands of ballot transfer forms.

We coded the ballot dropbox forms using a program written for MTurk, Amazon's human intelligent task workforce.⁹ MTurk workers were presented with a dropbox transfer form and asked to select the county, dropbox location, date of pickup, and number of ballots collected. Supplementary Appendix B contains a full description of the coding procedures, a sample of the ballot transfer forms, and a description of the reliability checks

used to validate the MTurk workers' coding accuracy. The result of the MTurk coding process is a count on the total number of ballots cast in each dropbox for each day of the election period. Again, like prior studies, we do not know which voters cast their ballots in dropboxes, but by collecting this data we *do* know how many ballots were cast in each ballot dropbox on each day.

Data on voting behavior comes from the voter registration, voter history, and absentee voter files provided by the Georgia Secretary of State's Office. Georgia registration records include a voter's residential address. Using this address, we geocoded voters to geographic locations. Over 92 percent of voters in every county were successfully geocoded at the street address or point address level.¹⁰

We then routed each geocoded voter to all dropboxes located within their county and calculated the driving distance to reach each dropbox for every voter living in a county with at least one dropbox.¹¹ Using a voter's records in their history and absentee file, we can determine their method of voting in the 2020 election. This data collection yields us information on distances between all voters and dropboxes, how voters proximate to each dropbox voted, and the number of ballots cast in each box—roughly 5 million voters who cast a ballot in Georgia during the 2020 November General Election.

MEASURES OF ACCESSIBILITY AND USE

As state legislatures consider reducing access to dropboxes (but not wholly eliminating them), our study aims to assess whether proximity increases the rate at which dropboxes are used. This is the most important relationship for understanding how voting behavior may be affected as counties reduce the number of dropboxes available to voters. We

⁸We refer to mail-in ballots which are granted to absentee voters but not successfully returned as "undelivered." We do not include voters who requested a mail-in ballot but voted by other means in any analysis of undelivered ballots.

⁹Variance between forms, low image quality, and challenging to read handwriting limited our ability to use optical character recognition software (OCR) to code the thousands of ballot transfer forms.

¹⁰We used the ArcGIS Business Analyst geocoder to achieve this level of accuracy. Using Tiger/Line Census files (open source) yielded similar but slightly less accurate geocoding results.

¹¹These calculations reflect distance on roads, not as-the-crow flies measurements.

AU1 ► EFFECT OF DISTANCE ON DROPBOX USAGE

address this in two ways: first, how an individual’s proximity to a dropbox affects their voting behavior, and second, how a dropbox’s location relative to groups of voters affects its’ rate of use.

Our independent variables aim to capture the accessibility of dropboxes used in the 2020 general election. We estimate accessibility in two ways, as a simple distance between a voter i and their nearest dropbox j , and as a function of distance decay. As demonstrated by Gimpel and Schuknecht (2003), the same increase in distance is likely to have a larger effect on voters closer to their destination than voters farther away. An extra mile will likely matter more to a voter who was originally half a mile away to begin with compared to a voter already expecting to travel ten miles. Further, at distances farther away from dropboxes, travel is likely to be unimpeded and straightforward (assuming that election officials sought to locate dropboxes in areas of high density) (Gimpel and Schuknecht 2003). Distance decay measures are familiar to studies of accessibility in the context of markets and elections and are generally derived from a standard gravity model (Song 1996; Fotheringham and O’Kelly 1989; Kwan 1998; Haynes and Fotheringham 2020).

AU0 ►

Distance decay, A_i , can be derived as the inverse of the squared distance d between a voter’s origin i and destination j such that:

$$A_i = 1/d_{ji}^2$$

The distance decay model inflates the increasing costs of travel at short differences. Consider a voter traveling two miles (distance decay value of .25) and a voter traveling three miles (distance decay value of .11). Here, a one mile increase in distance corresponds to a change in distance decay of .14. If instead those two voters were traveling nineteen (distance decay value of .0028) and twenty miles (distance decay value of .0025), a one mile increase in distance only corresponds to a change in distance decay of .003. Distance decay captures the relative unimportance of a voter needing to travel an extra mile when they are already planning to travel longer distances.

For our individual level analysis, our first dependent variable is whether a voter cast a by-mail ballot. We control for a voter’s history of voting by mail by including a categorical variable for vote method in 2018 as a control. Voters who voted by

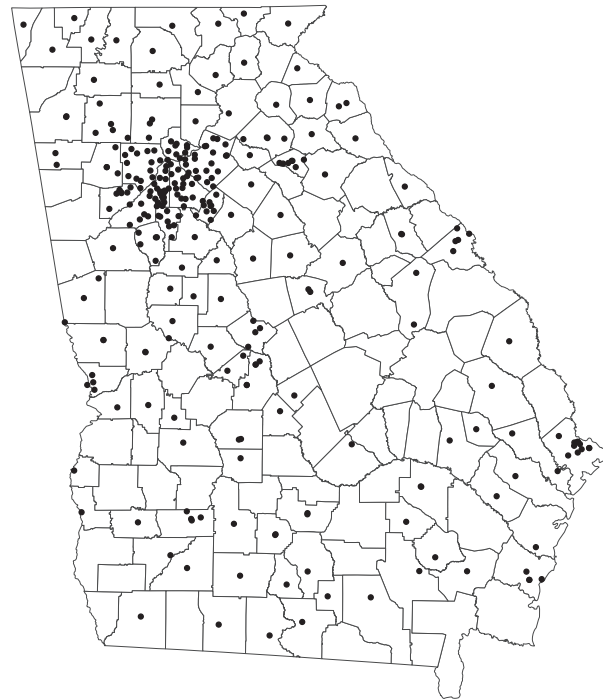


FIG. 1. Counties and dropboxes in Georgia

mail in a past election are much more likely to vote by mail in the future. We also control for age and race. Our second dependent variable for the individual-level analysis is whether or not a mail-in ballot was successfully delivered. These models use the same control variables.

