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Articles

Do Drop Boxes Improve Voter Turnout? Evidence from King County, Washington

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ABSTRACT

Considerable interest among academics and practitioners alike centers around identifying ways to improve voter turnout and voting parity across various subgroups in the U.S. population. Many scholars have investigated convenience voting and found mixed results in terms of its effects on turnout and its composition. A relatively new but unstudied method of voting is via ballot drop box, a method states and voters have increasingly turned to. We exploit the placement of over 30 new drop boxes in King County, Washington, the home of Seattle, during the 2016 election to investigate their effect on turnout. We find that distance to the closest ballot drop box increases one's probability of voting but primarily in off-year elections and primaries. We find mixed results for heterogeneous treatment effects. Implications are discussed.

Keywords: voter turnout, vote by mail, drop box, accessibility

INTRODUCTION

While the United States prides itself on having a vibrant democracy, voter turnout lags behind that of most other democracies. A 2017 Pew Research study found that out of 35 democratic countries worldwide, the United States came in 28th in turnout among the voting-age population (VAP), and in recent years some cities nationwide have seen some of their lowest participation ever (Desilver 2017; Maciag 2014). Low turnout typically means uneven turnout, with some groups (typically minority, low income, and younger voters) turning out at especially low rates (Rosenstone and Hansen 1993). Evidence shows that such voting disparities can lead to political outcomes that are biased against groups that don't vote (Hajnal 2010).

There is considerable interest among academics and elected officials centered around identifying ways to improve voter turnout. As more locales introduce alternative forms of voting—such as vote by mail (VBM) and early voting—assessing the impact of such alternatives on voting behavior becomes more important. One relatively new form of alternative voting is drop box voting, whereby voters drop their mail-in ballots into a secured box at designated sites.

Washington State is one of 22 states with a no-excuse absentee provision, and since 2013, all voting in the state has been conducted by mail. This makes Washington one of three states nationwide to use a VBM system, with all elections now conducted via mail-in ballot. In Washington, voters typically must provide postage for their ballot, but counties are also required to provide drop boxes—large secure boxes where unstamped ballots can be deposited anytime,

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day or night. Washington State's largest county, King County, recently underwent an expansion in the number of these drop boxes in 2016, growing from a county-wide total of 10 to a total of 43 boxes. The stated purpose of these additions was to improve citizens' access to voting so that (in the words of the King County Executive), "everyone's voice is heard in our region" (King County Newsroom 2016). This study measures the effect this expansion in drop boxes has had both in terms of overall voter turnout in King County and on the turnout among those residing close to a new drop box. Our intent is to estimate the effect these additional drop boxes have on voter turnout overall.

We begin with a brief description of turnout and trends in turnout in the United States, followed by a review of literature assessing the relationship between the form voting takes and voter turnout. A third section describes recent voting in King County, its switch to a VBM system, and its recent expansion of drop boxes. Section four details our data and methodology, and section five presents our results. We discuss the results in a sixth section, and a final section concludes with suggestions for future research.

BACKGROUND

There is a growing consensus among scholars that policymakers pay more attention to the preferences of those who vote over those who do not, and particularly to those who are affluent (Gilens 2012). It is therefore concerning that the 2012 and 2016 presidential contests saw turnout only in the 50th percentile, while participation in non-presidential elections tends to be even poorer, with a meager 36.4 percent of eligible voters casting a ballot in the 2014 midterm election (DelReal 2014). Those who do vote tend to be older, wealthier, more educated, and white, calling into question who exactly is represented in our political system (Bartels 2009; Wolfinger and Rosenstone 1980). Voter turnout, therefore, is both a significant problem in the United States and one that has a serious potential to bias public policy against those who systematically vote at lower rates. In response, some scholars, government officials, and activists have been seeking ways to target non-voting populations to improve turnout among them.

Institutional factors that make it harder to vote can play a role in the likelihood of voting, especially among those who may need more than a simple nudge to vote (Barreto, Nuno, and Sanchez 2009). One of the most important of these is geography. How close to or far from a polling location a voter is can increase or decrease the ease of voting, which in turn can increase or decrease the likelihood of participation in any given election. In a study of Clark County, Nevada, Dyck and Gimpel (2005) found that as the distance between a voter's home and their precinct location increased, the likelihood of voting decreased. Brady and McNulty (2011) similarly found that in Los Angeles, increasing the distance to a voter's polling place reduced the likelihood of voting, though Gimpel and Schuknecht (2003) found that distance played the largest role for those in metropolitan areas. Suburban voters and those in the middling areas of metro areas saw the greatest effect of distance on voting likelihood, in part likely due to traffic congestion. In rural areas, where traffic is less of an issue, distance played a significantly smaller role (Gimpel and Schuknecht 2003).

Based on this evidence, one would predict that increasing the ease of voting, particularly by increasing the number of drop box locations, should eventually lead to improved voter turnout. Indeed, evidence does suggest that voters will use alternative methods of voting should they be given the opportunity. In 2000, an estimated 10 percent of ballots cast nationwide were cast by mail, and by 2012, this figure had risen to nearly 20 percent (Greene and Ueyama 2015). And by 2014, nearly one-third of voters used some form of alternative voting, whether via the mail or by early voting (File 2015). Similarly, King County has seen an increasing number of voters return their ballots via drop boxes as the number of these boxes has increased, as we discuss later in this article.

VBM AND DROP BOXES

To date, evidence suggests that mail-in ballots do indeed increase voter turnout in both candidate and non-candidate elections, though the effect varies based on the demographic group in question, the type of election, and the novelty of being able to vote by mail (Gronke et al. 2008; Gronke and Miller 2012; Hamilton 1988; Jeffe and Jeffe 1990; Kousser and Mullin 2007; Magleby 1987; Mutch 1992; Southwell and Burchett 1997; Southwell and Burchett 2000; Southwell 2016). One aspect of vote-by-

mail states that has received little scholarly attention is the additional convenience of drop boxes for mail-in ballots. In VBM elections, a stamp is almost always required of voters, as ballots are generally collected via the U.S. Postal Service. No such stamp is necessary with a drop box, as voters must simply slide their ballot into the slot in the box and they're done.

