Universal Mail Ballot Delivery Boosts Turnout: The Causal Effects of Sending Mail Ballots to All Registered Voters

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Abstract

Prior to the COVID-19 pandemic, some American states had transitioned to universal voting-by-mail, where all registered voters receive a mail ballot. But due to the pandemic, universal voting-by-mail was suddenly used in a larger number of states in 2020. Here we study a unique situation in which registered voters in some legislative districts in Los Angeles County were subjected to universal voting-by-mail in the March 2020 primary. Using difference-in-differences and geographic boundary-based designs on individual-level records, we take advantage of this within-jurisdiction situation to estimate the causal effects of universal voting-by-mail on voter turnout and on who votes. Our results indicate that voter turnout increased by 3 to 4 percentage points for voters who do not automatically receive a mail ballot, and the increase is generally larger for registered partisan voters than those without a party affiliation.

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1. Introduction

Research on voting by mail in the United States has generally concentrated on two important questions. First, does offering eligible voters the opportunity to obtain and return their ballot by mail increase the likelihood that they will cast a ballot? Second, does offering a voting-by-mail option alter the demographic or political composition of the electorate? We consider both of these questions in this paper, taking advantage of a novel situation that arose in the 2020 March statewide primary in Southern California.

Voting by mail in American elections is generally implemented in one of two ways. The first is what we call absentee voting — which is an opt-in process, whereby a registered voter needs to request that they receive a ballot in the mail, and in some jurisdictions the requesting voter needs to meet some conditions to be eligible to receive the mail ballot. The second approach is what we call universal voting by mail (UVBM), where all registered voters in a jurisdiction automatically receive a ballot in the mail. We focus on UVMB in this paper, and discuss the UVMB process specifically in the next section.[1]

Regarding whether voting by mail in general stimulates turnout, past academic research has produced mixed results. On the one hand, a number of studies have indicated that voting by mail (whether absentee voting or UVBM) might increase voter turnout modestly; for example, see Southwell and Burchett (2000), Richey (2008), or Gerber, Huber and Hill (2013). On the other hand, competing studies have argued that voting by mail does not boost turnout (Gronke and Miller, 2012), and may even depress turnout (Kousser and Mullin, 2007; Bergman and Yates, 2011; Keele and Titiunik, 2018). For an excellent review of this literature, see Gronke et al. (2008).

Perhaps not surprisingly, as studies have produced mixed results about whether voting by mail boosts turnout (and when it appears to boost turnout, the effects are slight or modest), most academic research on voting by mail has also concluded that it does not

[1] Since universal voting by mail is a stronger intervention than absentee voting, it likely provides an upper bound on the effect of voting by mail.

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change the composition of the electorate. This has particularly been the case for partisan and politically consequential changes in the composition of the electorate. Early research found that making registration and voting more convenient did not have strong partisan consequences (Wolfinger and Rosenstone, 1980), with early studies of absentee voting arguing that it only seems to boost partisan vote shares in places where a particular political party is already strong (Patterson and Caldeira, 1985). This has generally been confirmed in more recent research (Gerber, Huber and Hill, 2013; Thompson et al., 2020; Barber and Holbein, 2020; Bonica et al., 2021).

A critical problem with past studies on the behavioral implications of voting by mail is that most (though not all) of the studies have been observational. Typically the observational studies have used ecological or survey data, not individual micro-level data, and have not used methods that are appropriate for causal inference. Exceptions are a number of more recent studies, which typically take advantage of staggering adoption of universal voting by mail across counties where transitions to voting by mail have occurred gradually within or across a number of western states (Washington, Utah, and California in particular) (Gerber, Huber and Hill, 2013; Thompson et al., 2020; Barber and Holbein, 2020; Bonica et al., 2021). We provide a summary of the research literature on universal voting by mail in the paper's Supplementary Information, Table SI.1.

Our study advances research on the turnout and electoral composition effects of universal voting by mail, as we estimate the causal effects within a single jurisdiction. We apply appropriate causal inference techniques (difference-in-differences and geographic boundary-based designs) to individual-level data from Los Angeles County's March 2, 2020 primary election (conducted before the COVID-19 pandemic altered California election administration), where voters in some legislative districts received ballots in the mail while voters in neighboring areas in the county did not. Our focus on this limited geographic area is what differentiates our study from past research, which has examined how universal voting by mail affects individual voters across different election administration jurisdictions, namely different counties or states.[2]

First, even within states like Washington, Utah, and California, there is considerable variation across counties in terms of election administration, political competition and culture, and their social and demographic composition. For example, county election officials are often allowed to decide the number of polling places, set precinct boundaries, and enforce voter identification laws (Brady and McNulty, 2011; Atkeson et al., 2014; White, Nathan and Faller, 2015; Merivaki and Suttmann-Lea, 2023). These county-by-county differences produce unobserved confounders, which could bias their estimates of the electoral effects of universal voting by mail.

Moreover, since counties usually have discretion over when or whether to opt to implement universal voting by mail, the implementation is correlated with observable and unobservable county characteristics and past turnout. For example, five rural counties (of 39 total counties) were the first to implement universal voting by mail in Washington State (Gerber, Huber and Hill, 2013). The counties' self-selection into treatment could lead to endogeneity bias if the selection is in part based on turnout history, or omitted variable bias if the selection is correlated with county characteristics that are unobservable or not subject to control.[3]

Another important issue is how universal voting by mail was typically implemented in these states, usually as part of a package of different reforms, including the elimination of neighborhood polling places and the use of an extended period of pre-election voting opportunities. The elimination of polling places that accompanied universal voting by mail as cost-saving measures in several states' election reforms may reduce turnout (Gerber, Huber and Hill, 2013; Keele and Titiunik, 2018) and therefore explain the null or

[2]Barber and Holbein (2020) noted the violation of the parallel trends assumption in the cross-county study (page 3). Thompson et al. (2020) and Barber and Holbein (2020) address this violation by making parametric assumptions about the underlying turnout trends (linear or quadratic) absent the policy. By contrast, our research design directly addresses the underlying issues.

[3]As Keele and Titiunik (2018) noted, "given that voter administration is conducted by county governments, counties may choose their mode of voting to try to accomplish their specific voter turnout goals. This type of strategic decision-making may complicate naive statistical inferences that simply compare all-mail counties to in-person counties."

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negative effects on turnout found in previous studies. Those compounding treatments make it difficult for these studies to isolate the treatment effect of universal voting by mail.

In comparison, our study takes advantage of within-county variation between universal vote-by-mail districts and non-universal vote-by-mail districts. Our within-jurisdiction design mitigates potential confounding factors that exist in earlier cross-county and cross-state studies. Counties in California are the basic unit of election jurisdiction, and in terms of the administration of the 2020 primary election, there was little other than universal voting by mail that varied across the districts in our analysis. By focusing on a single jurisdiction, our analysis avoids confounding factors that are present in previous cross-jurisdictional studies (for example, a transition to vote centers or a substantial reduction of in-person voting opportunities, as studied by Stein and Vonnahme (2008) and Brady and McNulty (2011)). And while Los Angeles County has considerable demographic diversity, we take that into consideration in our analyses discussed below. In particular, recognizing that registered voters are not uniformly distributed throughout Los Angeles County, we account for that heterogeneity by incorporating demographic and socioeconomic characteristics into our difference-in-differences and geographic boundary-based designs. Thus our study has strong internal validity, in particular relative to previous studies employing cross-county or cross-state variation.

In addition to leveraging within-county variation, our research design has two other advantages. First, we make a crucial distinction between permanent and non-permanent absentee voters and separately estimate the effects of the universal vote-by-mail on these two groups of voters. Since permanent absentee voters automatically receive a mail ballot regardless of the policy, estimating the effects on all registered voters conflates how many voters are affected by the policy and how much they are affected. Secondly, our study is the first to use a geographic boundary-based design within a jurisdiction to estimate the effects of universal vote-by-mail on voter turnout. By focusing on the local average treatment effects, the geographic boundary-based design provides a way to control for unobservable confounders that may remain in the difference-in-differences design.[4]

In the next section, we discuss universal voting by mail, and the particular situation pertinent to our research design, in more detail and argue that our design has especially strong internal validity. Then we discuss the data and methods that we employ, and thereafter we present the results of our analysis. We conclude by discussing the implications of our work for the national conversation about universal voting by mail.

2. Universal Mail Elections

Conventional wisdom about election administration in the United States (including much of the debate that occurred prior to the 2020 presidential election) seems to assume that allowing eligible citizens to obtain and cast ballots remotely is a new and untested voting procedure. Quite the contrary is the case — for example, since the American Civil War, military personnel have been able to obtain and cast ballots from where they are stationed or deployed, whether by using a remote polling process, the mail, or some electronic method (Alvarez, Hall and Roberts, 2007). Different forms of remote voting have been available in most states in the more contemporary period; by the 1980s, most states allowed excuse-backed absentee voting, with three states allowing no-excuse absentee voting and one state allowing in-person early voting (Gronke et al., 2008).

The first state to implement the universal mail voting model was Oregon, which piloted universal mail elections in 1995 and 1996, with statewide implementation in 1998. The Oregon model has been widely studied, though whether sending every registered

[4]Geographic boundary-based designs including regression discontinuity designs have proven to be a useful tool in the study of voter turnout. For example, Gerber, Kessler and Meredith (2011) estimated the effect of a partisan campaign activity on voter turnout, while Keele, Titiunik and Zubizarreta (2015) estimated the effect of a ballot initiative on voter turnout, both using regression discontinuity designs.

voter a ballot in the mail has boosted turnout in Oregon elections has been debated (Southwell and Burchett, 2000; Gronke and Miller, 2012). The universal mail election model has been more recently adopted by Washington and Colorado (Gerber, Huber and Hill, 2013), and was used in other states during the 2020 general election due to the COVID-19 pandemic (Kamarck et al., 2020).[5] Recent changes in California's election laws mandate that future elections in the state follow the universal voting by mail model.

In the pre-pandemic era, California began to experiment with universal mail elections through the Voter's Choice Act (VCA). In the 2018 election cycle, five California counties implemented the VCA (Madera, Napa, Nevada, Sacramento, and San Mateo). Research has found that voter turnout increased by about three percent in the VCA counties in the 2018 primaries and general elections (McGhee et al., 2020). Ten additional counties implemented the VCA in the 2020 election cycle for their statewide primary and general elections (Amador, Butte, Calaveras, El Dorado, Fresno, Los Angeles, Mariposa, Orange, Santa Clara, and Tuolumne). Unlike other California counties transitioning to the full VCA, Los Angeles County was exempted from the provision that required sending to all registered voters countywide a vote-by-mail ballot for the March 2020 primary election. However, to ensure uniformity of voting experience within a congressional or state legislative district, Los Angeles County was required to send mail ballots to voters who live in districts that span Los Angeles and other neighboring VCA counties.

How does universal voting by mail increase turnout? Here the theory of the calculus of voting provides support for the general argument that the areas of Los Angeles County that received the universal voting by mail treatment should show higher levels of voter turnout (Riker and Ordeshook, 1968). The calculus of voting posits that registering to vote, finding out where to vote, learning about the candidates and issues on the ballot, and taking the time to vote on Election Day, are all costly actions. As the returns from voting

[5] In addition to Colorado, Hawaii, Oregon, Washington, and Utah, which had enacted universal voting by mail before 2020, four more states—California, Nevada, New Jersey, and Vermont—sent mail ballots to all registered voters for the November 2020 general election.

are not typically great, the costs of these actions may at the margin lead many eligible citizens to not participate, which has been confirmed by many studies (Rosenstone and Wolfinger, 1978; Leighley and Nagler, 2013). Universal voting by email eliminates some of these costs of voting, and may also give registered voters a subtle "nudge" to make sure they participate (Kim, 2023). Thus, based on the theory of the calculus of voting, we expect that voters residing in the areas of Los Angeles County treated by universal voting by mail in the March 2020 primary should be more likely to turn out in the election.