Our dependent variable for the dropbox-level analysis is a dropbox’s use rate. A dropbox’s use rate is calculated by dividing the number of ballots collected in a drop box by the total number of eligible ballots. We estimate the number of eligible ballots as all registered voters for whom a given dropbox is their closest available (within their county) dropbox. The actual number of ballots collected in a dropbox is then divided by the number of eligible voters to calculate a dropbox’s use rate.

Most counties only used one dropbox (see Figure 1, see also Figure D.1 in Supplementary Appendix D for a zoomed view of the large number of boxes in the Atlanta Metro area). In these cases, linking voters to their closest available dropbox means that the voters eligible to use a particular dropbox are all registered voters in a given county and that important control variables like age, race, and population density can be taken from the registration statistics at the county level. However, several counties used more than one dropbox. Age

and race are individual level variables and can be aggregated up from the individual-level data to create age and race statistics for a given drop box based on the individuals for whom a given dropbox is their closest option. We control for the Democratic share of the vote using support for Hillary Clinton in the 2016 General Election, the percent of individuals without any undergraduate college degree, and median household income. Importantly, we also include a control for the percent of individuals in a dropbox’s use zone who previously voted by mail. Voters who voted by mail prior to the roll-out of dropboxes in 2020 may already be familiar with the process and habituated to sending their ballot in the mail.

AU0 ▶

To estimate population density we create geographically based dropbox “use zones” conceptualized as thiesen polygons—areas partitioned into regions based on proximity to a point (in this case, the nearest dropbox). Densities for these areas are calculated using the full population living in the approximated polygon. This aims to capture the ease of movement near a dropbox as higher density areas are likely to be more difficult to navigate quickly because of traffic, stoplights, and other impediments. By using eligible voters in the denominator of the outcome variable, we also control for the total number of people in a dropbox’s use zone.

RESULTS: PROXIMITY AND VOTING BEHAVIOR

T1 ▶ Table 1 presents the estimated magnitude of the effect of proximity to dropboxes on the likelihood of a voter registered to vote in the 2020 election casting a by-mail absentee ballot. All ballots cast via dropbox were absentee by-mail ballots. Columns 1 and 2 report the base effect of distance and include a county fixed-effect. Column 1 uses miles and and column 2 uses distance decay. Model 1 estimates that a one mile increase to the nearest dropbox is associated with a decrease in the likelihood of voting by mail by -0.3 percentage points. A unit increase in the value of distance decay is associated with an increase in the likelihood of voting by mail by 1 percentage point. A decrease from 1 mile to 0.25 miles (an increase from 1 to 2 in distance decay) is associated with a 1 percentage point increase in the likelihood of voting by mail. These estimates support the theory that a decrease

in cost to voting in a certain form increases the likelihood that a voter will use that form of voting.

Models 3 and 4 include controls for vote method in 2018. The reference category for the vote method used in 2018 is an electronic ballot cast, a method used by overseas voters under the Uniformed And Overseas Citizens Absentee Voting Act (UOCAVA). While all controls are statistically associated with the likelihood of a voter choosing to vote by mail, the important confounder controlled for with the inclusion of this variable is whether or not a voter previously voted by mail. Voters who in 2018 voted by mail were very likely to vote by mail again in 2020. Models 5 and 6 include controls for race and age, demographic factors that may vary with how voters choose to vote. The reference category for race is non-hispanic white. Across all models, the measures for dropbox distance are statistically significant and in the expected direction. Models directly interacting distance to dropbox and vote method used in 2018 are reported in Table 6 of Supplementary Appendix C. Figures charting average marginal effects for these models are in Figure C.1. Average marginal effects of the interaction between distance to dropbox and race are presented in Figure C.2 in Supplementary Appendix C.¹²

◀ AU0

◀ F2

Figure 2 charts the likelihood of a voter casting a by-mail ballot based on the effect of distance (in miles) estimated in Model 1 of Table 1. At near zero miles to the closest dropbox, the estimated likelihood of a voter casting a by-mail ballot is about 15.75 percent. At ten miles away from the nearest dropbox, the estimated likelihood of a voter casting a by-mail ballot is about 14.9 percent.

Prior studies have demonstrated an increase in turnout resulting from proximity to a ballot dropbox roughly equal to the effect estimated for vote-by-mail specifically above. Our research design does not identify a causal relationship, but, the associations we find comport with prior causal estimates made in prior studies (Collingwood et al. 2018; Collingwood and Gonzalez O’Brien 2021). Using the information in Georgia’s publicly available data, however, we can also estimate the effect of proximity to a dropbox on the likelihood that a requested by-mail ballot goes undelivered (this does not

¹²The estimates from these models show that the association between decreased dropbox proximity and voting by mail does not vary to a distinguishable level by race/ethnicity.