The use of mail-in voting options is growing throughout the United States, and where 24-hour drop boxes are available these have proven very popular (Greene and Ueyama 2015). While researchers are not entirely sure as to why voters might use a drop box over a mail-in ballot, in one survey the most common reason given for using ballot drop boxes was their convenience, followed by the fact that postage was not required. The third most common reason given was the greater trust that one's vote was actually being cast (Greene and Ueyama 2015). On its face, walking or driving to one's nearest drop box seems more inconvenient—and possibly more expensive—than stamping and mailing a ballot. However, in an era where people communicate significantly less by mail (i.e., pay bills online, e-mail or online message rather than writing and mailing a letter), many people may not have stamps readily available. Therefore, people might carry a completed ballot around with them as they go about chores, shopping, etc., and simply put the ballot into the drop box at their convenience. To be sure, further research needs to be done to unpack the mechanisms behind drop box usage; nonetheless, the evidence is clear these boxes are popular.

Counties in VBM states increasingly are providing drop boxes as alternatives to the use of stamped envelopes. In Oregon, 56 percent of votes are cast in some alternative to the post office, and in Washington, 39 percent are, although this number grew to 50 percent in the 2016 general election. In Pierce County, Washington, just south of King County, over 50 percent of ballots are returned via drop boxes. Thus, as states look to make voting easier, ballot drop boxes appear to be a popular alternative to traditional Election Day voting and even to returning a ballot by mail.

While drop boxes are heavily used when available, it isn't apparent whether their existence causes people to vote who otherwise would not, or simply diverts ballots from a stamped to an unstamped route to the county elections office. Generally, the expansion of drop boxes is incremental, making any measurement of their effect difficult. However, in 2016 King County, Washington, expanded their stock of drop boxes from 10 to 43, offering an opportunity to examine the impact of these boxes on voter participation.

We do not test the mechanism of drop box usage in this article; rather we examine whether drop boxes influence turnout—and if so, amongst whom. Given the extant research on the effect of easier voting, we hypothesize that drop boxes will positively enhance turnout—specifically, those voters who physically reside closer to a drop box will be more likely to vote all else equal. We think this drop box effect will be enhanced in lower salience elections where the drop box provides visual cues and reminders to those who live near them. While these cues are present in all elections, general elections in presidential years have so many cues and reminders that the added benefit of a drop box is miniscule, whereas in an off-year and primary election the cues should be more distinct and therefore stand out more. In addition, low salience elections may well be perceived as less important by many voters, so voters are less likely to make the effort to vote. Given that a closer drop box likely makes it a bit easier to vote, we should see a drop box turnout effect when the election overall is perceived to be less important (i.e., primaries and off-year generals).

Finally, fitting with the extant voting literature, we think drop boxes will increase voting overall but are unlikely to shift the makeup of the voting pool much. That is, low income, younger, and racial ethnic/minority voters—groups that historically exude lower turnout rates than wealthy, older whites—will not be more likely to turn out because of a drop box—all else equal.

KING COUNTY, WASHINGTON

King County, Washington, with Seattle as its seat, has 2.15 million residents, making it the United States' 13th largest county, and larger than 15 states (U.S. Census Bureau 2016). With 30 percent of Washington's residents, it is also the largest county in Washington, having experienced rapid population growth in recent years. Relative to national and state averages, King County's population is disproportionately of working age. Residents are also ethnically and racially diverse, with 17 percent Asian, 10 percent Hispanic, 7 percent African American, 21 percent foreign born, and a quarter speaking

some language other than English at home (U.S. Census Bureau 2016b). It is also a well-educated county, with 48 percent of its residents age 25 and older having a college degree, compared with 29 percent at the national level. Median household income ($75,000) and per capita income ($42,000) are nearly 50 percent above the national average, and significantly above the state average; the poverty rate is also below both. With a density of over 900 people per square mile, the county is about nine times denser than both the U.S. average and the state average.

King County has more than one million registered voters (1,170,638 registered voters in 2012; 1,288,327 registered voters in 2016). In terms of votes cast, King County residents strongly lean toward Democratic candidates and issues, although some suburbs in the east and to the south are more moderate. Since 2000, over 60 percent of presidential votes cast have been for Democratic candidates, with Hillary Clinton winning 70 percent of the vote in 2016, and Barack Obama receiving 69 percent of the votes cast in 2012 (King County Elections 2016).

In terms of turnout rates, defined as the percent of registered voters who vote, the size and pattern varies by the election type, which can be categorized into four groups. First are elections held every four years when voters decide on the U.S. president. Turnout for the last several general presidential elections has been rising slightly, from 75 percent in 2000 to 85 percent in 2012 and 82 percent in 2016. A second type of election is the midterm election when congressional seats are determined. For this cycle, turnout in King County typically ranges from 55 to 75 percent. Third, Washington State also holds off-year elections where voters decide ballot initiatives and referenda, as well as cast votes for local offices, like Seattle mayor. As is typical nationwide, turnout for general off-year elections is low, averaging around 50 percent, with the occasional very low turnout of 36 percent in 2003 and 42 percent in 2017. A final fourth category of elections is the primaries that occur during any of the three election cycles above. Primary turnout is low in all years, averaging about 40 percent during presidential elections, 33 percent during midyear elections, and 29 percent during off years.[1]

Like most locales, King County exhibits very uneven voting patterns at the precinct level. In the 2014 election, 53 percent of registered voters voted. However, a number of precincts experienced less than 30 percent turnout, whereas others had over 71 percent turnout.

DROP BOXES AND THEIR EXPANSION

As is true across the nation, King County has turned increasingly to alternative forms of voting. In 1974, all voters in Washington could request an absentee ballot, and in 1985 that request could be made permanent. In 1983, jurisdictions could request a vote by mail for special elections, a right given to counties for local elections in 1987 and for statewide elections in 1993. In 2005, Washington counties could conduct all elections by mail (Secretary of State 2007), and by 2007 all King County voters received their ballots in the mail, although one-third still chose to vote in person. In 2009, the county closed all precinct voting, and from that year on, all voting has been by mail. In 2011, the Washington legislature passed a law requiring all counties to conduct their vote by mail, and since that year the entire state has exclusively voted by mail.