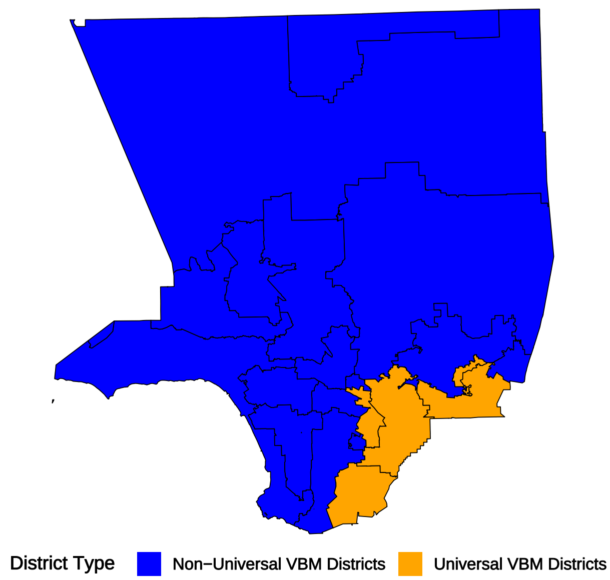
3. Data and Methods

Pertinent to this research is Section 4007 of the VCA, which required Los Angeles County to send mail ballots to Los Angeles County voters who live in state legislative or federal congressional districts that span Los Angeles and other neighboring VCA counties.[6] Since Orange County was the only VCA county adjacent to Los Angeles County in the 2020 election cycle, Los Angeles County voters residing in districts spanning Los Angeles County and Orange County automatically received a mail ballot for the March 2020 presidential primary elections, regardless of their permanent absentee status. We call these districts *universal vote-by-mail districts*. Figure 1 provides a congressional district map in Los Angeles County with the universal vote-by-mail districts in orange and non-universal vote-by-mail districts in blue. In summary, the UVBM treatments in this election occurred:

- In three Congressional districts (CA 38, CA 39, and CA 47) that span Los Angeles County and Orange County, with Los Angeles County registered voters in those three Congressional districts automatically receiving their ballot in the mail.
- In two Congressional districts (CA 32 and CA 40) that overlap with California State

[6]California Elections Code, Division 4, Mail Ballot Elections, Section 4007(a)(8) https://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=ELEC&division=4.&title=&part=&chapter=1.&article=.

Figure 1: Districts with and without Universal VBM in Los Angeles County



Note: Universal vote-by-mail districts (in orange) include California's 38th, 39th, and 47th Congressional districts, as well as parts of California's 32nd and 40th Congressional districts (29th and 32nd State Senate districts). The rest of Los Angeles County are non-universal vote-by-mail districts (in blue).

Senate districts that span Los Angeles County and Orange County (CA Senate districts 29 and 32), with Los Angeles County registered voters who reside in Senate District 29 and Congressional District 32 or in Senate District 32 and Congressional District 40, automatically receiving a ballot in the mail. Registered voters in these two Congressional districts who do not reside in these two State Senate districts did not automatically receive their ballot in the mail.

Additional discussion of the context of the VCA and the March 2020 statewide primary in Los Angeles County is in the paper's Supplementary Information, Section SI.2, and characteristics of these Congressional districts relative to other Congressional districts in California are discussed in Supplementary Information, Section SI.3.

We use voter registration and voting history files for the 2016 and 2020 primary elections from Los Angeles County. Los Angeles County is the largest election jurisdiction in the United States, with over 7 million registered voters. The voter files contain, among other information, each registered voter's name, address, party registration, registration precinct, whether/when they obtained permanent absentee status, and history of turnout and vote mode. We further obtain voter demographic characteristics including age, gender, and race/ethnicity from the voter file as well as inferences based on their names and addresses. Appended to these data are the Census block-group-level socioeconomic characteristics including education attainment, household income, rent, and home valuation from the American Community Survey. Additional information about the administrative data we use is in Supplementary Information, Section SI.4.

Table SI.3 and SI.4 show the demographic and socioeconomic composition of the universal and non-universal vote-by-mail districts. The age and gender distribution of registered voters in universal and non-universal vote-by-mail districts are very similar. There are, however, some differences in terms of race and ethnicity, with universal vote-by-mail districts having 8 percentage points (p.p.) more white voters, 5 p.p. more black voters, 5 p.p. fewer Asian voters, and 8 p.p. fewer Hispanic voters compared to non-universal vote-by-mail districts. Regarding socioeconomic characteristics, the differences in the distribution of education attainment and household income between universal and non-universal vote-by-mail districts are substantively modest. There are, however, differences in home valuation. In particular, non-universal vote-by-mail districts have 12 p.p. more homes valued at 1 million dollars or more, and 12 p.p. fewer homes valued between 500,000 and 750,000 dollars. While balances in demographic and socioeconomic composition are neither necessary nor sufficient for the difference-in-differences design (which requires the parallel trends assumption) and geographic boundary-based designs, we demonstrate that our results continue to hold while incorporating these variables in our analyses.

Our analysis proceeds in three stages. We start by examining the aggregate voter turnout in universal and non-universal vote-by-mail districts from 2012 to 2020. Using precinct-level and individual-level voter turnout, we test the validity of the parallel trends assumption for our difference-in-differences design.

In the second stage, using a difference-in-differences design on individual records, we estimate the effects of sending mail ballots to all registered voters, on turnout and the composition of the electorate.[7] Specifically in our difference-in-differences analyses we compare voters residing in universal vote-by-mail districts (the treatment group) to those living in non-universal vote-by-mail districts (the control group), in terms of their turnout in 2020 (after the policy was implemented) relative to 2016 (before the policy was implemented). Crucially, we conduct the difference-in-difference analysis for non-permanent absentee voters and permanent absentee voters separately.[8] For non-permanent absentee voters (the main focus of this paper), mail ballots were automatically sent to them only if they resided in universal vote-by-mail districts and only in 2020. Therefore the difference in differences in turnout yields an estimate of the desired causal effect. By contrast, since permanent absentee voters received mail ballots automatically regardless of the policy under consideration, the policy should not directly affect them but may have indirect effects.[9] We use a voter's permanent absentee status as of the 2018

[7]We also examined whether sending mail ballots to all registered voters affected voter registration numbers by taking advantage of the fact that the overwhelming majority of mail ballots were sent out to registered voters on February 3, a month before the election. We find that 0.86% of registered voters in universal vote-by-mail districts were newly registered between February 3 and the election day, and 0.94% of registered voters in non-universal vote-by-mail districts were newly registered during the same period. These numbers indicate that registered voters receiving their ballots automatically in the mail did not induce other eligible voters to register.

[8]We include in the category permanent absentee all registered voters designated as being covered by the Uniformed and Overseas Citizens Absentee Voting Act (UOCAVA voters). UOCAVA voters account for less than 1% of permanent absentee voters.

[9]One channel through which permanent absentee voters may be indirectly affected is the spillover effect. For example, it may occur in situations where permanent absentee voters reside in a household with non-permanent absentee voters; one resident receiving a ballot in the mail could affect the other resident's likelihood of turning out to vote. Our research design does not allow us to distinguish the different channels of these indirect effects, but as we show in the results section, the estimated effects on permanent absentee voters are statistically indistinguishable from zero.

general election—–before the policy was implemented—–in our analyses.[10]

The difference-in-differences design estimates the average treatment effect on the treated. In addition to the average effect, policymakers may also be interested in the treatment effects on different subgroups. To this end, we explore the heterogeneity of treatment effects by demographics and neighborhood socioeconomic characteristics. Moreover, we incorporate these covariates in our difference-in-differences design following Callaway and Sant'Anna (2021). Their approach allows for covariate-specific trends in turnout between universal and non-universal vote-by-mail districts, which is particularly useful in situations where the distribution of covariates varies across groups (Callaway and Sant'Anna, 2021).

In the third stage, we estimate the causal effects of sending mail ballots to all registered voters using geographic boundary-based designs on geo-coded individual records. Specifically for our geographic boundary-based designs, we geo-locate all registered voters in Los Angeles County using a combination of the Census API and the Google Maps API, and calculate the distances of their residential addresses to the boundary of universal and non-universal vote-by-mail districts.[11] Using the distances to the boundary, we conduct a geographic boundary-based regression discontinuity analysis using the distance to the boundary as the running variable. The geographic boundary-based regression discontinuity analysis allows us to estimate the *local* average treatment effect of the policy on voters residing near the boundary of universal and non-universal vote-by-mail districts. By focusing on the causal effects on voters residing close to the boundary, the regression discontinuity analysis provides us a way to control for remaining confounding

[10]A voter's permanent absentee status as of the 2018 general election is pre-treatment and hence avoids potential post-treatment bias from using the permanent absentee status as of the 2020 primary election. Moreover, non-permanent absentee voters in non-universal vote-by-mail districts could still sign up for the permanent absentee status before the 2020 primary election to automatically receive their ballots in the mail, providing the desired counterfactual for non-permanent absentee voters in universal vote-by-mail districts absent the policy.

[11]Neither the Census API nor the Google Maps API work for 100% of the addresses due to compatibility issues between addresses in the voter file and addresses in the Census or Google Maps databases. To make sure that we do not systematically miss any subset of voters due to these issues, we manually checked and resolved all street names that appeared ten times or more in the voter file.

factors in our difference-in-differences analysis.

The key identification assumption of a regression discontinuity design is the continuity assumption, which requires the potential outcome to change continuously at the cutoff. We examine this assumption by a series of placebo designs with past election turnout information and look at the distribution of demographic and neighborhood socioeconomic characteristics in the vicinity of the boundary of universal and non-universal vote-by-mail districts. Research designs based on geographic boundaries often face unique challenges (Keele and Titiunik, 2015), and in our case, such challenges come from the fact that district lines in California were drawn by the California Citizens Redistricting Commission in accordance with federal and state regulations and often follow community boundaries. In light of the challenges, we also conduct additional analyses where we match registered voters in universal and non-universal vote-by-mail districts near the boundary based on their demographics, neighborhood socioeconomic characteristics, as well as school districts, and conduct difference-in-differences analyses on the matched subset of registered voters near the boundary.[12]

4. Results

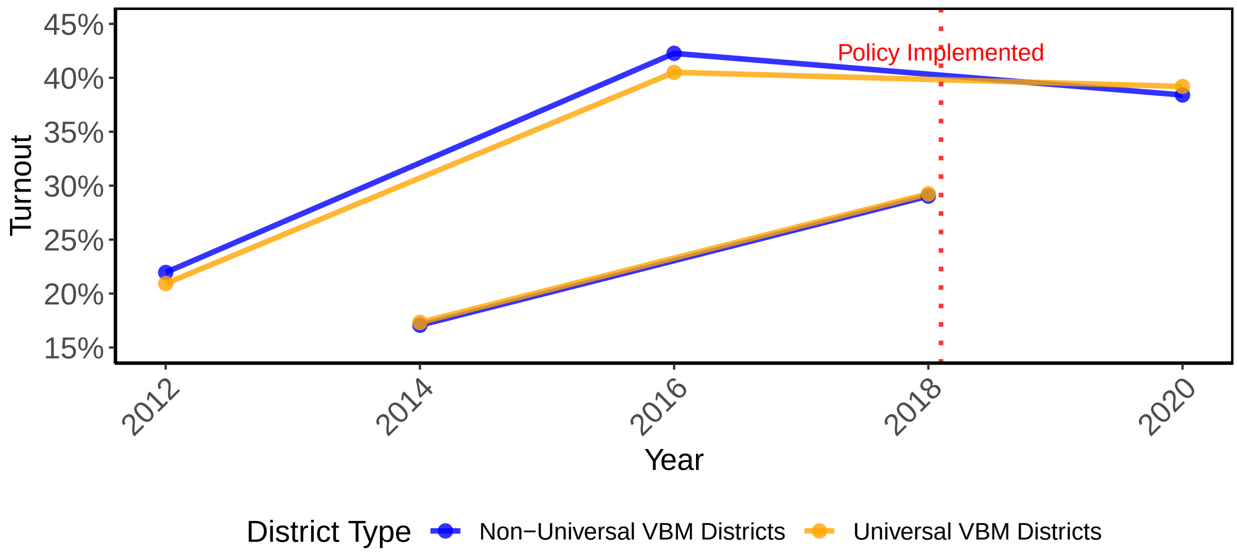
4.1 Aggregate Results

Before diving into results from our individual-level analyses, we examine aggregate voter turnout in universal and non-universal vote-by-mail districts. Figure 2 shows the voter turnout among all registered voters in universal vote-by-mail districts (blue) and non-universal vote-by-mail districts (orange) in primary elections from 2012 to 2020.[13] We

[12]For methodological discussions on using matching in geographic boundary-based designs and other applications, see Keele, Titiunik and Zubizarreta (2015) and Keele et al. (2017).