AU1 ► EFFECT OF DISTANCE ON DROPBOX USAGE

TABLE 1. PROXIMITY TO DROPBOX AND MAIL-IN BALLOTS

	<i>Dependent variable: Voted by Mail 2020</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
Miles	-0.003*** (0.0003)		-0.005*** (0.0004)		-0.004*** (0.0004)	
Dist. decay		0.010*** (0.003)		0.031*** (0.003)		0.013*** (0.003)
Voted early '18			0.633*** (0.029)	0.564*** (0.027)	0.142*** (0.035)	0.050 (0.034)
Voted by mail '18			2.297*** (0.029)	2.230*** (0.028)	1.821*** (0.035)	1.733*** (0.034)
No vote '18			-0.314*** (0.029)	-0.378*** (0.027)	-0.349*** (0.035)	-0.435*** (0.034)
Voted in person '18			0.207*** (0.029)	0.138*** (0.027)	-0.072** (0.035)	-0.164** (0.034)
Asian					0.699*** (0.009)	0.701*** (0.009)
Am. Indian					0.173*** (0.025)	0.178*** (0.026)
Black					0.283*** (0.003)	0.288*** (0.003)
Hispanic					0.245*** (0.008)	0.248*** (0.008)
Other					0.003 (0.004)	0.006 (0.004)
Age					0.041*** (0.0001)	0.041*** (0.0001)
Constant	-1.576*** (0.031)	-1.596*** (0.029)	-1.790*** (0.038)	-1.758*** (0.036)	-3.794*** (0.043)	-3.739*** (0.041)
Observations	4,938,065	4,938,065	4,938,065	4,938,065	4,938,065	4,938,065
County F.E.	✓	✓	✓	✓	✓	✓
Log likelihood	-2,488,279	-2,440,002	-2,350,128	-2,305,334	-2,196,565	-2,154,820
Bayesian inf. crit.	4,976,605	4,880,051	4,700,364	4,610,775	4,393,329	4,309,840

Note: *p<0.1; **p<0.05; ***p<0.01

include ballots surrendered by voters at early voting locations, surrendered at election day voting locations, or returned spoiled). This dependent variable is coded 1 for voters with requested and undelivered ballots, and 0 for requested and delivered ballots.¹³ The independent variables are the same as those used in the above models.

Column 1 reports that a one mile increase in distance to the closest dropbox is associated with a 0.6 percentage point increase in the likelihood of that ballot being undelivered. Using distance decay rather than raw miles, the model presented in column 2 reports that a one unit increase in distance decay is associated with a 4.5 percentage point increase in the likelihood of a by-mail ballot being undelivered. A change from the mean value of distance decay (.18, or 2.35 miles) increasing by one standard deviation (to .54, or 1.36 miles) corresponds to a roughly 1.5% decrease in the likelihood of a ballot being undelivered. The distribution of dis-

tance decay values is such that the vast majority of observations fall between 0 and 1, meaning that the model estimate of 4.5% reflects a move over nearly the entire range of observed values. The larger magnitude of the distance decay association with undelivered ballots (as compared to raw miles) reflects the importance of distance differences at small values (e.g, a dropbox being within walking distance or not).¹⁴ The addition of control variables in models 3 and 4 does not change substantively the estimates of the effect of distance to

¹³Results for the same models using all voters (rather than only voters who at least requested a ballot) are presented in Table 5 in Supplementary Appendix C.

¹⁴It is important to again note here that this measure is an inverse exponent, meaning that it cannot be extrapolated linearly in miles (e.g, an increase from 3 miles to 4 miles (a distance decay decrease of only .07) would have a significantly smaller association with the outcome variable than 4.5 a percentage point increase).

AU8 ▶

TABLE 2. PROXIMITY TO DROPBOXES AND UNDELIVERED BY MAIL BALLOTS

	<i>Dependent variable: Ballot Undelivered</i>			
	(1)	(2)	(3)	(4)
Miles	0.006** (0.003)		0.008*** (0.003)	
Dist. decay		-0.045** (0.022)		-0.045** (0.022)
Voted early '18			-0.687*** (0.201)	-0.710*** (0.194)
Voted by mail '18			-1.180*** (0.203)	-1.194*** (0.196)
No vote '18			-0.940*** (0.201)	-0.962*** (0.194)
Voted in person '18			-0.775*** (0.201)	-0.801*** (0.194)
Age			-0.008*** (0.0005)	-0.008*** (0.0005)
Asian			0.154*** (0.058)	0.146** (0.059)
Am. Indian			0.535*** (0.150)	0.488*** (0.153)
Black			0.165*** (0.019)	0.164*** (0.019)
Hispanic			0.292*** (0.052)	0.292*** (0.052)
Other			0.135*** (0.031)	0.128*** (0.031)
Constant	-4.719*** (0.100)	-4.685*** (0.098)	-3.470*** (0.226)	-3.398*** (0.217)
Observations	1,051,709	1,051,709	1,051,709	1,051,709
County F.E.	✓	✓	✓	✓
Log likelihood	-76,339.250	-74,443.280	-75,981.890	-74,098.380
Bayesian inf. crit.	152,720.100	148,928.100	152,144.000	148,376.800

Note: * p<0.1; ** p<0.05; *** p<0.01

drop box. Voters with previous vote by mail experience and older voters were less likely to leave mail ballots undelivered. Compared to white voters, all racial and ethnic groups were more likely to leave by-mail ballots undelivered.