Washington State requires all counties to provide at least two drop box locations where voters can drop off their ballots any time of the day, and almost all provide many more drop boxes than this. King County has been slower than most to expand its drop boxes beyond this minimum. By 2015, county residents had access to 10 permanent drop boxes and 13 temporary ballot-drop vans with limited hours. This compared with 30 permanent boxes in nearby Pierce County, which has only half of King County's population.

During the 2015 general election for the director of King County elections, the two candidates campaigned on a platform of expanding drop box locations, and the eventual winner set a goal of 40 by the following 2016 general election (Connelly 2015). The stated purpose of the expansion was to ensure that 90 percent of residents lived within three miles of a drop box (Buhain 2016). On drop box expansion, the newly elected director of elections, Julie Wise, stated, "We should make it as easy as possible to exercise the right to vote and this is a good step in that direction" (Capitol Hill Seattle Staff 2016). Throughout the summer and fall of 2016, these drop boxes were installed somewhat equitably throughout the county (see Figure 1), although

[1]There are also special elections, not discussed here. Turnout for these is low but variable, occasionally reaching above 50 percent.

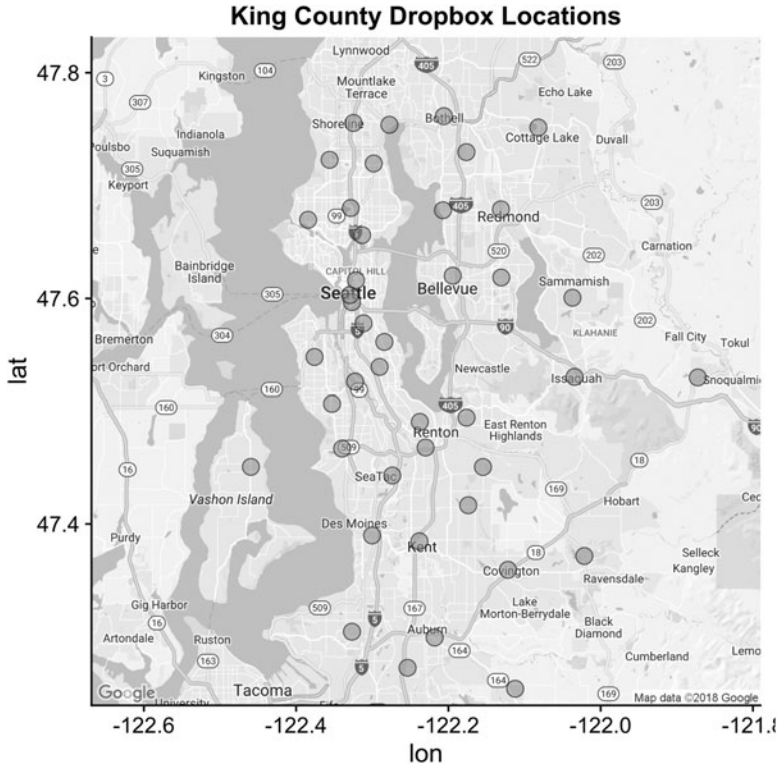

FIG. 1. King County ballot drop box locations as of the 2016 general election.

the final selected locations were *not* randomly determined.[2] Early results from the primary, which occurred during the middle of the drop box expansion (29 of the total 43 drop boxes were in place), showed their popularity: 36 percent of primary voters used the drop box, compared with 26 percent during the 2015 general election (King County 2016).

We next outline our data, methods, and identification strategy to determine whether distance to ballot drop boxes increases turnout and if these effects differ by election type. On balance, we anticipate that living near a drop box will associate with higher voter turnout. However, drop box effects are likely to vary as a function of election salience.

DATA AND METHODOLOGY

To assess whether the location of drop boxes affects voter turnout, we contracted with a nationally known voter file vendor (Labels and Lists, or L2), who maintains lists of Washington's voters taken directly from the state's Secretary of State office. When voters register to vote, several bits of information are required of them, including their age, gender, address, and in some states, party identification and race (the latter are not requested in Washington). These files are augmented with numerous variables, including precinct, registration date, census and commercial data that provide estimates of income, education, and race/ethnicity, and vote history for the past twelve years. The voter file records whether each voter cast a ballot in every possible election over this 12-year window. Given our interest, we restrict the Washington voter file to King County.

Our goal is to determine whether the placement of drop boxes has influenced voter turnout. But because drop box effects likely vary by type of election (i.e., primary versus general, presidential

[2]According to a report from the King County Elections Office produced in early 2016, the drop box locations were determined by site from Elections staff to over 100 possible sites across King County. The office established a set of criteria with which to score each possible location, which included: alignment with department and county goals, operational effectiveness, general accessibility, and continuity of service. Once all sites had been scored on this basis, a short list of locations was drawn up which also took into account geographic equity and site owner input (King County Elections Office 2016).

versus off-year), we construct several dependent variables to measure voting in a variety of scenarios. We analyze four elections (2015 general, 2015 primary, 2016 general, and 2016 primary), where in each, our dependent variable is a binary indicator equal to one if an individual is recorded as voting or zero otherwise.[3] In our estimation strategy, which we describe below, we collapse the four dependent variables into two models (a general election model and a primary election model). To assess heterogeneous treatment effects, we conduct discrete subgroup analyses for the following: age, gender, income, race/ethnicity.

The creation of our independent variable is somewhat more complex. We wish to measure the average treatment effect a drop box has on voter turnout. To do so, we craft a distance measure for each voter to her closest drop box for the 2015 primary (when there were 10 total boxes), 2015 general (10 boxes), 2016 primary (29 boxes), and 2016 general (43 boxes) elections. While it is certainly possible voters will not use the drop box closest to their residence—for instance, voters may use the drop box closest to their work—voter residence is the only geographic characteristic available. Besides, distance to polling location from home has been the measure traditionally employed in similar analyses (e.g., Gimpel and Schuknecht 2003; Stein and Vonnahme 2008).