[13]In the paper, we focus on turnout among registered voters. Researchers may also be interested in turnout among eligible voters, a population for which we do not have individual-level or high-quality granular data. The best estimate we can get is the 5-year American Community Survey data on citizen voting-age population (CVAP) from the U.S. Census Bureau. According to our best estimate based on Census data, turnout among the citizen voting-age population increased by half a percentage point in

Figure 2: Voter Turnout in Universal and Non-Universal VBM Districts in Los Angeles County



Note: *Universal VBM Districts* refer to congressional districts and state legislative districts where all registered voters automatically received a ballot in the mail in the 2020 primary elections, shown in orange in Figure 1. The orange lines trace the turnout in these districts before they were made universal vote-by-mail in 2020. Similarly, the blue lines trace turnout in districts that were not universal vote-by-mail in 2020. Turnout is computed using data from the Statements of Votes.

can see that in both presidential primary years prior to the policy, 2012 and 2016, voter turnout was between one and two percentage points lower in universal vote-by-mail districts than non-universal vote-by-mail districts. Absent the policy, one would expect the turnout to continue to be lower in universal vote-by-mail districts than non-universal vote-by-mail districts in 2020. However, by 2020, voter turnout became one percentage point higher in universal vote-by-mail districts than non-universal vote-by-mail districts. Meanwhile, in both statewide primary years without a presidential contest, 2014 and 2018, voter turnout was virtually the same in universal and non-universal vote-by-mail districts.

non-universal vote-by-mail districts and by two percentage points in universal vote-by-mail districts from 2016 to 2020.

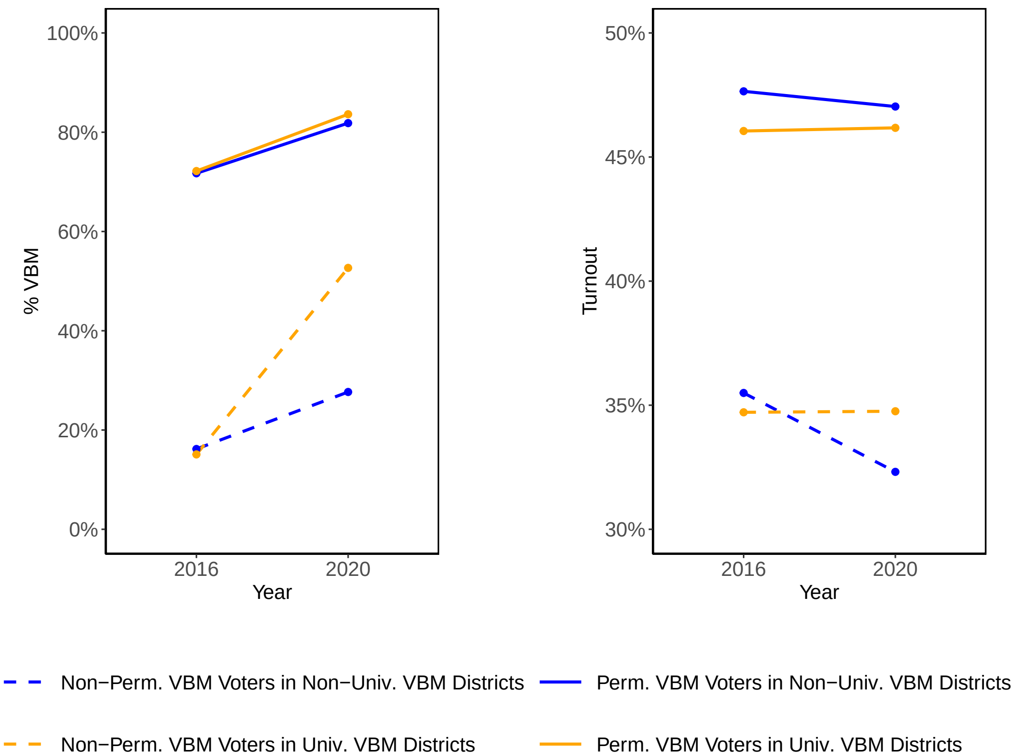
We formally test the parallel trends assumption for our difference-in-differences design using precinct-level and individual-level voter turnout. First, using precinct-level voter turnout from the Statement of Votes, we can test if voter turnout exhibits parallel trends between universal and non-universal vote-by-mail districts. As shown in Figure SI.10, the turnout difference between universal vote-by-mail districts and non-universal vote-by-mail districts in 2012 is statistically indistinguishable from 2016, supporting the parallel trends assumption. By contrast, the turnout difference between universal and non-universal vote-by-mail districts in 2020 is significantly larger than in 2016, suggesting a positive treatment effect.

Second, using individual-level voter turnout from the voter files and focusing on voters registered in Los Angeles County since 2012, we can test the parallel trends assumption separately for permanent and non-permanent absentee voters. As shown in Figure SI.11, the turnout difference between universal vote-by-mail districts and non-universal vote-by-mail districts in 2012 is again statistically indistinguishable from 2016, for both permanent and non-permanent absentee voters. By contrast, among non-permanent absentee voters, the turnout difference between universal and non-universal vote-by-mail districts in 2020 is significantly larger than in 2016, suggesting a positive treatment effect. The turnout difference is smaller and statistically indistinguishable from zero for permanent absentee voters.

4.2 Difference in Differences

We begin by looking at the effects of sending mail ballots to all registered voters on the percentage of voters voting by mail, separately for permanent absentee voters and non-permanent absentee voters (Figure 3, left panel). For permanent absentee voters, sending mail ballots to all registered voters does not directly impact them because they automatically receive a mail ballot for each election. We find that permanent absentee voters in universal vote-by-mail districts and non-universal vote-by-mail districts cast

Figure 3: Effects on Percent Voting by Mail and Turnout, Los Angeles County



Note: *Universal VBM Districts* refer to congressional districts and state legislative districts where all registered voters automatically received a mail ballot in the 2020 primary elections. The lines trace the turnout of the same group of voters in the previous primary election. The y-axes are on different scales. The estimated effect on turnout is 3.2 percentage points (s.e. = 0.88 p.p.) for non-permanent VBM voters and 0.7 percentage points (s.e. = 0.86 p.p.) for permanent VBM voters. Complete results are in Table SI.5 and Table SI.6.

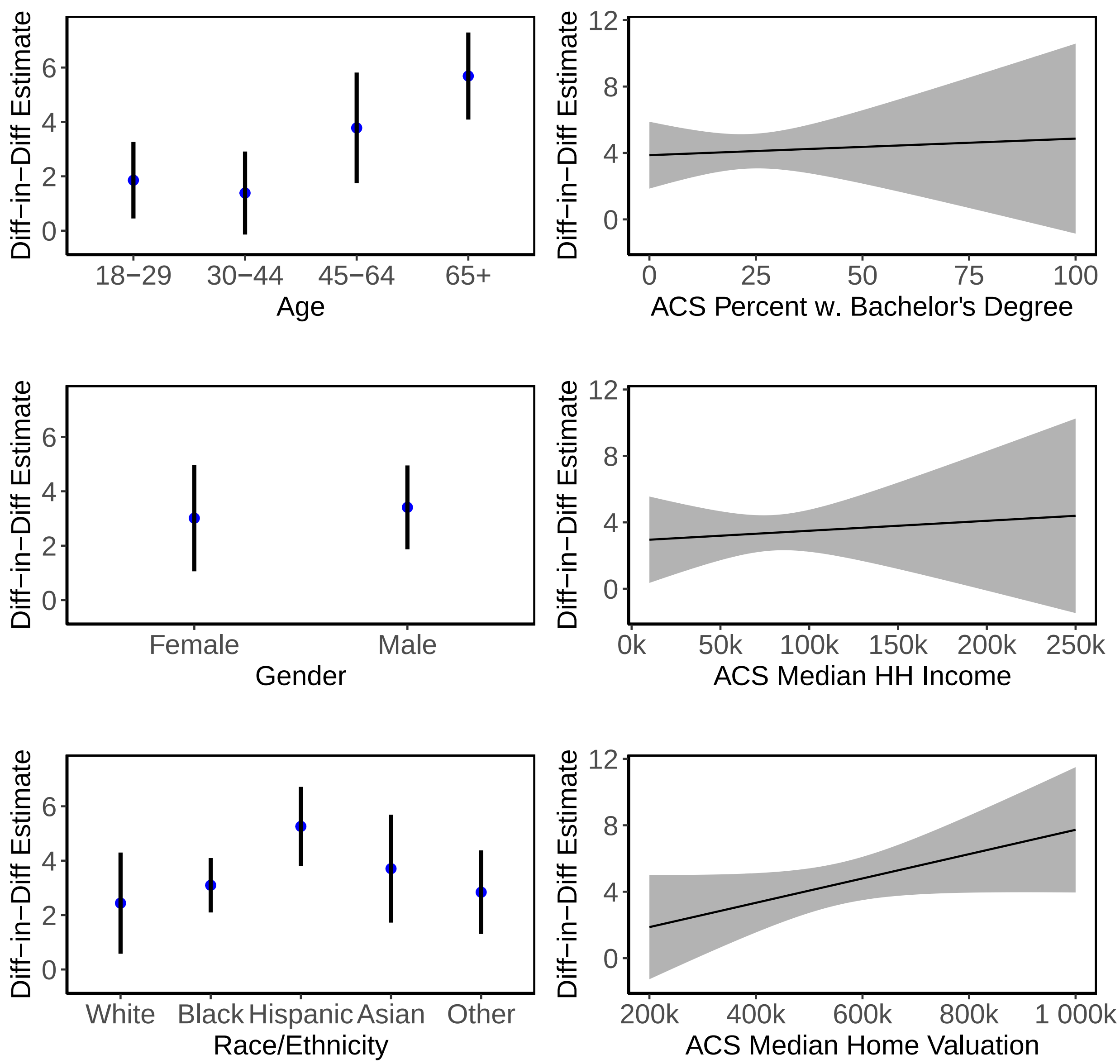
their vote by mail in substantively similar percentages in both the 2016 and 2020 elections. For non-permanent absentee voters, however, the policy has a direct impact on them because they automatically receive a mail ballot only if they reside in a universal vote-by-mail district. Those residing in a non-universal vote-by-mail district need to request a mail ballot before the request deadline to vote by mail. While more voters cast their ballots by mail over time, the increase in the percentage of voters voting by mail is much larger in universal vote-by-mail districts (37.6%) than in non-universal vote-by-mail districts (11.5%), in 2020 compared to 2016.

We now look at the effects of sending mail ballots to all registered voters on voter turnout (Figure 3, right panel). For non-permanent absentee voters, turnout in non-universal vote-by-mail districts is 3.2 percentage points lower in 2020 compared to 2016, while turnout in universal vote-by-mail districts remains the same. The result indicates a boost of 3.2 percentage points in turnout across Los Angeles County attributable to the policy, according to our difference-in-differences estimate. By contrast, the difference-in-differences estimate for permanent absentee voters is substantively smaller (0.7 percentage points) and statistically indistinguishable from zero.