AU0 ▶

RESULTS: DROPBOX USE RATE AND PROXIMITY

At an individual level, proximity affects voting behavior in mode of voting and the successful delivery of by-mail ballots. Election administrators, however, may be interested in the efficacy of ballot dropbox placement (especially in instances where counties may use multiple dropboxes or be limited to a certain number of dropboxes). The correlation between distance traveled and dropbox use provide strong descriptive evidence that proximity is an important factor for understanding variation in drop-

box use rates (full histogram of dropbox use rates in Supplementary Appendix A). Figure 3 illustrates the negative correlation between dropbox use rates (measured at the dropbox level) and travel distance to dropbox. The use rate of a dropbox and the median travel time of its potential users correlate with a Pearson’s correlation coefficient of -0.22 (95% confidence interval of -0.33 to -0.1). Median distance decay and dropbox use rate correlate at 0.30 (95% confidence interval of 0.19 to 0.40).

◀ F3

◀ AU0

Figure 3 also demonstrates that beyond about 6 miles, increasing travel times have little effect on dropbox usage. This suggests that the covariance between dropbox usage and distance times is primarily driven by dropboxes with median distances at or below 6 miles. This finding adds further evidence that distance decay is a useful measure for capturing the accessibility of a dropbox. Because voters do not appear to have their behavior

AU1 ► EFFECT OF DISTANCE ON DROPBOX USAGE

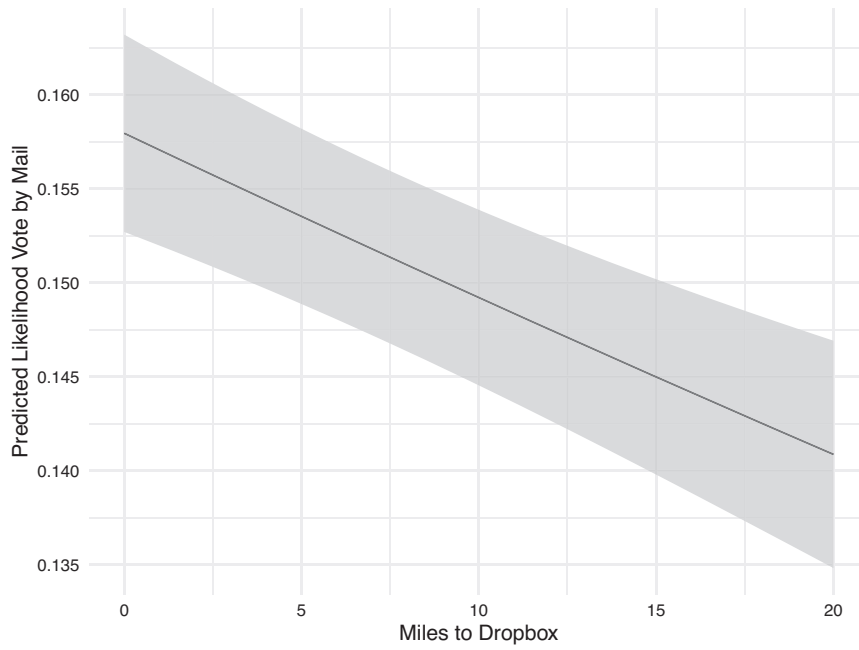


FIG. 2. Average marginal effect of distance on voting behavior.

changed by distances that already involve a significant amount of travel, most of the substantively important variance in cost should be between 0-5 miles, which distance decay highlights as most important.

T3 ► Table 3 reports models estimating the effect of the median distance and median distance decay

for voters in a given dropbox's use zone on the use rate of that dropbox. Only voters for whom that dropbox is the closest usable dropbox are included in this calculation. The model uses ordinary least squares estimation. Alternative modeling specifications including a beta regression estimation, a model including a fixed-effect by county,

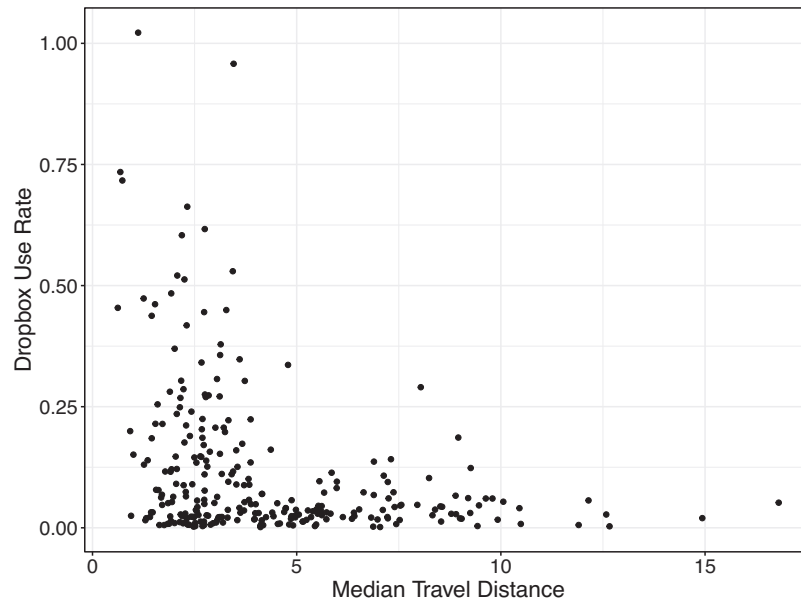


FIG. 3. Travel distance and dropbox use rate.