Because the number of drop boxes in the two 2015 elections are the same—10 boxes—this distance measure is also the same for the 2015 elections. However, King County expanded to 29 drop boxes by the 2016 primary and to 43 by the 2016 general. Thus, each voter has three separate distance measures, which we exploit to estimate the average treatment effect. To calculate a voter's distance to their nearest drop box, we began by using a geocoding process to calculate the longitude and latitude coordinates of all 43 drop boxes in King County. The location of each drop box was given to us by the King County board of elections and is mapped in Figure 1. We repeated this geocoding process with the address of every registered voter. Next, we calculated the haversine (in meters) between each voter to all drop boxes, for that particular election. Similar to Euclidean or cosine distance, haversine is a formula used to measure the distance between two latitude and longitude coordinates on a sphere, such as the earth (Robusto 1957, Collingwood 2017). The measure is particularly well-suited for distances relatively close to one another, such as distances within a county. Haversines were then converted to miles for purposes of interpretation. For each voter, we then selected the smallest distance between their residence and drop box, which becomes the drop box distance for that voter in that particular election.

The additional drop boxes were not placed randomly around the county, but instead were installed in areas where planners anticipated higher demand and in areas farther from existing drop box locations. This means that if we simply compare turnout of voters living in precincts with new drop boxes to voters living in precincts without drop boxes, pretreatment selection effects might actually show new drop boxes having a negative effect on turnout. In other words, other variables that correlate with voter participation might also correlate with drop box placement.

To address this problem, we employ a conditional logit model to estimate the relationship between distance to the nearest drop box and an individual's probability to vote. The conditional logit model exploits the fact that we have multiple observations for most of the voters in our data set. Generally speaking, the conditional logit model is designed to deal with case-control comparisons within "grouped" data. In our context, we treat each individual as a "group" observed over several time periods. This allows us to estimate the effect of a change in distance to the nearest drop box by treating the observation of each individual prior to the installation of new drop boxes as their own "control." This effectively controls for all time-invariant individual characteristics (e.g. race, gender, etc.) that might otherwise influence the probability to vote.

Assume an individual (i) chooses among J alternatives to maximize utility (U). The utility of choice $j \in J$ is

$$U_{ij} = \boldsymbol{z}'_{\boldsymbol{ij}}\boldsymbol{\beta} + \varepsilon_{\boldsymbol{ij}} \quad (1)$$

Where $\boldsymbol{z}'_{\boldsymbol{ij}}$ is a vector of individual and choice-specific attributes. Assume $\boldsymbol{z}'_{\boldsymbol{ij}} = \left[\boldsymbol{x}_{\boldsymbol{ij}},\ \boldsymbol{w}_{\boldsymbol{i}}\right]$, where $\boldsymbol{w}_{\boldsymbol{i}}$ is a vector of individual characteristics that do not vary over choices, while $\boldsymbol{x}_{\boldsymbol{ij}}$ are characteristics that vary across choices (j) and individuals (i). For

[3]We subset the data to only voters who were eligible to vote in both election years.

TABLE 1. SUMMARY STATISTICS

Variable	*Mean*	*Std. Dev.*	*Min.*	*Max.*
Voted (general election)	0.54	0.50	0	1
Voted (primary election)	0.27	0.44	0	1
Distance to nearest drop box (general election)	2.59	2.28	0.00	60.97
Distance to nearest drop box (primary election)	2.82	2.37	0.00	60.97

example, in studying voting behavior, $\boldsymbol{w_i}$ might include gender or ethnicity. The term $\boldsymbol{x_{ij}}$ might include the voter's distance to nearest drop box. Imposing some distributional assumptions on ε_{ij} in (1), the probability that an individual (i) will choose a given outcome (j) is

$$[\Pr(Y_i) = j] = \frac{e^{z'_{ij}\boldsymbol{\beta}+\varepsilon_{ij}}}{\sum_{j=1}^{J} e^{z'_{ij}\boldsymbol{\beta}+\varepsilon_{ij}}} \quad (2)$$

If $\boldsymbol{z'_{ij}}$is linear in $\boldsymbol{x_{ij}}$ and $\boldsymbol{w_i}$, we can rewrite $\boldsymbol{z'_{ij}} = \boldsymbol{\beta'} x_{ij} + \boldsymbol{\alpha'} w_i$ and substitute into (2):

$$\Pr(Y_i) = j = \frac{e^{\boldsymbol{\beta'} x_{ij}+\boldsymbol{\alpha'} w_i}}{\sum_{j=1}^{J} e^{\boldsymbol{\beta'} x_{ij}+\boldsymbol{\alpha'} w_i}}$$

Or,

$$\Pr(Y_i) = j = \frac{e^{\boldsymbol{\beta'} x_{ij}} e^{\boldsymbol{\alpha'} w_i}}{\sum_{j=1}^{J} e^{\boldsymbol{\beta'} x_{ij}} e^{\boldsymbol{\alpha'} w_i}} \quad (3)$$

By assumption, $\boldsymbol{w_i}$ does not vary over j. This means the terms containing $\boldsymbol{w_i}$ will cancel out in (3). In other words, we can estimate the relationship between $\boldsymbol{x_{ij}}$ and individuals' choice behavior without including explicit controls for individual characteristics that do not vary over j. In this context, the conditional logit model can be used in much the same way as are other fixed effects models: it controls for the influence of time-invariant unobserved characteristics of individuals that might affect an individual's choice (Chamberlain 1980). Instead, we rely entirely on variation in the attributes of choices, e.g. distance to the nearest drop box. In this way, each individual acts as their own control—holding constant any potential effects from their $\boldsymbol{w_i}$ (Greene 2003).

Furthermore, we subset the data to include only voters who had registered by January 1, 2015 and had not moved. This ensures that any change in voting behavior is not due to a change in registration status. We also include a fixed effect for the year 2016 to capture any change in the probability to vote between 2015 and 2016 that might be common across all individuals. Since voters are generally more likely to turn out in presidential election years, we expect this fixed effect will be positively related to the probability to vote. We also estimate the models separately for primary and general elections. We do so because we suspect that the overall probability to vote, as well as the effect of distance to drop box on the probability to vote, varies between primary and general elections. In each model, the independent variable of interest is the individual's distance to closest drop box, which changes between the 2015 general (10 total boxes) and 2016 general (43 total boxes), and then also between the 2015 primary (10 total boxes) and the 2016 primary (29 total boxes). After we derive our main results, we also interact our distance variable with dummy variables indicating socioeconomic status—age, gender, income, and ethnicity. We expect that the relationship between distance to the nearest drop box and the probability of voting differs along these dimensions. Table 1 displays the summary statistics of relevant variables.