Unsurprisingly, there are some baseline differences in turnout with respect to voter demographics and neighborhood (Census block group) socioeconomic characteristics, as shown in Table SI.7. In terms of voter demographics, we find that older voters, female voters, and White voters are much more likely to turn out to vote compared to younger voters, male voters, and racial minority voters, respectively. Regarding neighborhood socioeconomic characteristics, we find that less educated neighborhoods and less affluent neighborhoods have lower voter turnout compared to their more educated and affluent counterparts. There is also heterogeneity in treatment effects by these demographics and neighborhood socioeconomic characteristics, as shown in Figure 4. While turnout among female voters and turnout among male voters are equally boosted by universal voting by mail, the policy has a larger effect on older voters than younger voters, and a larger effect on racial minority voters, especially Hispanic voters and Asian voters, than White voters. Regarding neighborhood socioeconomic characteristics, the effect on voter turnout is larger in more affluent neighborhoods than their less affluent counterparts. Neighborhoods with various levels of education attainments all receive a boost in voter turnout due to the policy.

We further incorporate voter demographics and neighborhood (Census block group) socioeconomic characteristics in our difference-in-differences design following Callaway

Figure 4: Difference-in-Differences Estimates by Demographic and Socioeconomic Characteristics



Note: The three figures on the left display the difference-in-differences estimates by age group, gender, and race/ethnicity, respectively. Points and lines correspond to point estimates and 95% confidence intervals, respectively. The three figures on the right display the difference-in-differences estimates by Census-block-group level education attainment, median household income, and median home valuation. Lines and shaded areas correspond to point estimates and 95% confidence intervals, respectively. Numbers in the figure are percentage points.

Table 1: Difference-in-Differences Estimates with Covariate-Specific Trends

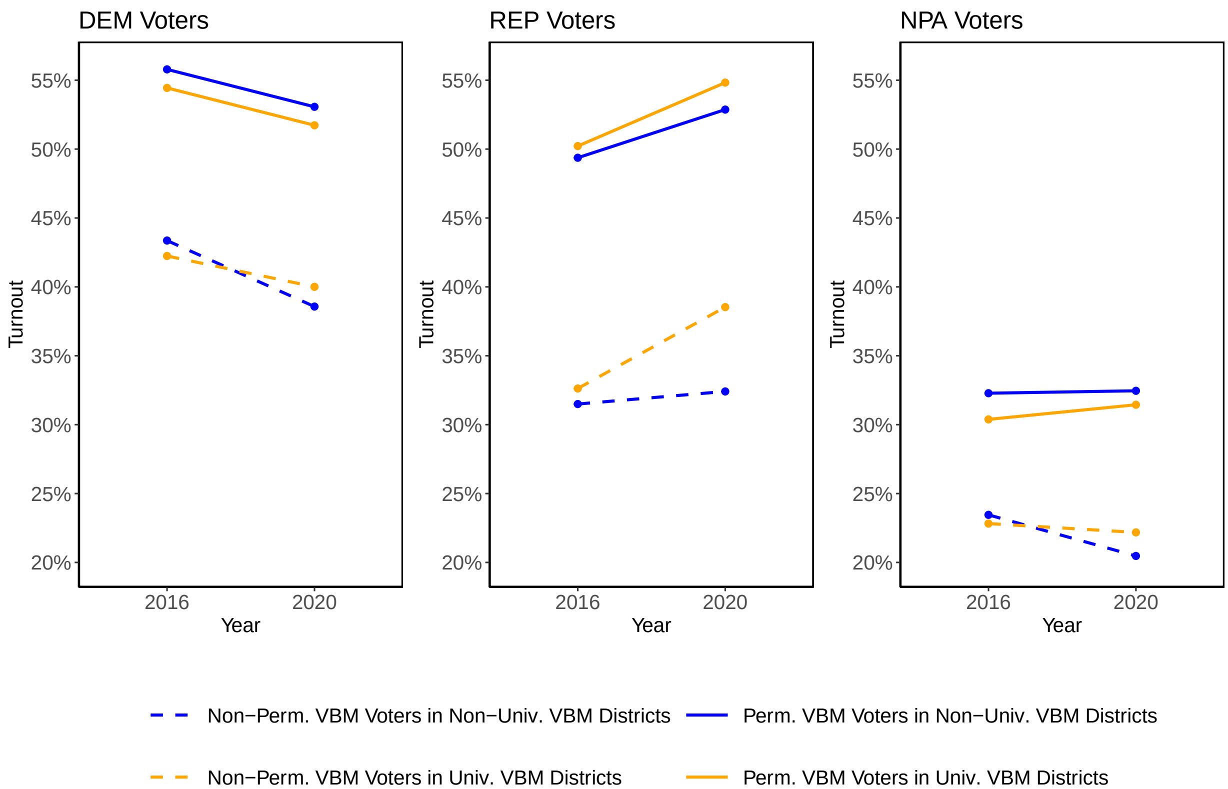
	Non-Perm. VBM Voters			Perm. VBM Voters		
Estimate	4.0	4.5	3.8	1.2	1.6	1.0
	(1.5)	(1.6)	(1.6)	(1.1)	(1.2)	(1.2)
Age	✓	✓	✓	✓	✓	✓
Gender	✓	✓	✓	✓	✓	✓
Race/Ethnicity	✓	✓	✓	✓	✓	✓
ACS median house value		✓	✓		✓	✓
ACS education attainment			✓			✓
ACS median HH income			✓			✓
Observations	4.1m	3m	3m	1.4m	1m	1m

Note: The estimates are from difference-in-differences designs that allow for covariate-specific trends following Callaway and Sant'Anna (2021), using the *did* package in R. Age, gender, and race/ethnicity are from the voter file, and neighborhood median house value, education attainment, and median household income are from the American Community Survey. For voters who did not provide gender and race/ethnicity in their voter registration, we used the most likely prediction based on probabilistic assessments. Standard errors are clustered at the (congressional and state legislative) district level.

and Sant'Anna (2021), which allows for covariate-specific trends in turnout between universal and non-universal vote-by-mail districts. The results are presented in Table 1. After incorporating age, gender, and race/ethnicity, our difference-in-differences estimate for non-permanent absentee voters becomes slightly larger (4 percentage points). Further incorporating neighborhood median house value, education attainment, and median household income does not change our difference-in-differences estimate for non-permanent absentee voters by much, even though we lose some observations in the process due to missing values in the Census data.

Finally, we look at whether sending mail ballots to all registered voters has different effects on voters of different party registrations (Figure 5). First, non-permanent absentee

Figure 5: Effects on Turnout by Party Registration, Los Angeles County



Note: The estimated effects for non-permanent VBM voters are 2.6 percentage points (s.e. = 0.93 p.p.) for Democrats, 5.0 percentage points (s.e. = 0.92 p.p.) for Republicans, and 2.3 percentage points (s.e. = 0.89 p.p.) for NPA voters. Complete results are in Table SI.8.

Democratic voters in both types of districts saw a decrease in turnout in 2020 compared to 2016, but the decrease is much smaller in universal vote-by-mail districts than non-universal vote-by-mail districts. Moreover, non-permanent absentee Republican voters in both types of districts saw an increase in turnout in 2020 compared to 2016, and the increase is much larger in universal vote-by-mail districts than non-universal vote-by-mail districts. Overall, the differential increase in turnout in universal vote-by-mail districts over non-universal vote-by-mail districts is larger for registered Republicans than registered Democrats and non-party-affiliated voters.

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4.3 Geographic Boundary-Based Analysis

So far, we have estimated the effects of sending mail ballots to all registered voters using difference-in-differences designs. In this section, we take advantage of individual-level administrative records with geo-locations to conduct further analysis using geographic boundary-based designs.

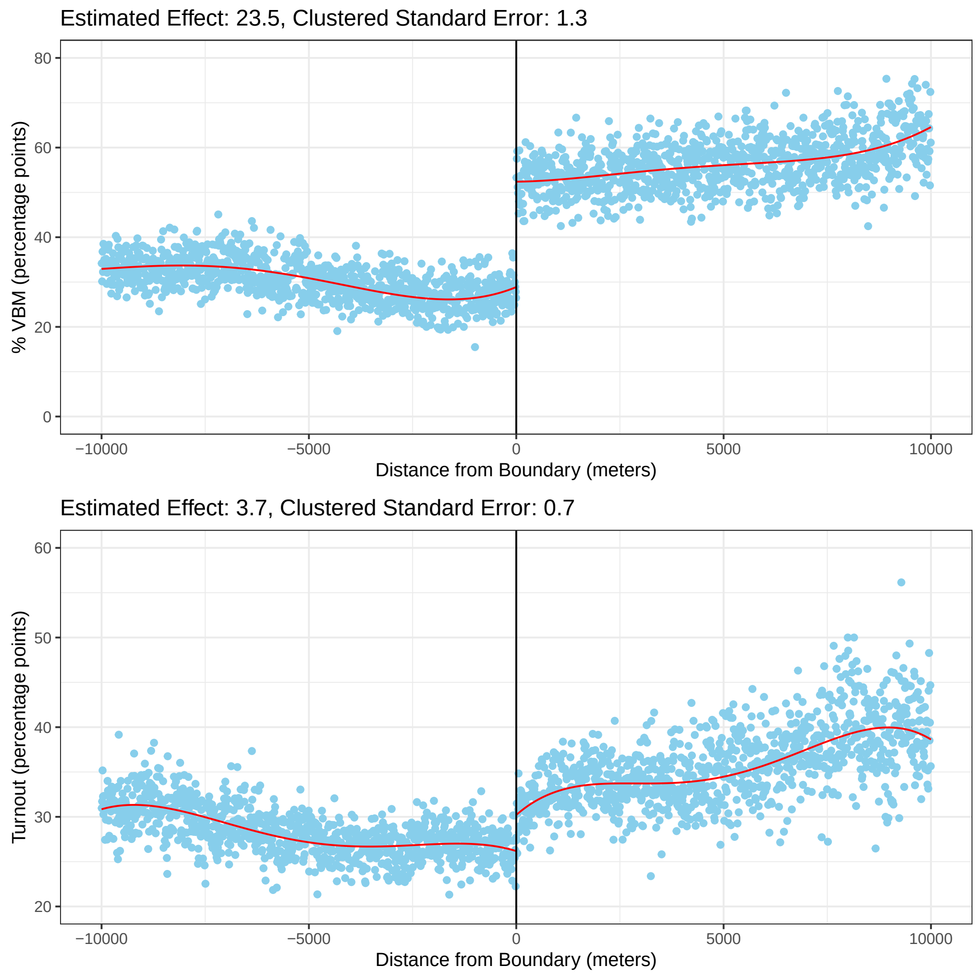
We start with a simple geographic boundary-based regression discontinuity analysis with the distance from the boundary of universal and non-universal vote-by-mail districts as the running variable. Since almost all registered voters living in universal vote-by-mail districts reside within 10 kilometers of the boundary (Figure SI.8), we focus on the estimates from analyses on registered voters residing within 10 kilometers of the boundary.[14] Compared to the difference-in-differences design, the geographic boundary-based regression discontinuity design focuses on voters residing near the boundary of universal and non-universal vote-by-mail districts and yields a local average treatment effect. The local average treatment effect may differ from the average treatment effect for the entire county as the demographic and socioeconomic composition of the population differ.[15] The geographic boundary-based regression discontinuity design offers a way to control for confounders that may remain despite leveraging only within-county variations in the difference-in-differences design.

Results from this geographic boundary-based analysis are presented in Figure 6 for non-permanent absentee voters and Figure SI.12 for permanent absentee voters. Similar to the difference-in-differences results, sending mail ballots to all registered voters dramatically increased the likelihood of voting by mail for non-permanent absentee voters, who are directly impacted by the policy. Moreover, we find that non-permanent

[14]In the previous version of this paper, we were only able to geo-locate registered voters residing within 2 kilometers of the boundary due to resource constraints. We also run the analyses with various radii as robustness checks below, and the results are similar.

[15]Table SI.9 and Table SI.10 show the demographic and socioeconomic composition of registered voters residing near the boundary of universal and non-universal vote-by-mail districts compared to the county at large. There is a higher concentration of Hispanic voters living in these areas, and more houses are valued at a lower price close to the boundary compared to other parts of the county.

Figure 6: Effects on Percent Voting by Mail and Voter Turnout, RD Estimates



Note: Regression discontinuity plots and estimates from R package *rdrobust*.

absentee voters are more likely to turn out in universal vote-by-mail districts than non-universal vote-by-mail districts, by 3.7 percentage points. By contrast, the difference in turnout between universal vote-by-mail districts and non-universal vote-by-mail districts is substantively smaller (1.6 percentage points) and statistically indistinguishable from zero for permanent absentee voters.