TABLE 3. TIME, DISTANCE, AND DROPBOX USE RATES

	<i>Dependent variable: Dropbox Use Rate</i>	
	(1)	(2)
Median distance	-0.028** (0.013)	
Median distance decay		0.435*** (0.090)
Percent Black	-0.107 (0.130)	-0.079 (0.125)
Mean age	0.00004 (0.0001)	0.0001 (0.0001)
Number boxes in county	0.0001 (0.005)	-0.003 (0.005)
Percent ballots mailed '18	1.632 (2.367)	2.372 (2.277)
Median household income	0.207 (0.191)	0.222 (0.180)
Population density	0.0004 (0.002)	-0.001 (0.001)
Dem. share of '16 vote	0.100 (0.266)	0.074 (0.257)
Percent less than college	0.002 (0.009)	0.004 (0.008)
Constant	-2.179 (2.192)	-2.629 (2.081)
Observations	275	275
R ²	0.079	0.139
Adjusted R ²	0.047	0.109
Residual std. error (df=265)	0.394	0.381
F Statistic (df=9; 265)	2.511***	4.737***

Note: * p<0.1; ** p<0.05; *** p<0.01

and a model including a spatially lagged dependent variable are all reported in Supplementary Appendix C. Across all model specifications the effect of distance is statistically significant with estimated effects in the expected direction (increased median distance to dropbox associated with decreased box usage).

Across both models reported in Table 3, dropboxes for which the average user would need to travel farther are associated with lower rates of use. As a reminder, because distance decay is calculated as the inverse of the distance squared, larger distances equal lower distance decay values (meaning that a positive coefficient for distance decay indicates that an increase in distance corresponds to a decrease in drop box use). The proportion of likely dropbox users that are Black has no distinguishable effect on use rate. Similarly, the average age, population density, income, Democratic vote-share in 2016, percent without college education, and percentage of 2018 ballots cast via mail in a dropbox's use zone have no distinguishable effect on dropbox use rate.

Interpretation for the models using median distance is quite straightforward: a one mile increase in the median distance traveled by a voter in a dropbox's use zone corresponds to a 2.8 percentage

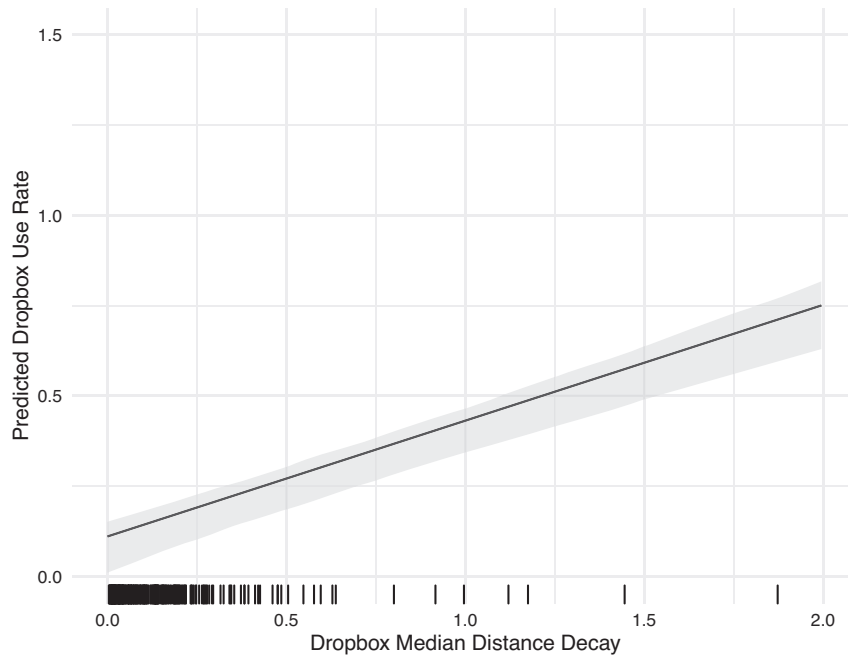


FIG. 4. Distance decay and dropbox use rate, mail-in voters.

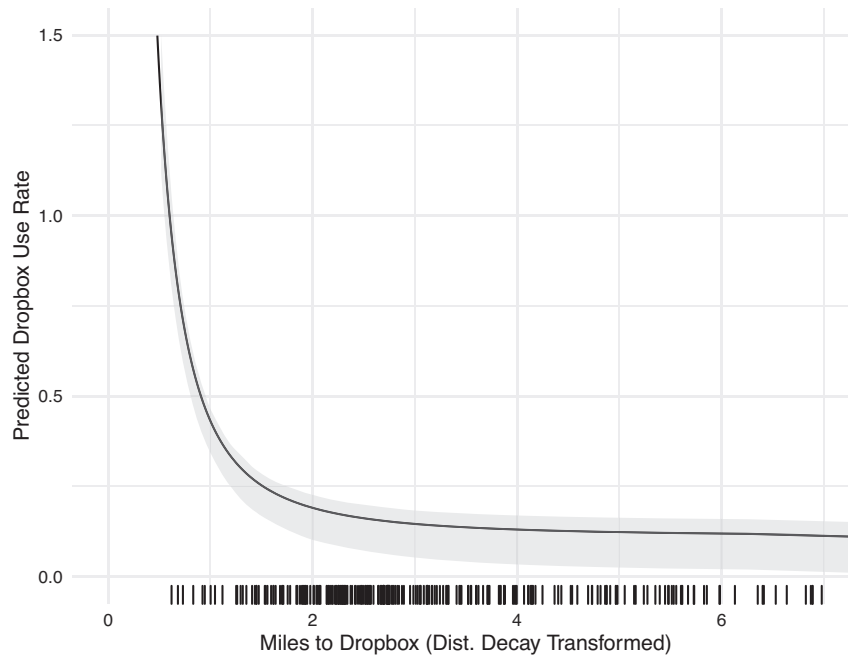


FIG. 5. Dropbox use-rate among mail-in voters.

point decrease in the use rate for a given dropbox. For example, if we consider a dropbox as being accessible to 18,000 registered voters and with a use rate of 0.15 (roughly the sample means for eligible voters and use rate), we would expect a one mile increase in the median distance to correspond to a use rate decrease of about 0.03 (to 0.12), all else equal. In this scenario, the number of voters using the dropbox would decrease from 2,700 to 2,160. For reference, the average median distance in the sample is around 4 miles, so a shift of one mile in distance represents quite a big change in the context of these data.