The estimated relationships are expressed in terms of odds ratios. Odds ratios are the factor by which an increase in the independent variable changes the odds that the dependent variable is equal to one. An odds ratio equal to one indicates no relationship between distance to the nearest drop box and the probability to vote. A value greater than one indicates greater distance to the nearest drop box increases the odds of voting, and a value below one indicates greater distance to the nearest drop box decreases the odds of voting. Odds ratios are convenient for summarizing the direction and magnitude of the estimated effects, but are not always intuitive to the reader. For convenience, we also use our estimates to generate and plot predicted probabilities of voting, which show how changes in the distance to the nearest drop box affect the probability of voting, holding all else constant.

We expect an odds ratio greater than one on our year fixed effect and an odds ratio lower than one

on our measure of distance to the nearest drop box. We also expect a larger effect (odds ratio closer to zero) for the primary election. Given the salience of the presidential race, we expect drop box distance to play a limited role in the 2016 general election compared to the primaries or the 2015 general, which are lower salience elections.

RESULTS

Our primary interest is to assess whether drop boxes increase turnout in elections, and if so, if the effects are stronger in low salience competitions. Then, we want to assess whether these turnout effects vary by relevant social characteristics. The estimated odds ratios for the baseline model are reported in Table 2. Values in parentheses are *p*-values calculated using robust standard errors clustered at the individual level. The results conform to our expectations, and all results are statistically significant at the one percent level. The estimated odds ratio on our year dummy in column (1) is 42.66, implying that the odds of voting in the 2016 general election were 42.66 times higher than the odds of voting in the 2015 general election, holding all else constant. This, of course, comports with turnout rates. The odds ratio on the year dummy for the primary election was only 3.36, implying a much smaller change in the odds of voting in the primary elections between 2015 and 2016.

We also find that greater distance to the closest drop box was associated with a lower probability to vote. The odds ratio on our distance measure in column (1) is 0.98, implying a one mile increase in the distance from the nearest drop box will decrease the odds an individual will vote by approximately two percent. The effect is larger for primary elections, as reported in column (2). Here, we find that a one mile increase in the distance from the nearest drop box will decrease the odds an individual will vote by approximately four percent.

For ease of interpretation, Figure 2 plots the predicted probabilities of voting in the four analyzed elections, based on the estimates reported in Table 2.[4] The bottom right panel presents voting probabilities during the 2016 general election as a function of distance from the nearest drop box. These estimates hold time-invariant individual characteristics constant, and show the relationship between distance to the nearest drop box and likelihood of voting for the average registered voter in the estimation sample. We can see from the figure that the probability of voting declines very slowly until we start looking at individuals more than 20 miles away from their nearest drop box. However, an examination of the rug at the bottom of the plot (voter distance density) reveals that very few voters live more than 20 miles from the nearest drop box. We can get an even stronger sense of the magnitude of the drop box effect in the bottom right panel of Figure 3, which focuses on the region of the plot one standard deviation above and below the mean value of distance to the nearest drop box. This figure shows that a one standard deviation increase or decrease from the mean changes the likelihood of voting by less than one percentage point. In short, the drop box effect on turnout in the 2016 general was minimal, as hypothesized.

The upper right quadrants in Figures 2 and 3, respectively, repeat this exercise for the 2015 general election. The plots show that the likelihood of voting is generally lower in 2015 (as indicated by the odds ratio on our year dummy), and also more sensitive to changes in the distance to the nearest drop box. In Figure 2, we can see that the likelihood of voting varies between 20% and 50% over the whole estimation sample. Figure 3 shows the change in the likelihood of voting for one standard deviation above and below the mean of the distance variable. This figure shows that a one standard deviation decrease in distance to the nearest drop box relative to the mean

Table 2. Estimated Odds Ratios for Conditional Logit Models

Note: Values reported are odds ratios	*(1) General election*	*(2) Primary election*
Year = 2016	42.66***	3.36***
	(0.000)	(0.000)
Distance to nearest drop box	0.98***	0.94***
	(0.000)	(0.000)
Equiv. of distance coeff.	0.000	
p-value		
Observations	846,918	455,060

Robust *p*-value in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

[4]We also estimated all models among respondents within 30 miles and 15 miles of a drop box, respectively. The findings are essentially identical.

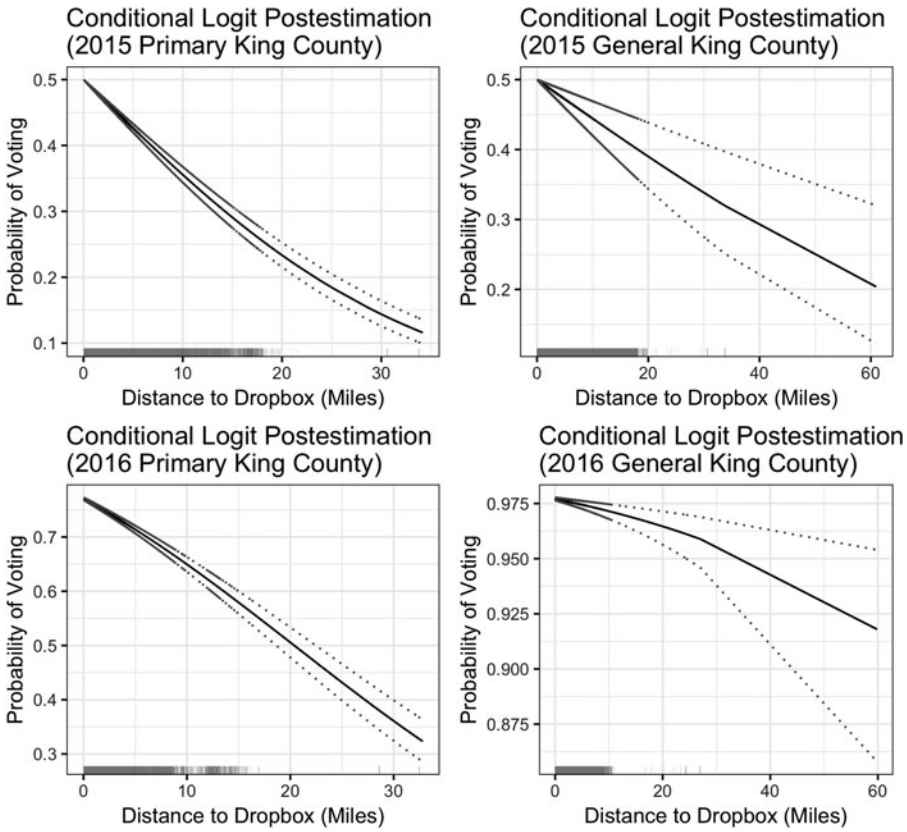

FIG. 2. Predicted probability of voting vs. distance to nearest drop box for the 2016 general, 2016 primary, 2015 general, 2015 primary elections.

increases the likelihood to vote by approximately 1.5 percentage points.