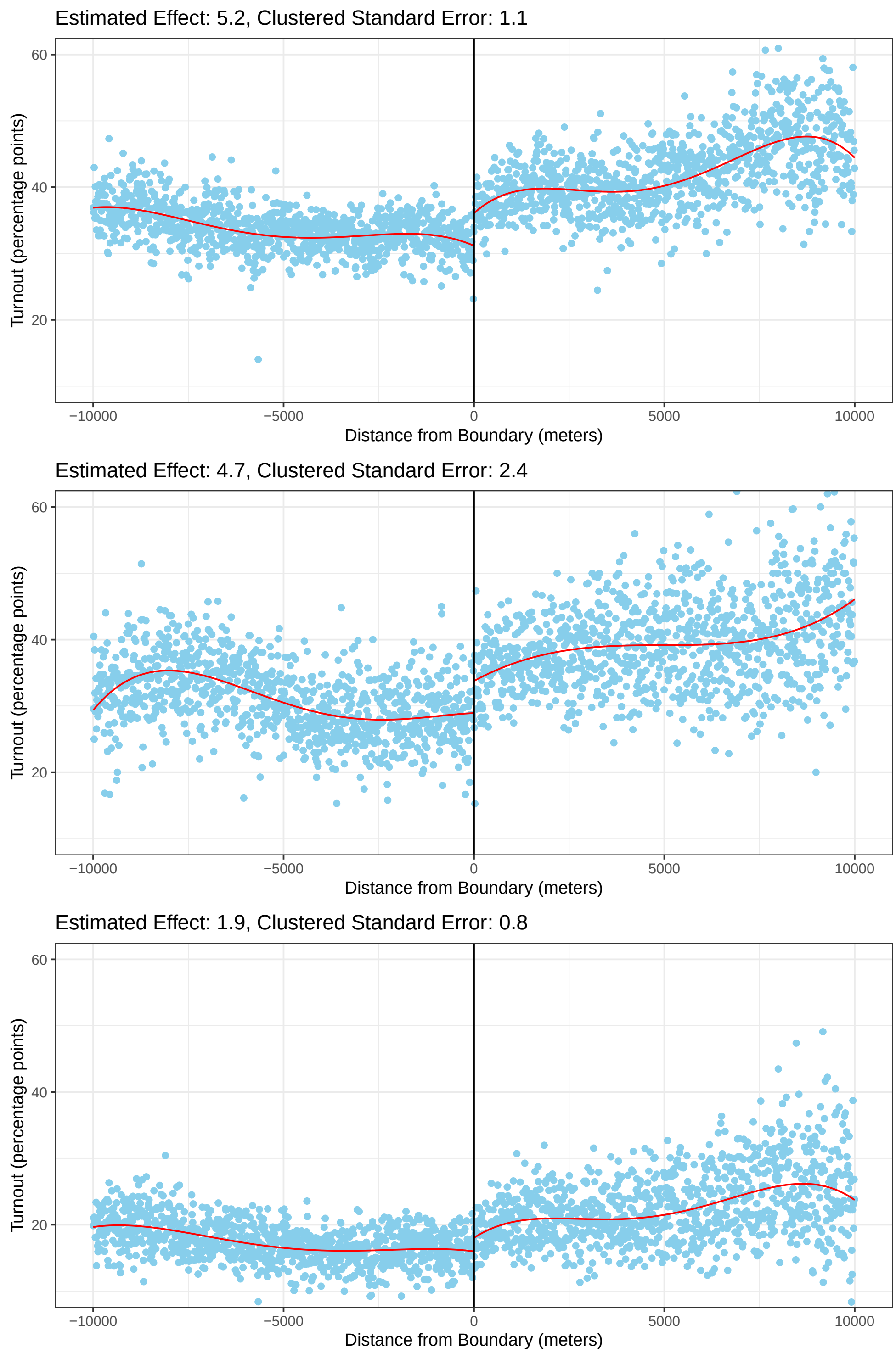
We conducted a few additional analyses in the Supplementary Information. First, we vary the distance from the boundary within which registered voters were included in the analysis. As Figure SI.13 shows, the estimates for non-permanent absentee voters stay around the same across different distances. Second, we exclude a varying number of registered voters who reside closest to the boundary in "donut" regression discontinuity designs (Eggers et al., 2015). As Figure SI.14 shows, after 1-10% of the observations closest to the boundary are dropped, the estimates for non-permanent absentee voters again are close to the standard regression discontinuity estimate. Third, we use voter turnout in the previous statewide elections as the outcome variable in a series of placebo regression discontinuity designs. As Figure SI.15 shows, for seven out of eight statewide elections under the same district map, the estimates for non-permanent absentee voters are statistically indistinguishable from zero and substantively small.[16]

We also look at whether sending mail ballots to all registered voters has different effects on voters of different party registrations (Figure 7). We find that the boost in turnout among non-permanent absentee voters is larger for registered Democrats and registered Republicans than voters registered without a party affiliation, with the point estimate for registered Democrats (5.2%) close to registered Republicans (4.7%).

There are, however, still imbalances in voter characteristics in the vicinity of the boundary of universal and non-universal vote-by-mail districts (Table SI.12), which is perhaps unsurprising given that district lines in California, like in many states, are drawn in a way that often (but not always) respects community boundaries. In light of the challenges, we conduct a series of analyses where we match registered voters close to the boundary on observable characteristics and conduct a series of difference-in-differences analyses on the matched sets of voters. After matching on demographics including age, gender, and race/ethnicity, the estimated effects on non-permanent absentee voters within various distances to the boundary range from 3.5 to 4.3 percentage points. We further match on neighborhood median house value (via coarsened exact matching, with balances after matching in Table SI.13), our main covariate capturing neighborhood

[16]And the only exception is a negative estimate for the 2016 primary election.

Figure 7: Effects on Voter Turnout by Party Registration, RD Estimates



Note: Regression discontinuity plots and estimates from R package *rdrobust*.

Table 2: Difference-in-Differences Estimates with Matched Subsets of Voters Close to the Boundary of Universal and Non-Universal Vote-by-Mail Districts

	Non-Perm. VBM Voters			Perm. VBM Voters		
10km	4.2	4.0	4.1	2.0	1.5	0.9
	(1.2)	(1.1)	(1.5)	(1.1)	(1.1)	(1.4)
5km	4.4	3.7	5.2	2.3	1.3	0.6
	(1.5)	(1.6)	(1.2)	(1.5)	(1.5)	(1.6)
2km	3.5	2.7	5.1	1.8	1.4	2.1
	(1.8)	(2.0)	(2.1)	(1.6)	(1.7)	(1.8)
1km	4.0	3.4	5.4	2.0	1.9	2.7
	(1.7)	(1.8)	(1.8)	(1.5)	(1.6)	(1.9)
500m	4.3	4.4	5.0	1.4	1.0	1.3
	(1.8)	(1.8)	(1.7)	(1.7)	(2.0)	(1.6)
Age	Exact	Exact	Exact	Exact	Exact	Exact
Gender	Exact	Exact	Exact	Exact	Exact	Exact
Race/Ethnicity	Exact	Exact	Exact	Exact	Exact	Exact
ACS median house value		CEM	CEM		CEM	CEM
School district			Exact			Exact

Note: The table displays estimates from difference-in-differences analyses on matched sets of voters within 10, 5, 2, 1, and 0.5 kilometers from the boundary of universal and non-universal vote-by-mail districts, respectively. Age, gender, and race/ethnicity are from the voter file, and neighborhood median house values are from the American Community Survey. For voters who did not provide gender and race/ethnicity in their voter registration, we used the most likely prediction based on probabilistic assessments. Exacting matching was implemented for age group, gender, race/ethnicity, and school districts, while coarsened exact matching (CEM) was implemented for neighborhood median house values. Standard errors are clustered at the (congressional and state legislative) district level.

socioeconomic characteristics. The estimates become slightly smaller, at between 2.7 and 4.4 percentage points, depending on distances to the boundary. Finally, we take advantage of the fact that most school districts near the boundary contain areas in

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both universal and non-universal vote-by-mail districts, and add school districts to our matching algorithms. School districts capture both neighborhood socioeconomic characteristics and geographic proximity. The estimates become slightly larger, now at between 4.1 and 5.4 percentage points. By contrast, the estimates for permanent absentee voters are substantively smaller and statistically indistinguishable from zero.

5. Discussion

Past research examining the implications of universal voting-by-mail on voter turnout has generally been conducted across election jurisdictions, sometimes across states, sometimes within states but across counties. But since counties in these states are the unit of election administration, this means that across-jurisdiction studies may have potential confounding factors that might have biased their results. Also, in many of the places where universal voting-by-mail has been implemented, the transition was accompanied by other important changes in election administration that are difficult or impossible to account for in any analysis of how universal voting-by-mail might affect voter turnout.

In contrast, our study is the first that examines how universal voting-by-mail affects voter turnout within a jurisdiction. We do this by taking advantage of a unique aspect of election administration in the 2020 primary elections in Southern California. As we described in detail earlier in our paper, our within-jurisdiction design allows us to produce what we argue are the best available estimates of the effect of universal voting-by-mail on voter turnout and electoral composition. Our use of micro-level data, different causal inference techniques, and the examination of our data across different congressional districts help further underscore the robustness of our results.

Also, our study uses data from before the time that the COVID-19 pandemic led to changes in state and county election administration later in 2020. The pandemic led many election jurisdictions (including Los Angeles County and the State of California) to change voting procedures to minimize in-person contact, and also led Los Angeles County and the state to launch new voter outreach campaigns to inform eligible citizens about safe registration and voting procedures during the general election. With the easing of pandemic restrictions, and with concerns in some states about the integrity of the voting by mail process, it is likely that in future elections we will see many of those jurisdictions alter voting procedures. While we believe our results should hold as election administration returns to normal, future research needs to revisit it once we reach a more stable situation with respect to election administration in the post-COVID environment.

Of course, the use of data from primary elections in a single jurisdiction raises questions about generalizability. Primary elections are known to be lower-turnout affairs, in which the costs of voting and of obtaining information are greater than in general elections (Gerber et al., 2017). However, previous studies (e.g., McGhee et al. 2020) have found similar effects of universal voting by mail for primary and general elections. Also, research has not come to a clear consensus on whether primary election systems like California's top-two induce changes in voter turnout (Kousser, 2015; Bonneau and Zaleski, 2021; Hill, 2022). Whether or not the results reported here generalize to general elections nationwide and to primary elections in jurisdictions with closed and partisan primaries awaits additional research. Second, our studies use data from Los Angeles County, a large and diverse election jurisdiction in Southern California, and these two election cycles had their own particular characteristics. While we recognize these potential questions, we also note that the size and diversity of Los Angeles County are comparable to (or exceed) the size and diversity of many other American states.[17] So in our opinion, between the within-jurisdiction design of our study and the size and diversity of the election jurisdic-

[17] According to the U.S. Census, Los Angeles County has a total population of over 10 million as of April 2020. There are over 6 million eligible voters and 5.5 million registered voters in Los Angeles County as of February 18, 2020, two weeks before the March 2020 primary elections, according to the California Secretary of State. See SI Section 2 for further discussion of Los Angeles County and SI Section 3 for a detailed analysis of how the treatment areas compare to other congressional districts in California.

tion we study, our results have external validity and thus provide important guidance for other election jurisdictions considering changing to universal voting by mail.

While we have argued strongly for the utility of a within-jurisdiction design to study convenience voting reforms (especially when the jurisdiction is large and diverse), we believe that reforms like universal voting by mail need to be studied with both within- and across-jurisdiction designs. We have argued that the within-jurisdiction design has strong internal validity, while the cross-jurisdiction design has strong external validity. Our study is the only one that we are aware of that takes this within-jurisdiction approach to study voter turnout and universal voting by mail, and we argue that other scholars should consider similar approaches that have strong internal validity. But the cross-jurisdiction design's strength (the many ways that the jurisdictions differ, thus allowing for the results from such a study to be generalized to other situations) also raises complicated methodological issues, in particular how to account for all of the differences across jurisdictions while estimating treatment effects, because the demographic, political, and administrative covariates that vary across jurisdictions are likely to be correlated with the outcomes of interest. Future research might pursue the use of causal or experimental methods to evaluate how administrative covariates might enhance the turnout effects of universal voting by mail that we estimate here.[18] In the end, because each approach has strengths relative to the other, we argue that the field of election science needs to utilize both types of research design to best make policy recommendations.