F4 ► Interpreting the estimated effect of distance decay is much less straightforward. Modeled using distance decay, a decrease in mileage from 1 to 0.25 (a one unit increase in distance decay) corresponds to 43.5 percentage point increase in the dropbox use rate. Figure 4 graphs simulated predicted probabilities of predicted dropbox use rates across the range of observed values for a dropbox use zone’s median value of distance decay. The predictions are based on the results for Model 2 in Table 3. For these simulations, covariate values for control variables are generated by sampling observed values from the data. The dashes at the bottom of Figure 4 indicate observed values of median distance decay in the data. A me-

dian distance decay of 0.25 (2.13 miles) corresponds to a dropbox use rate of about 0.22, and a one standard deviation increase to a distance decay of about 0.5 (1.41 miles) corresponds to a dropbox use rate of about 0.26.

Figure 5 presents the same predicted outcomes as F5 ◀ Figure 4, but with the axis transformed to represent miles to dropbox rather than the distance decay value. The predicted use rate drops dramatically between half of a mile and 2 miles, but then tapers to a relatively slow drop over the remaining increases in distance to the dropbox. This figure highlights that changes made to dropbox access in the most dense, urban environments are likely to affect the voting behavior of nearby voters. We discuss the implications of this along other findings in the discussion.

RESULTS: DROPBOX PROXIMITY AND VOTE TIMING

Modeling the effect of dropbox access on the likelihood of a late-cast or last-minute ballot is somewhat simpler. We use logistic regression with a fixed effect for each county to estimate the effect of a voters distance and distance decay to their nearest drop box on their likelihood of casting a late or

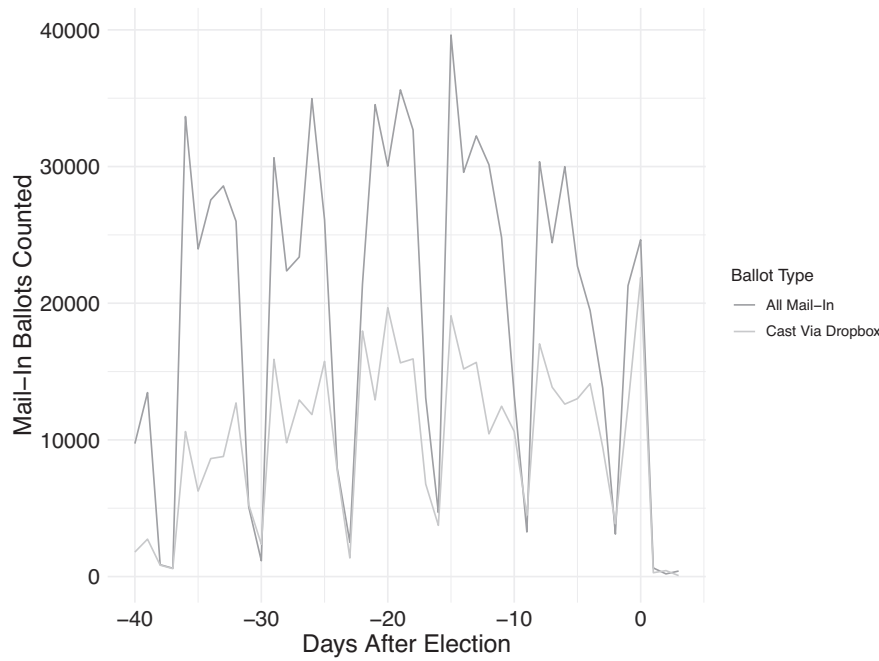


FIG. 6. Mail-in ballots counted by date and ballot cast type.

last-minute ballot. We consider last-minute ballots as those cast within 5 days of the election.¹⁵

Proponents of ballot dropboxes argue that access to mail-in ballot dropboxes affects decisions on vote timing and ballot approval (Brower 2022). As election day approaches, absentee voters may worry that their mail-in ballot will not be counted if they mail it too late and choose instead to vote via dropbox. By eliminating use of the USPS from their voting cost-benefit calculation, voters can confidently cast mail-in ballots up to election day in a ballot dropbox.

F6 ▶ Figure 6 charts the number of mail-in ballots *accepted* each day up to and through election day in Georgia. The totals are separated by ballot type (mail-in via mail or dropbox). The cyclical week effects are to be expected, as is the general higher magnitude of mail-in ballots over dropbox ballots. Critically, however, the gap between mail-in and mail-in via dropbox ballots narrows dramatically for ballots counted day of and day before election ballot totals.