The bottom left quadrants of Figures 2 and 3, respectively, plot the relationship between distance to the nearest drop box and the likelihood of voting for the 2016 primary election. Compared to the 2016 general, the probability of voting is generally lower, and much more sensitive to changes in distance to the nearest drop box. The likelihood of voting varies between approximately 30% and 80% over the whole estimation sample. The bottom left quadrant in Figure 3 focuses on changes from one standard deviation above and below the mean distance to the nearest drop box. We find that decreasing the distance to the nearest drop boxes by one standard deviation relative to the mean increases the likelihood to vote by approximately two percentage points.

Finally, the top left quadrants of Figures 2 and 3, respectively, plot the relationship between the likelihood of voting and distance to the nearest drop box for the 2015 primary election. This election shows the lowest overall rates of turnout and the greatest sensitivity to changes in distance to the nearest drop box. This is the election with the lowest salience; thus, the turnout magnitude comports with our expectations. As shown in Figure 2, the likelihood of voting ranges between 10% and 50% for the entire estimation sample, and drops off sharply as the distance increases. Figure 3 shows that a one standard deviation decrease in distance to the nearest drop box relative to the mean increases the likelihood of voting by approximately four percentage points.[5] Thus, the overall pattern of findings indicates that drop boxes have greater turnout effects in less salient elections, fitting with our theoretical priors.

The secondary focus of our analysis is to assess heterogeneous treatment ballot drop box turnout effects. To examine this, we re-estimate our models

[5]Due to the skewness of the distance to nearest drop box's distribution, we also include a first difference plot of change in first to third quartile (see Fig. 4). Results are similar as the standard deviation change plots.

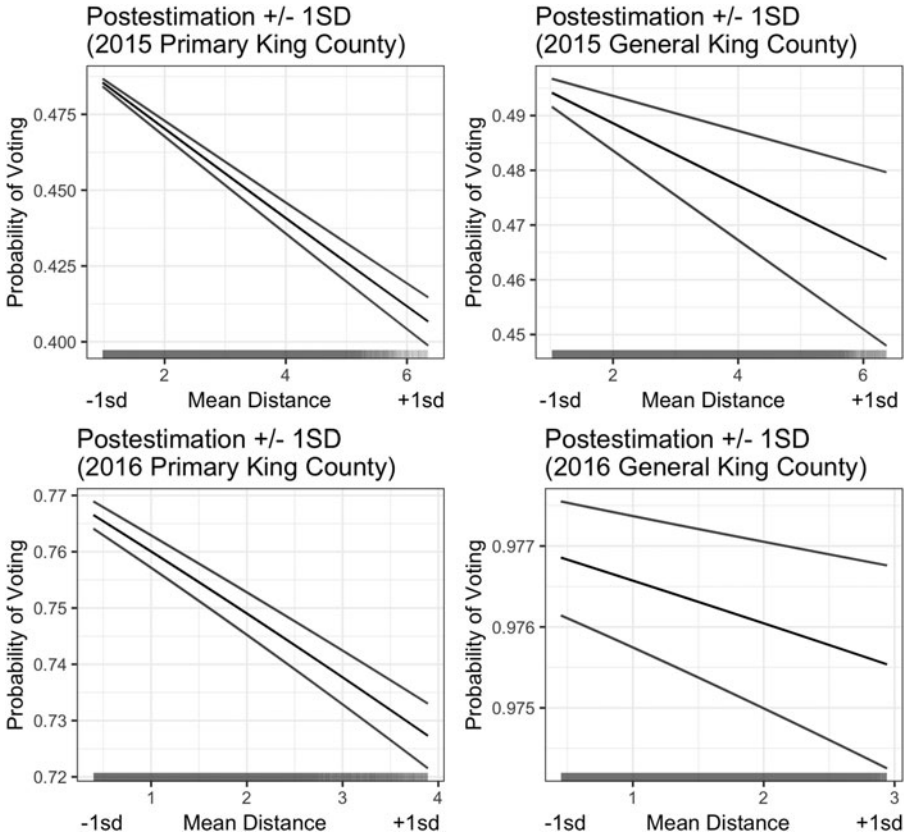

FIG. 3. Predicted probability of voting vs. distance to nearest drop box one standard deviation above and below the mean for the 2016 general, 2016 primary, 2015 general, 2015 primary elections.

by including interaction terms between our distance variable and dummy variables indicating sociodemographic groups, including age (three categories), income (three categories), gender (two categories), and race/ethnicity (five categories). However, we should note that the determination of an individual's race/ethnicity and income is based on a combination of surname, neighborhood characteristics, and other consumer data, so the match is not necessarily exact.[6] Given the extant literature on VBM and the effect of greater ease of voting, ceteris paribus, we do not expect voters from groups lower in socioeconomic status to disproportionately be influenced by the presence of a drop box.

Table 3 presents results for the general elections. In column (1), we include interactions with dummy variables indicating middle age votes (37–55) and older voters (56 or older). The estimated odds ratio on the distance variable represents the effect for the excluded category: younger voters (18–36). It is important to note that the interaction terms are multiplicative, not additive. This means the estimated odds ratio for younger voters is 1.0008, while the estimated odds ratio for middle aged voters is 0.978 (=1.008 * 0.970). The *p*-value on the odds ratio for middle age and older voters is for the test of the null hypothesis that the odds ratio for that group is not significantly different from the odds ratio for the excluded category. These results indicate that middle age voters ($p=0.029$) and older voters ($p=0.000$) are more likely to be affected by reduced distance to the nearest drop box. The effect is largest for the oldest voter group. This fits well with the existing literature on the impact of increasing the ease of voting, which indicates that groups who are already likely to vote (older voters) are

[6]Unfortunately, the voter file vendor could not provide us with precise methodology for flagging voters by race/ethnicity and income.