6. Conclusion

We have consistently shown in our paper that the use of universal voting-by-mail in the 2020 primary election in Southern California had three implications. One of the

[18]For example, recent observational research on mail ballots has studied administrative differences in rejection rates (Baringer, Herron and Smith, 2020; Shino, Suttmann-Lea and Smith, 2022). Future research on UVBM might try to estimate the causal effects of different UVBM administrative procedures on voter turnout.

implications is perhaps unsurprising, but among non-permanent voters in the universal voting-by-mail areas, they were much more likely to vote by mail in the 2020 primary. Thus, sending these registered voters a ballot in the mail made it more likely that they would return their ballot by mail.

Second, and of more importance to researchers and policymakers, we have found that for non-permanent registered voters in the universal voting-by-mail areas, sending them a ballot in the mail increased their likelihood of turning out to vote in the primary election. The estimated increase in turnout varied slightly across our various analyses, but was consistently positive and statistically significant, at around 3 to 4 percentage points. This is a considerable boost in voter turnout.

Third, when we looked for partisan heterogeneity in the effects of universal voting-by-mail on turnout, we found that turnout increased for registered Democrats, Republicans, and those with No Party Preference; generally, we found that turnout increased greater for registered partisans, especially Republicans, than for registered non-partisans (No Party Preference). This is consistent with some previous studies (Berinsky, Burns and Traugott, 2001; Berinsky, 2005) that find higher-propensity voters are more likely to be affected by voting-by-mail reforms. Moreover, we found that in our countywide analyses, registered Republicans who were subjected to the policy were more likely to turn out to vote than were registered Democrats. Our results also indicate that there is heterogeneity among different demographic and socioeconomic groups in the effects of the policy. Additional studies with strong internal validity need to unpack the mechanisms underlying these heterogeneous effects.

During the 2020 presidential general election, many states, like California, shifted to universal voting-by-mail as a means to conduct large-scale elections during the COVID-19 pandemic. California will continue to use universal voting-by-mail in future statewide elections, and other states may do the same. In 2020, some states that did not shift to universal voting-by-mail did make the process of voting by mail easier for registered voters.

But we have seen other states move to restrict many "convenience" voting measures. Our results indicate that universal voting-by-mail is generally likely to produce an increase in voter turnout, meaning that states desiring to boost turnout may consider moving towards universal voting-by-mail. Our results also show that turnout rises for both Democratic and Republican voters, and perhaps that it increases slightly more for registered Republicans — a result that should be of interest to legislators and policymakers on both sides of the aisle.

Finally, while we have shown that universal voting-by-mail increased turnout in the 2020 primary election, voting-by-mail has other consequences. Past research has indicated that ballots cast by mail may lead to a higher residual vote rate, meaning that they may be more likely to have undervotes or overvotes (Alvarez, Beckett and Stewart, 2013). Voters returning their ballots by mail cannot take advantage of error-checking technologies that in-person voters can use. Also, some ballots sent by mail may reach election officials after the deadline, or may be lost, mis-delivered, or damaged (Stewart, 2010, 2011). Depending on the state law governing the process and a jurisdiction's ballot processing capacity, ballots cast by mail may take longer to process and lead to vote share shifts after Election Day (Li, Hyun and Alvarez, 2022). Policymakers considering universal voting-by-mail should also examine how to mitigate or eliminate these potential issues with the expansion of voting-by-mail.

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Supporting Information

Contents

SI.1. Summary of Literature on Universal Voting by Mail

Gerber, Huber, and Hill (2013) is the first paper with a clear causal design; Table 1 in Gerber, Huber, and Hill (2013) provides a nice summary of the earlier literature. Here, we summarize the literature starting from Gerber, Huber, and Hill (2013), with a focus on their research design. Following Gerber, Huber, and Hill (2013), most of these recent papers or reports exploit the staggering adoption of universal voting by mail to conduct a county-level difference-in-difference analysis in Washington, Utah, and/or California. Exceptions are Elul, Freeder, and Grumbach (2017) (matching VBM-only precinct with traditional precincts in California), Keele and Titiunik (2018) (geographic natural experiment in Basalt, Colorado), and Bonica et al. (2021) (matching Colorado voters with non-Colorado voters).

Table SI.1: Summary of Literature on Universal Voting by Mail

Gerber, Huber, and Hill (2013)
county-level difference-in-difference
cross-county variation; counties opt into universal VBM at different time
1 state (WA), 39 counties, 156 county-years
2.6-3.3% on overall turnout, 7.4-8% on turnout among previous polling place voters

Elul, Freeder, and Grumbach (2017)
matching VBM-only precincts with traditional precincts in California
cross-precinct variation; CA law stipulating that county election officials may declare precincts with 250 or fewer registered voters a VBM-only precinct
-1.3% to -1.1% on overall turnout

Showalter, Manson, and Courtney (2018)
county-level difference-in-difference (used predicted turnout instead of past turnout)
cross-county variation; counties opt into universal VBM at different time
1 state (UT), 29 counties
5.4-7.4% on overall turnout

Keele and Titiunik (2018)
cross-sectional design with geographically close units (geographic natural experiment)
cross-county variation; counties decide whether to run universal VBM for 2010 primary
1 town (Basalt), 1,597 voters (977 treated, 620 control)
-6.9% to -5.8% on overall turnout

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Summary of Literature on Universal Voting by Mail, Continued

McGhee et al. (2019)
county-level difference-in-difference
cross-county variation; counties decide whether to implement universal VBM for 2018
1 state (CA), 58 counties, 116 county-years
3% on turnout for the general election, 3.5% on turnout for the primary election
Thompson et al. (2020)
county-level difference-in-difference
cross-county variation; counties opt into universal VBM at different time
3 state (WA, UT, and CA), 126 counties, 1240 county-years
2% on overall turnout; does not favor either party
Barber and Holbein (2020)
county-level difference-in-difference
cross-county variation; counties opt into universal VBM at different time
$>$ 42,000 county-years , but variation coming from 4 states (WA, UT, CA, and NE)
2.9% on overall turnout; does not favor either party
Bonica et al. (2021)
matching Colorado voters with non-Colorado voters
cross-state variation
$>$ 20m cases consisting of matching pairs of CO and non-CO voters
5.8-8.2% on overall turnout; point estimates: independents $>$ Democrats $>$ Republicans

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SI.2. March 2020 Primary in Los Angeles County

Typically California holds statewide primaries in June of evenly-numbered years, but in 2020 the state moved the primary to early March to be one of the Super Tuesday states. The Democratic presidential primary was quite competitive in February 2020, but after the South Carolina primary on February 29, 2020, the Democratic race largely consolidated to one between Joe Biden and Bernie Sanders. Sanders ran a spirited campaign in California, and in the end, he beat Biden statewide. On the Republican side, the presidential primary was won by Donald Trump. In addition to the presidential primaries, the March 2020 primary election had the U.S. House of Representatives, State Assembly and Senate, and various local races on the ballot. Turnout statewide for this presidential primary election was 46.89% of registered voters, in the general range of turnout in recent presidential primaries in California (47.72% in 2016 and 46.78% in 2012).

In both the 2016 and 2020 primaries, the presidential race was the biggest contest on the ballot, with 91-96% of voters who received a party ballot voting in the presidential races. A slightly smaller percentage of voters voted in the down-ballot House races (mostly in the high eighties in 2016 and low nineties in 2020 across different congressional districts in Los Angeles County). In Los Angeles County, three congressional races (two in control areas and one split between control and treated areas) in 2016 and one congressional race (in treated areas) in 2020 had no Republican candidate running, and hence slightly lower voter participation, but still 78-85% of voters voted in these races. Overall, we see no evidence to suggest that differences in congressional races across congressional districts drive our result.

Moreover in Los Angeles County, the March 2020 primary saw the first stage of the transition from the traditional neighborhood polling place model to the vote center/early voting model established by the California Voter's Choice Act. As discussed in the main text of this paper, unlike other California counties transitioning to the VCA, Los Angeles

County was exempted from the provision that required sending to all registered voters countywide a mail ballot for the March 2020 primary election, even though the county did transition to the vote center/early voting model in this primary election.

As part of this transition, in the 2020 March primary Los Angeles County also implemented a voting technology transition, in which in-person voters were given the option to use a new type of ballot marking device. Many other innovations in the election administration process were implemented in March 2020, part of the county's "Voting Solutions for All People" (VSAP) initiative — like redesigned mail balloting materials.

It's important for our purposes to note that the VSAP innovations were implemented county-wide in the March 2020 primary, with the exception of universal voting by mail. In other words, the registered voters in the areas treated by universal voting by mail were also treated by the other VSAP innovations, just like registered voters who were not in the areas treated by universal voting by mail.

In general the implementation of the VSAP changes in the March 2020 primary went well, though there were problems with respect to in-person voting during the early voting period and on Election Day. The primary manifestation of these problems was that there were longer lines than anticipated in some voting locations and that some voters were unexpectedly asked to use the provisional balloting process. These issues were generally attributed to issues with the electronic pollbooks and their connectivity with the electronic voter registry.[1] These problems were generally evenly distributed throughout the county, though there were some clusters in west Los Angeles, downtown Los Angeles, and Southern Los Angeles County — in both treated and control areas with respect to universal voting by mail.[2] We have no reason to believe that these issues serve as a confounder in our analysis.

[1]See the County's report on these issues, https://lavote.gov/docs/rrcc/board-correspondence/VSAP-Board-Report.pdf?v=2 and report by researchers at Caltech and American University https://bit.ly/3u9sSdf.

[2]See Figure 9, page 17, https://bit.ly/3u9sSdf.

		2016 Primary	2020 Primary
President	Democratic	✓	✓
	Republican	✓	✓
	American Independent	✓	✓
	Libertarian	✓	✓
	Green	✓	✓
Senate		✓	No Senate Race
House	CA-23	✓	✓
	CA-25	✓	✓
	CA-26	✓	✓
	CA-27	✓	✓
	CA-28	✓	✓
	CA-29	No R candidates	✓
	CA-30	✓	✓
	CA-32 (split)	✓	✓
	CA-33	✓	✓
	CA-34	No R candidates	✓
	CA-35	✓	✓
	CA-37	✓	✓
	CA-38 (treated)	✓	No R candidates
	CA-39 (treated)	✓	✓
	CA-40 (split)	No R candidates	✓
	CA-43	✓	✓
	CA-44	✓	✓
	CA-47 (treated)	✓	✓

Note: The table provides basic information on whether multiple candidates ran in each party's presidential primary and whether candidates from the two major parties ran in the Senate and House primaries. Checkmarks indicate the presence of multiple candidates running in each party's presidential primary and candidates from the two major parties running in the Senate and House primaries.