Whereas the number of mailed-in ballots counted decreases as election day approaches and arrives, the number of mail-in ballots cast via dropbox increased up to election day. Voters behave rationally by casting mail-in ballots via dropbox when the deadline draws near. A pertinent question then is whether or not a voter may be dissuaded from voting if they need to vote with a mail-in ballot but a dropbox is not accessi-

ble? To understand this relationship we regress whether a ballot was cast at the last minute and whether a ballot was accepted on a voter’s distance to dropbox and distance decay values for every voter who requested a mail-in ballot. Although we detect statistically significant effects of distance and distance decay on these outcomes, the substantive effects are so minimal as to cast doubt on the substantive importance of the results (especially given the high number of observations). We find no meaningful evidence that closer access to dropboxes within a county leads a voter to cast a last minute ballot. Full models reporting this finding are located in Supplementary Appendix C.

◀ AU0

DISCUSSION

Beginning with the 2022 midterm elections, many voters had to travel farther to reach a dropbox than they did in 2020. Arizona, Florida, Georgia, Iowa, and Wisconsin have all implemented or are considering implementing severe limitations on the ability of local election officials to make

¹⁵As we discuss later, the results for this test are statistically significant but the substantive effect is extremely small. Defining a last-minute ballot as one cast within 4 or 6 days rather than 5 days does not affect the results.

AU1 ► EFFECT OF DISTANCE ON DROPBOX USAGE

AU5 ► dropboxes accessible to their constituents. In Georgia, the state legislature has mandated that counties not use more than one dropbox for every 100,000 voters (Georgia S.B. 2020). According to our data, this suggests that the number of dropboxes in the Atlanta area will drop by approximately 75%. The eliminated dropboxes are among the most efficiently placed and well-used dropboxes in the state. Limiting the number of dropboxes forces election administrators to make choices about resource allocation. Our findings here point to certain dropboxes being more useful than others.

Dropboxes are used most frequently when they are within a short distance of a large number of voters. Although proponents of Georgia S.B 202 argue that all voters will still have access to a dropbox, curtailing access to dropboxes in densely populated areas is most likely to affect counties with dropboxes located within short distances of many voters. Voters residing in rural counties, where voters lived farther from dropboxes in 2020, are unlikely to be affected even if their distance to a dropbox increases, as changes in distance affect dropbox voting much less at further distances. An extra mile matters significantly more for a voter delivering their ballot as a walker, cyclist, or public transit user than it does for a driver.

This research has practical implications for election administrators. Our key finding is that voters farther from dropboxes are relatively unaffected by the need to travel further to use one. Consider a county with 200,000 registered voters in Georgia. According to Georgia’s recently passed *SB 202*, this county can only use 1 dropbox per 100,000 voters—a total of 2 dropboxes. While *SB 202* mandates that “drop boxes shall be evenly geographically distributed by population in the county,” this is somewhat vague. If the county has two dense population centers and a rural population distributed throughout the rest of the area, more ballots would be collected and fewer mail-in ballots would be undelivered if the election administrators place the drop boxes in the densely populated areas rather than a location that is more centrally located.

The data available for Georgia are limited. We cannot recover estimates for the effect of dropbox placement on overall turnout. Rural voters, systematically farther away from dropboxes, were more likely to vote in 2018 and 2020 than their urban counterparts. Distance from a dropbox correlates with rural location and likelihood of voting in 2018. A reduction in dropboxes carries the greatest

potential to harm voters living closest to locations that formerly had dropboxes. Because dropboxes locations were primarily in densely populated areas, a reduction in boxes will lead urban voters to vote in less convenient methods. Additionally, a reduction in drop boxes will lead to a greater share of by-mail voters failing to deliver their ballots. In 2020, 1.2 percent of white voters failed to return their mail-in ballots, while Black and Hispanic voters failed to return at rates of 2.0 and 1.9 percent, respectively. These are significant disparities that can be ameliorated through the use of dropboxes, which decrease rates of undelivered ballots.

◀AU0

Generally, changes made to one method of voting—like relocation or removal of precinct polling places—are accommodated by voters through substitution with a new method of voting (Clinton et al. 2021). Nonetheless, the focused removal of dropboxes from the highest population counties will disproportionately negatively affect voters living in urban and suburban areas. It likely not a coincidence that these dropboxes were targeted by a Republican legislature given that these areas have the largest concentration of non-white voters and the largest concentrations of Democratic voters in the state. In the context of Georgia, this correlates with the Atlanta Metro area, which contains Georgia’s most Democratic and diverse group of voters. While this research does investigate why Republican legislators enacted *SB 202*, the legislation will make voting less convenient and lead to more undelivered ballots in Georgia’s most reliably Democratic and least white counties.

SUPPLEMENTARY APPENDIX

◀AU6

A Descriptive Statistics

B Data Processing

C Auxilliary Results

D Auxiliary Map

REFERENCES

Aldrich, John H. 1993. “Rational Choice and Turnout.” *American Journal of Political Science* 37:246–278.