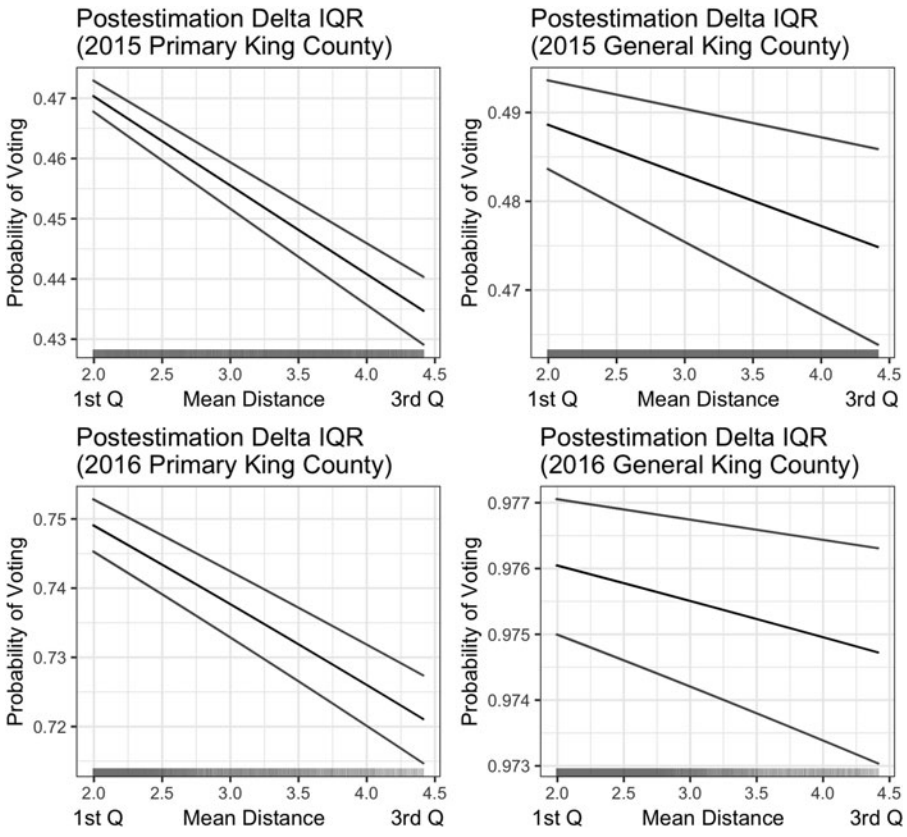

FIG. 4. Predicted probability of voting vs. distance to nearest drop box from first quartile to third quartile for the 2016 general, 2016 primary, 2015 general, 2015 primary elections.

precisely those who gain the most from interventions that make voting easier.

Column (2) presents results differentiating by gender. The excluded category is "male." The *p*-value on the estimated odds ratio for the "female" dummy indicates that there is no significant difference between men and women in terms of their response to distance to the nearest drop box in general elections. Column (3) differentiates voters by income, with the excluded category being lower-income voters (annual income $1,000–$74,999). We find no significant differences across income groups in the general elections. Column (4) differentiates by ethnicity. The excluded category is "Other," and the included categories are "Asian," "Hispanic," "European," and "African American." We find no evidence of differential effects across these groups for the general election. Finally, column (5) includes interactions for all the sociodemographic characteristics. This allows us to estimate the effect of each sociodemographic characteristic, holding the others constant. Here, we find that there are still differential effects by age, controlling for all of the other characteristics. They are approximately the same size and significance as in column (1).

Table 4 repeats the above exercise for the primary elections. Beginning with column (1), we find that the estimated odds ratio for younger voters (18–36) is 0.958, indicating that a one mile decrease in their distance to the nearest drop box increased their odds of voting by approximately 4.8% in the primary elections. There is no significant difference between the odds ratio for younger voters and the odds ratio for middle age voters. Once again, the largest effects are seen for older voters, with an estimated odds ratio of 0.932 ($=0.958 * 0.973$). The results in column (2) differentiate by gender. Once again, male is the excluded category, and the estimated odds ratios show that the effect of reduced distance to the nearest drop box was larger for men than for women ($p=0.017$) in the primary elections. Column (3) differentiates by income. As in Table 3, we find no differences among income groups in the primary elections. Column (4) differentiates by ethnicity and indicates there were no

Table 3. General Election Results by Sociodemographic Group

Variables	*(1) Age*	*(2) Gender*	*(3) Income*	*(4) Ethnicity*	*(5) All*
Distance to nearest drop box	1.008	0.973***	0.988	0.973	1.002
	(0.440)	(0.000)	(0.221)	(0.380)	(0.959)
Distance x Age 37–55	0.970**				0.971**
	(0.029)				(0.039)
Distance x Age 56+	0.955***				0.954***
	(0.000)				(0.000)
Distance x Female		1.013			1.015
		(0.251)			(0.179)
Distance x Income $75,000–$124,999			0.985		0.985
			(0.221)		(0.230)
Distance x Income $125,000+			0.989		0.994
			(0.463)		(0.704)
Distance x Asian				0.992	0.991
				(0.841)	(0.824)
Distance x Hispanic				1.061	1.060
				(0.109)	(0.125)
Distance x European				1.007	1.008
				(0.837)	(0.795)
Distance x African American				0.972	0.973
				(0.680)	(0.685)
Year 2016	50.151***	38.289***	35.355***	41.118***	35.326***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year 2016 x Age 37–55	1.319***				1.300***
	(0.000)				(0.000)
Year 2016 x Age 56+	0.518***				0.520***
	(0.000)				(0.000)
Year 2016 x Female		1.280***			1.317***
		(0.000)			(0.000)
Year 2016 x Income $75,000–$124,999			1.256***		1.172***
			(0.000)		(0.000)
Year 2016 x Income $125,000+			1.455***		1.334***
			(0.000)		(0.000)
Year 2016 x Asian				0.865*	0.853*
				(0.091)	(0.067)
Year 2016 x Hispanic				1.285***	1.278**
				(0.009)	(0.011)
Year 2016 x European				1.083	1.109
				(0.285)	(0.172)
Year 2016 x African American				0.770*	0.798
				(0.071)	(0.120)
Observations	746,318	746,318	746,318	746,318	746,318

Robust *p*-value in parentheses.
***$p<0.01$, **$p<0.05$, *$p<0.1$.

significant differences in responsiveness to distance to the nearest drop box along these lines. Finally, column (5) includes interaction terms for all of the sociodemographic characteristics. We find that the differential effects by age and gender are still present, with no differential effects seen across income or ethnic groups.