	2016 President			2016 House		
	N Ballots Cast	N Voted	% Voted	N Ballots Cast	N Voted	% Voted
CA-23	14,322	13,228	92%	15,315	13,746	90%
CA-25	109,869	101,911	93%	117,507	104,633	89%
CA-26	2,765	2,585	93%	2,920	2,616	90%
CA-27	138,284	129,546	94%	149,040	131,243	88%
CA-28	175,107	163,635	93%	189,276	159,128	84%
CA-29	106,895	101,446	95%	113,223	95,520	84%
CA-30	170,220	161,659	95%	179,542	153,190	85%
CA-32 (split)	113,557	106,406	94%	121,082	106,967	88%
CA-33	201,986	190,807	94%	214,979	184,709	86%
CA-34	108,808	103,808	95%	115,048	91,606	80%
CA-35	20,477	19,181	94%	21,728	19,238	89%
CA-37	164,159	157,863	96%	172,195	144,117	84%
CA-38 (treated)	126,978	117,615	93%	134,725	120,210	89%
CA-39 (treated)	32,995	29,973	91%	36,885	32,995	89%
CA-40 (split)	89,094	83,935	94%	93,701	79,535	85%
CA-43	128,898	122,112	95%	136,195	122,061	90%
CA-44	108,315	102,033	94%	114,158	100,276	88%
CA-47 (treated)	92,157	86,370	94%	98,549	85,435	87%

Note: This table displays the number of ballots cast, the number of voters who voted, and the percentage of voters who voted in the presidential primaries and the U.S. House primaries in 2016. In California, voters registered with the Democratic Party, the Republican Party, the American Independent Party, the Libertarian Party, and the Green Party are automatically eligible to vote in that party's presidential primary, and voters registered with no party preferences can request a ballot from the Democratic Party, the American Independent Party, the Libertarian Party to vote in that party's presidential primary. The differences between the number of ballots cast in the presidential primaries and the U.S. House primaries reflect the number of voters registered with no party preferences casting a nonpartisan ballot.

	2020 President			2020 House		
	N Ballots Cast	N Voted	% Voted	N Ballots Cast	N Voted	% Voted
CA-23	16,029	14,829	93%	17,585	16,148	92%
CA-25	124,417	115,270	93%	136,549	121,105	89%
CA-26	2,974	2,754	93%	3,216	2,996	93%
CA-27	151,135	141,984	94%	166,326	153,862	93%
CA-28	187,277	177,367	95%	202,919	185,080	91%
CA-29	99,146	93,650	94%	106,330	97,351	92%
CA-30	174,932	165,629	95%	187,476	170,223	91%
CA-32 (split)	117,040	108,915	93%	127,477	116,151	91%
CA-33	220,793	208,405	94%	237,499	215,080	91%
CA-34	116,331	111,044	95%	124,303	109,653	88%
CA-35	19,079	17,842	94%	21,204	19,518	92%
CA-37	166,837	160,175	96%	175,616	159,322	91%
CA-38 (treated)	133,578	124,225	93%	146,627	113,842	78%
CA-39 (treated)	35,821	33,155	93%	41,587	39,171	94%
CA-40 (split)	78,969	74,290	94%	84,245	76,578	91%
CA-43	125,861	118,330	94%	135,438	128,596	95%
CA-44	93,134	87,503	94%	99,100	89,812	91%
CA-47 (treated)	97,505	91,010	93%	106,421	96,757	91%

Note: This table displays the number of ballots cast, the number of voters who voted, and the percentage of voters who voted in the presidential primaries and the U.S. House primaries in 2020. In California, voters registered with the Democratic Party, the Republican Party, the American Independent Party, the Libertarian Party, and the Green Party are automatically eligible to vote in that party's presidential primary, and voters registered with no party preferences can request a ballot from the Democratic Party, the American Independent Party, the Libertarian Party to vote in that party's presidential primary. The differences between the number of ballots cast in the presidential primaries and the U.S. House primaries reflect the number of voters registered with no party preferences casting a nonpartisan ballot.

SI.3. Congressional Districts Containing Treatment Areas

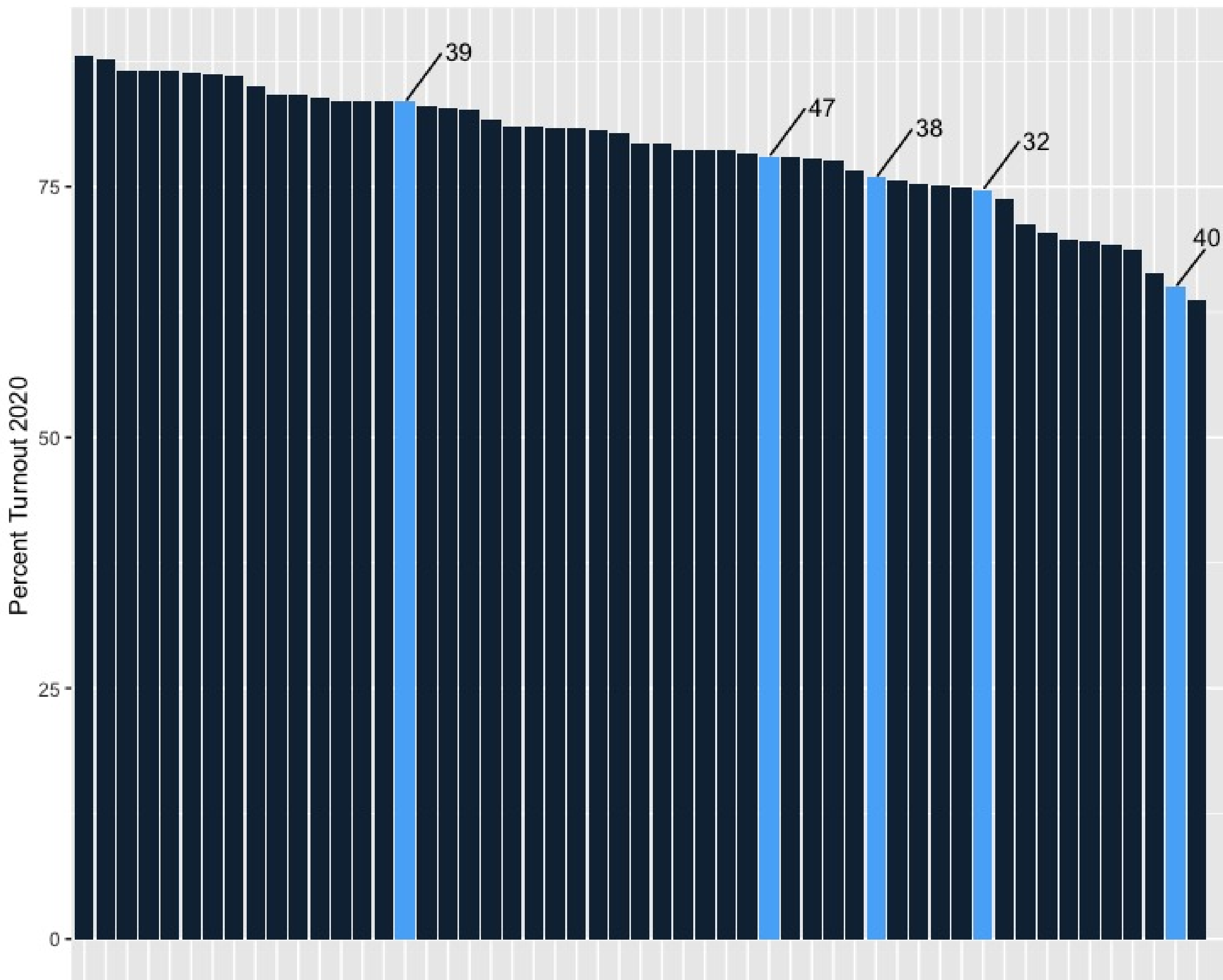
In addition to the particular context of the election that generated our observational data, the treatment was applied in specific congressional and state legislative districts in Southern California. In this section we present data about the political and demographic characteristics of the treatment areas, focusing on the five congressional districts that contain treatment areas and comparing them to the other congressional districts in California.

The argument that we make in this section using the available political and demographic data by California congressional district in 2020 is that the treatment areas in Southern California are indeed diverse in quite a number of ways. We also show that in most cases the congressional districts with treatment areas are not outliers among California congressional districts.

We start by comparing the political characteristics of the congressional districts containing treatment areas by examining their 2020 general election turnout, and the percentage of Biden and Trump votes in the general election. Data on ballots cast, Biden and Trump votes is from Dave Leip's Atlas of U.S. Presidential Elections (https://uselectionatlas.org/). Data on voter registration in California congressional districts is from the California Secretary of State's October 19, 2020 report of registration.

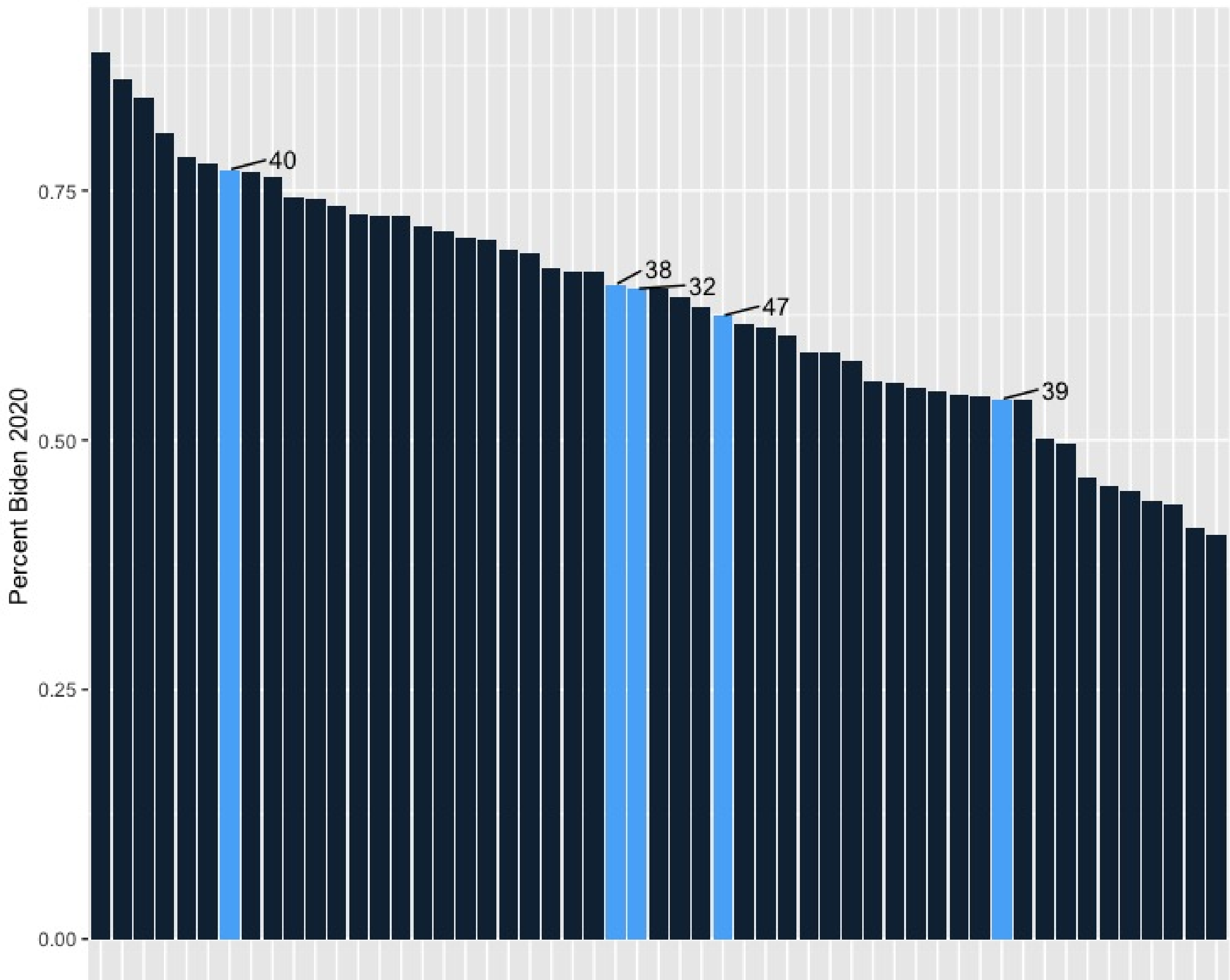
Figure SI.1 provides the 2020 general election turnout comparisons for the five congressional districts containing treatment areas relative to the other districts in California. Here we do not see anything unusual about these five districts, while four of them are in the upper part of the turnout distribution they do not seem wildly atypical. Figure SI.2 gives each California congressional district's Biden vote; here we see one district (40) in the lower tail, one in the upper tail (39), and the other three in the middle of the distribution.