- Anselin, Luc. 1988. *Spatial Econometrics: Methods and Models*, Volume 4. Springer Science & Business Media.
- Baringer, Anna, Michael C. Herron, and Daniel A. Smith. 2020. "Voting by Mail and Ballot Rejection: Lessons from Florida for Elections in the Age of the Coronavirus." *Election Law Journal* 19(3):289–320.
- Bivand, Roger, and David W. S. Wong. 2018. "Comparing Implementations of Global and Local Indicators of Spatial Association." *TEST* 27(3):716–748.
- Brady, Henry E., and John E. McNulty. 2011. "Turning Out to Vote: The Costs of Finding and Getting to the Polling Place." *American Political Science Review* 105:1–20.
- Brower, Mac. 2022. "The Republican War on Drop Boxes." *Democracy Docket*.
- Clinton, Joshua D., Nick Eubank, Adriane Fresh, and Michael E. Shepherd. 2021. "Polling Place Changes and Political Participation: Evidence from North Carolina Presidential Elections, 2008–2016." *Political Science Research and Methods* 9(4):800–817.
- Collingwood, Loren, and Benjamin Gonzalez O'Brien. 2021. "Is Distance to Drop Box an Appropriate Proxy for Drop Box Treatment? A Case Study of Washington State." *American Politics Research* 49(6):604–617.
- Collingwood, Loren, William McGuire, Benjamin Gonzalez O'Brien, Katherine Baird, and Sarah Hampson. 2018. "Do Drop Boxes Improve Voter Turnout? Evidence from King County, Washington." *Election Law Journal* 17(1):58–72.
- Cottrell, David, Michael C. Herron, and Daniel A. Smith. 2021. "Vote-by-mail ballot rejection and experience with mail-in voting." *American Politics Research* 49(6):577–590.
- Cribari-Neto, Francisco, and Achim Zeileis. 2010. "Beta Regression in R." *Journal of Statistical Software* 34(2): 1–24.
- Engstrom, Erik J. 2012. "The Rise and Decline of Turnout in Congressional Elections: Electoral Institutions, Competition, and Strategic Mobilization." *American Journal of Political Science* 56:373–386.
- Engstrom, Erik J., and Jason M. Roberts. 2020. *The Politics of Ballot Design: How States Shape American Democracy*. Cambridge, U.K.: Cambridge University Press.
- Fotheringham, A. Stewart, and Morton E. O'Kelly. 1989. *Spatial Interaction Models: Formulations and Applications*, Volume 1. Kluwer Academic Publishers Dordrecht.
- Gimpel, J.G., and J.E. Schuknecht. 2003. "Political Participation and the Accessibility of the Ballot Box." *Political Geography* 22(5):471–488.
- Haspel, Moshe, and H. Gibbs Knotts. 2005. "Location, Location, Location: Precinct Placement and the Costs of Voting." *Journal of Politics* 67:560–573.
- Haynes, Kingsley E., and A. Stewart Fotheringham. 2020. *Gravity and Spatial Interaction Models*. Regional Research Institute, West Virginia University.
- Jones, Colin J., and Robert M. Stein. 2021. "Recruiting Persons to Work the Polls." *Election Law Journal* 20:315–326.
- Joslyn, Nick, Andrew Bilbo, Jack Arndt, Heidi Berger, and Mark Joslyn. 2020. "Distance Traveled to Polling Locations: Are Travel Costs Imposed Equally on Party Members?" *The Social Science Journal* 57:14–25.
- King, Bridgett A., and Alicia Barnes. 2019. "Descriptive Representation in Election Administration: Poll Workers and Voter Confidence." *Election Law Journal* 18:16–30.
- Kwan, Mei-Po. 1998. "Space-Time and Integral Measures of Individual Accessibility: A Comparative Analysis Using a Point-Based Framework." *Geographical Analysis* 30(3):191–216.
- McGuire, William, Benjamin Gonzalez O'Brien, Katherine Baird, Benjamin Corbett, and Loren Collingwood. 2020. "Does Distance Matter? Evaluating the Impact of Drop Boxes on Voter Turnout." *Social Science Quarterly* 101(5):1789–1809.
- McNulty, John E., Conor M. Dowling, and Margaret H. Ariotti. 2009. "Driving Saints to Sin: How Increasing the Difficulty of Voting Dissuades Even the Most Motivated Voters." *Political Analysis* 17:435–455.
- Shear, Michael D, and Stephanie Saul. 2021. "Trump, in taped call, pressured Georgia official to 'find' votes to overturn election." *The New York Times*.
- Shino, Enrijeta, Mara Suttman-Lea, and Daniel A. Smith. 2022. "Determinants of Rejected Mail Ballots in Georgia's 2018 General Election." *Political Research Quarterly* 75(1):231–243.
- Song, Shunfeng. 1996. "Some Tests of Alternative Accessibility Measures: A Population Density Approach." *Land Economics*, 474–482.
- Suttman-Lea, Mara. 2020. "Poll Worker Decision Making at the American Ballot Box." *American Politics Research* 48:714–718.
- Walker, Hannah L., Michael C. Herron, and Daniel A. Smith. 2019. "Early Voting Changes and Voter Turnout: North Carolina in the 2016 General Election." *Political Behavior* 41:841–869.

Address correspondence to: ◀AU7

Dr. Michael Greenberger
University of Denver
Department of Political Science
College of Arts, Humanities & Social Sciences
2000 E. Asbury Ave.
Denver, Colorado
80208
USA

E-mail: michael.greenberger@du.edu

Received for publication March 3, 2023; received in revised form August 10,, 2023; accepted March 3, 2023, 2022; published online <XX>2023.

AUTHOR QUERY FOR ELJ-2023-0011-VER9-MICHAEL_1P

AU0: The Publisher requests for readability that no paragraph exceeds 20 typeset lines. This paragraph contains 21 lines or more. Please divide where needed.

AU1: Please confirm RRH/Short title.

AU2: Please confirm short author bios.

AU3: Please confirm keywords from pdf.

AU4: Please note footnote numbers adjusted to accommodate unnumbered bio references.

AU5: Please add full citation to reference list.

AU6: Please note appendix will be published online as supplementary material.

AU7: Please confirm corresponding address information.

AU8: Table 2 not cited in the main text. Please check.