DISCUSSION

Our estimation results support our basic hypothesis that increased proximity to drop boxes increases the likelihood that an individual will vote. This result is robust to controls for time-invariant individual characteristics that might otherwise affect

Table 4. Primary Election Results by Sociodemographic Group

Variables	*(1) Age*	*(2) Gender*	*(3) Income*	*(4) Ethnicity*	*(5) All*
Distance to nearest drop box	0.958***	0.934***	0.937***	0.934***	0.939***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Distance x Age 37–55	0.990				0.991
	(0.235)				(0.250)
Distance x Age 56+	0.973***				0.973***
	(0.001)				(0.000)
Distance x Female		1.014**			1.014**
		(0.017)			(0.017)
Distance x Income $75,000–$124,999			1.009		1.006
			(0.202)		(0.342)
Distance x Income $125,000+			1.002		1.001
			(0.776)		(0.886)
Distance x Asian				0.964	0.964
				(0.108)	(0.108)
Distance x Hispanic				1.028	1.028
				(0.209)	(0.212)
Distance x European				1.010	1.013
				(0.570)	(0.464)
Distance x African American				1.008	1.007
				(0.834)	(0.855)
Year 2016	3.085***	3.234***	3.333***	3.390***	2.969***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year 2016 x Age 37–55	1.058***				1.060***
	(0.002)				(0.002)
Year 2016 x Age 56+	1.163***				1.157***
	(0.000)				(0.000)
Year 2016 x Female		1.075***			1.077***
		(0.000)			(0.000)
Year 2016 x Income $75,000–$124,999			1.035**		1.048***
			(0.033)		(0.004)
Year 2016 x Income $125,000+			0.981		0.993
			(0.260)		(0.691)
Year 2016 x Asian				0.747***	0.745***
				(0.000)	(0.000)
Year 2016 x Hispanic				0.999	0.996
				(0.976)	(0.928)
Year 2016 x European				1.022	1.014
				(0.575)	(0.720)
Year 2016 x African American				0.795***	0.791***
				(0.002)	(0.002)
Observations	400,688	400,688	400,688	400,688	400,688

Robust *p*-value in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

the probability of voting (e.g., education, gender, race, etc.). The magnitude of this effect depends critically on the type of election being considered. If we focus on the changes associated with a one standard deviation decrease in the distance to the nearest drop box, we see that the effects were greatest in the 2015 primary, a much less salient election compared to the 2016 general.

This suggests that the mechanisms through which drop boxes affect voter behavior can be "crowded out" by other characteristics of the election. The election in 2016 was contentious and saturated U.S. media. Voters were apparently so motivated to turn out that proximity to the nearest drop box was not an important consideration. A primary election or an off-year general election (which is

actually common in Washington State) will receive less media coverage, and voters may be more sensitive to the increased convenience or security the drop box provides. Therefore, installing new drop boxes will boost turnout in low-salience (i.e., off-year or primary) elections, but has only small effects on turnout in presidential election years. Our examination of heterogeneous treatment effects produces results that should be of interest to both researchers and practitioners. In both primary and general elections, increasing the availability of drop boxes has the biggest effect on turnout for older voters. We also find evidence that men are more responsive to drop box expansion than are women in primary elections. We find no differences in responsiveness to drop boxes by income or ethnicity. The total effect of drop boxes on the "representativeness" of the electorate is not clear from these results, and a more systematic evaluation is beyond the scope of this study. However, these results clearly show that new methods of collecting ballots have significant effects not only on the level of turnout but also on its composition.

CONCLUSIONS

In this article, we set out to evaluate whether the expansion of ballot drop boxes influenced voter turnout. King County recently installed 33 new drop boxes around the county, and it is likely that the state will invest greater resources in this method of voting. Other VBM states, such as Oregon, have also implemented similar drop box voting methods. However, before this study, no one really knew if installing new drop boxes actually had any impact on voter turnout. In the end, are drop boxes a good use of government spending if the boxes simply shift the burden of voting to placing a ballot in a steel box as opposed to placing it in the post, if the new method has no effect on voter turnout?

Our results clearly show that drop boxes increase voter turnout, though the size of these effects differs by election type and sociodemographic characteristics of voters. While the effects of boxes in presidential general elections were found to be minimal, turnout effects in primaries and off year elections are clearly noticeable as seen in Figures 2 and 3. Moving from one standard deviation distance below the mean to one standard deviation above the mean, we observe an increase in probability of voting by two to seven percentage points (depending on the election). This is consistent with previous research showing that distance to polling location has a measurable effect on turnout—especially in off-year and primary elections.

Moving forward, scholars should investigate whether drop boxes influence turnout similarly in other jurisdictions, elections, and states. For instance, are drop boxes more effective in cities where voters are more likely to commute via buses, trains, and bicycles? Or, are drop boxes more likely to influence voting behavior in high-density locations than in low-density locations?

It is also important to find better measures for voters' distance to their nearest drop box. In this study, we assume that voters use the drop box closest to their home address. However, it is possible that voters tend to use drop boxes closer to their place of employment or major commercial centers. Answering this question is important for future research on drop boxes and would also have implications for future drop box placement.

Finally, more work should be done to identify through what mechanism drop boxes affect turnout. Do our findings reflect increased convenience, or does the presence of a drop box affect the salience of an election in that area? This is related to the differential responses we found to drop boxes by age and gender. Members of different sociodemographic groups may fail to turn out for different reasons. If drop boxes primarily influence turnout through increased convenience, they may not be an effective strategy for reaching voters that feel politically disengaged. While the design of this study is appropriate for measuring the causal effect of drop box expansion on turnout, identifying voters' motives and intentions may require the use of surveys or focus groups.

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