Figure SI.1: 2020 General Election Turnout by California Congressional District



Note: This graph shows the percentage of ballots cast among registered voters in the 2020 general election in each of California's 53 congressional districts. The five congressional districts with treatment areas (32, 38, 39, 40, and 47) are in blue, and the other districts are in black. Districts are arrayed by turnout, from high to low.

Figure SI.2: 2020 Biden Vote Share by California Congressional District



Note: This graph shows the percentage of ballots cast for Biden, of all ballots cast, in the 2020 general election in each of California's 53 congressional districts. The five congressional districts with treatment areas (32, 38, 39, 40, and 47) are in blue, and the other districts are in black. Districts are arrayed by the percentage of Biden votes, from high to low.

Table SI.2: Political Feature for California Congressional Districts with and without Treatment Areas

	CDs With Treatment Areas		Other CDs in California	
	Median	Mean	Median	Mean
Percent Biden Vote	65.15	64.87	64.72	63.59
Percent Trump Vote	32.81	32.99	33.07	34.19
Turnout among Registered	75.90	75.41	80.46	79.24

Note: Data on ballots cast, Biden and Trump votes is from Dave Leip's Atlas of U.S. Presidential Elections (https://uselectionatlas.org/). Data on voter registration in California congressional districts is from the California Secretary of State's October 19, 2020 report of registration.

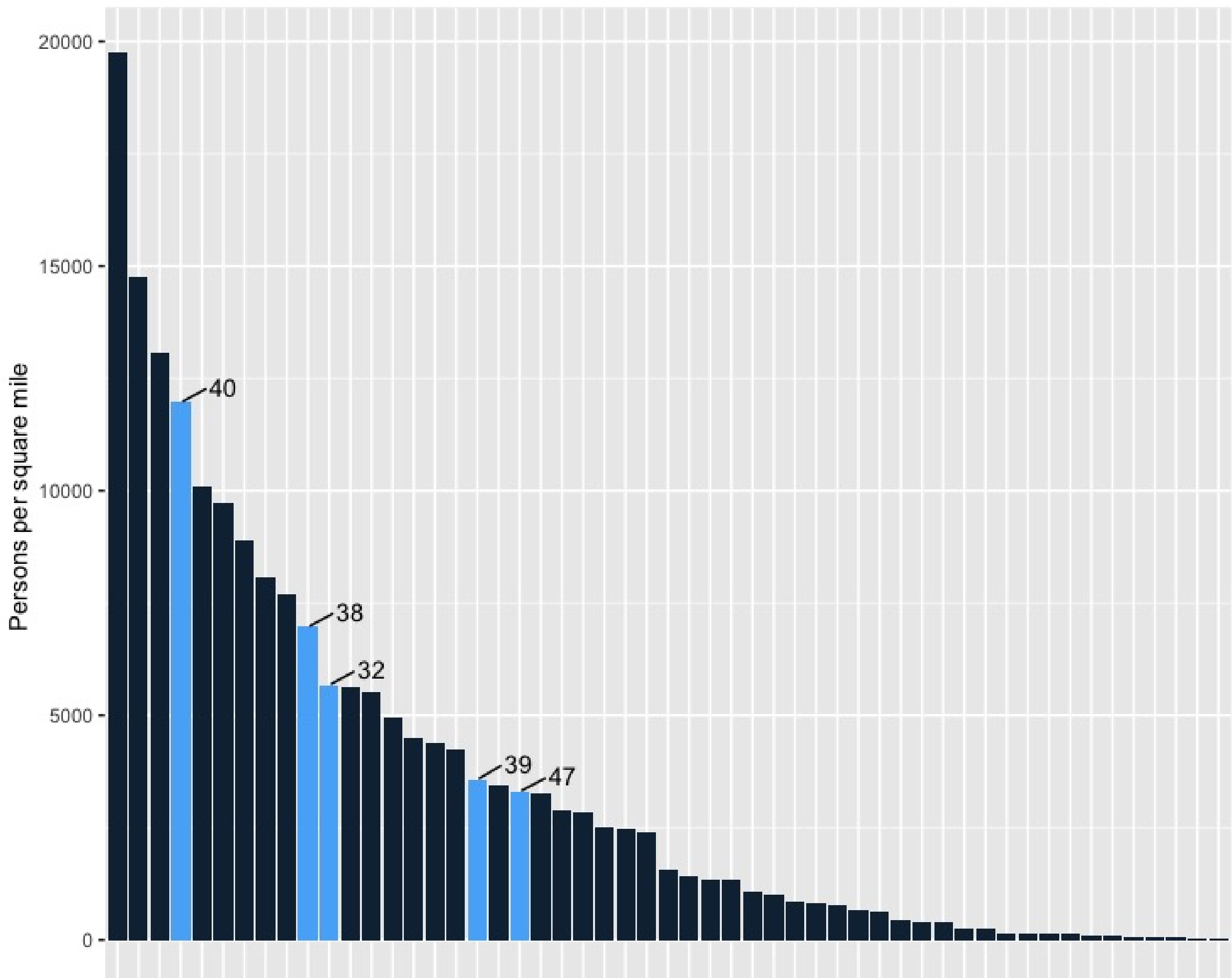
We provide summary statistics in Table SI.2. The table gives median and mean statistics for the percent Biden vote, the percent Trump vote, and the turnout among registered voters, for congressional districts with treatment areas and other other congressional districts in California. In terms of these three political features the table shows that there are no substantively significant differences between congressional districts with and without treatment areas. The mean Biden vote in congressional districts containing treatment areas is slightly higher than elsewhere in California, while the mean Trump vote is slightly lower. Turnout in the 2000 presidential general election is slightly lower in congressional districts containing treatment areas than in the other congressional districts in California.

For demographic information we use data from the California Department of Finance (https://dof.ca.gov/forecasting/demographics/redistricting-data/#profile). These data compare the 53 2020 California congressional districts using the 2020 Census Redistricting File (PL 94-171). Here we examine population density as well as the percentage white, non-Hispanics, the percentage Black, non-Hispanics, the percentage Asian, non-Hispanics, and the percentage Hispanic/Latino.

In Figure SI.3 we show the distribution of California congressional districts by 2020 population density. Here we see that the congressional districts containing treatment areas are generally among the higher population density congressional districts in the state, though the range of population density among the treatment districts is considerable. As these districts are located in the more densely-populated Southern California region, this is not surprising.

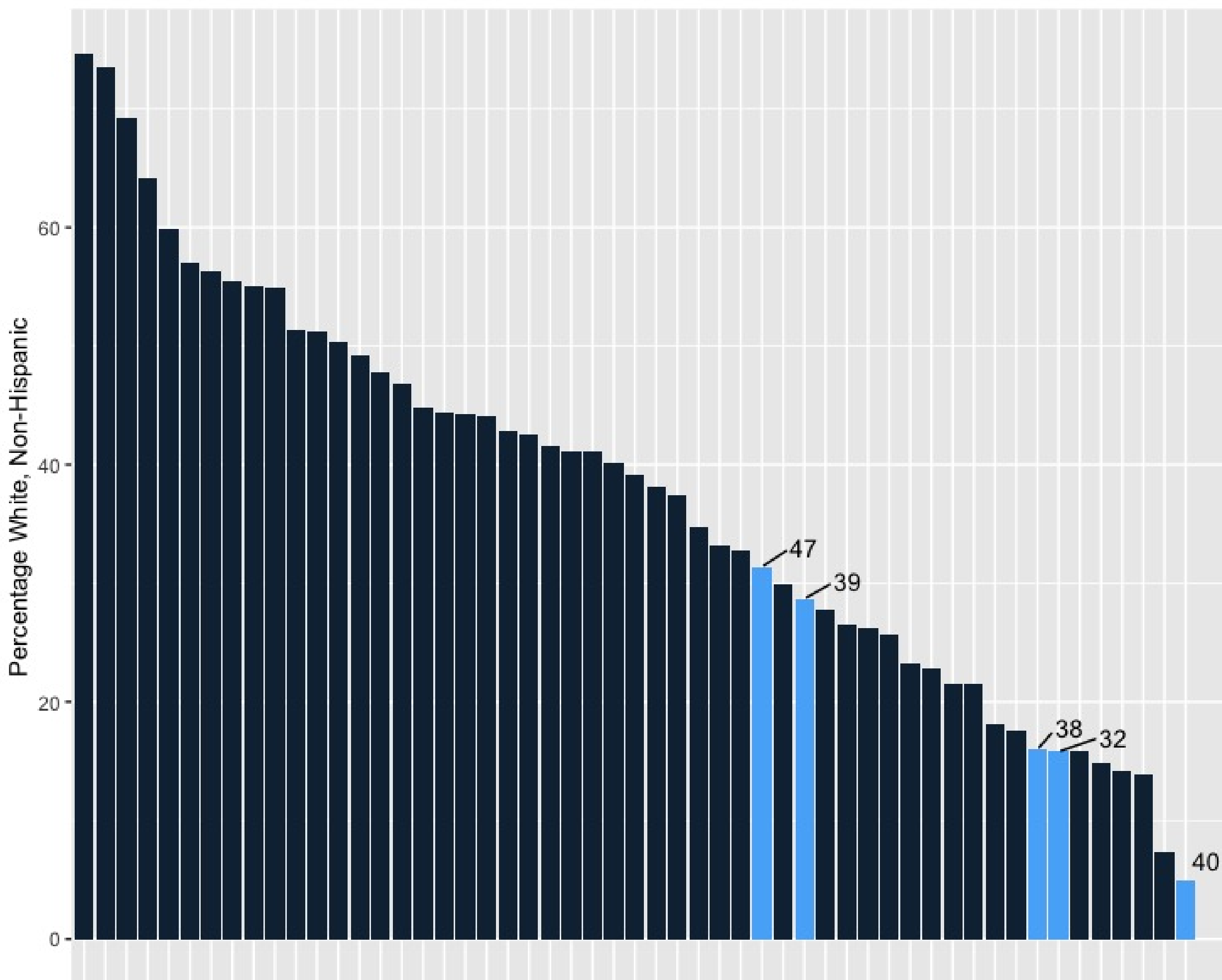
The next series of figures focus on race and ethnicity. In Figure SI.4 we show the distribution of 2020 California congressional districts by the percentage of their population that is white, non-Hispanic. Two congressional districts containing treatment areas (CA-47 and CA-39) have medium percentages of non-Hispanic whites in California, two congressional districts containing treatment areas (CA-38 and CA-32) have smaller percentages, and one congressional district (CA-40) has the smallest percentage of non-Hispanic whites in the state. Next in Figure SI.5 we provide the distribution of congressional districts by the percentage of their population that is Black, non-Hispanic; note that the five congressional districts containing treatment areas are scattered through the middle of this distribution. Figure SI.6 gives the distribution of 2020 California districts by the percentage of their population that is Asian, non-Hispanic. Here CA-40 is at one end of the distribution (the district with the smallest fraction of its population being Asian, non-Hispanic) while the other congressional districts containing treatment areas have above-state-median Asian, non-Hispanic populations. We see in Figure SI.7 that in terms of the percentage of each district's population that is Hispanic/Latino, the pattern is the reverse of that for non-Hispanic whites. In particular, two congressional districts containing treatment areas (CA-47 and CA-39) have medium percentages of Hispanics in California, two congressional districts containing treatment areas (CA-38 and CA-32) have larger percentages, and CA-40 has the largest percentage of Hispanics in the state. The overall pattern in terms of race and ethnicity is unsurprising given the overall population diversity in Los Angeles and the heterogeneity across the county.

Figure SI.3: Population Density by 2020 California Congressional District



Note: This graph shows the number of persons per square mile in each of California's 53 congressional districts. The five congressional districts with treatment areas (32, 38, 39, 40, and 47) are in blue, and the other districts are in black. Districts are arrayed by the number of persons per square mile, from high to low.

Figure SI.4: Percent White, Non-Hispanic by 2020 California Congressional District



Note: This graph shows the percentage of population that is white, non-Hispanic, in each of California's 53 congressional districts. The five congressional districts with treatment areas (32, 38, 39, 40, and 47) are in blue, and the other districts are in black. Districts are arrayed by the percentage of population that is white, non-Hispanic, from high to low.

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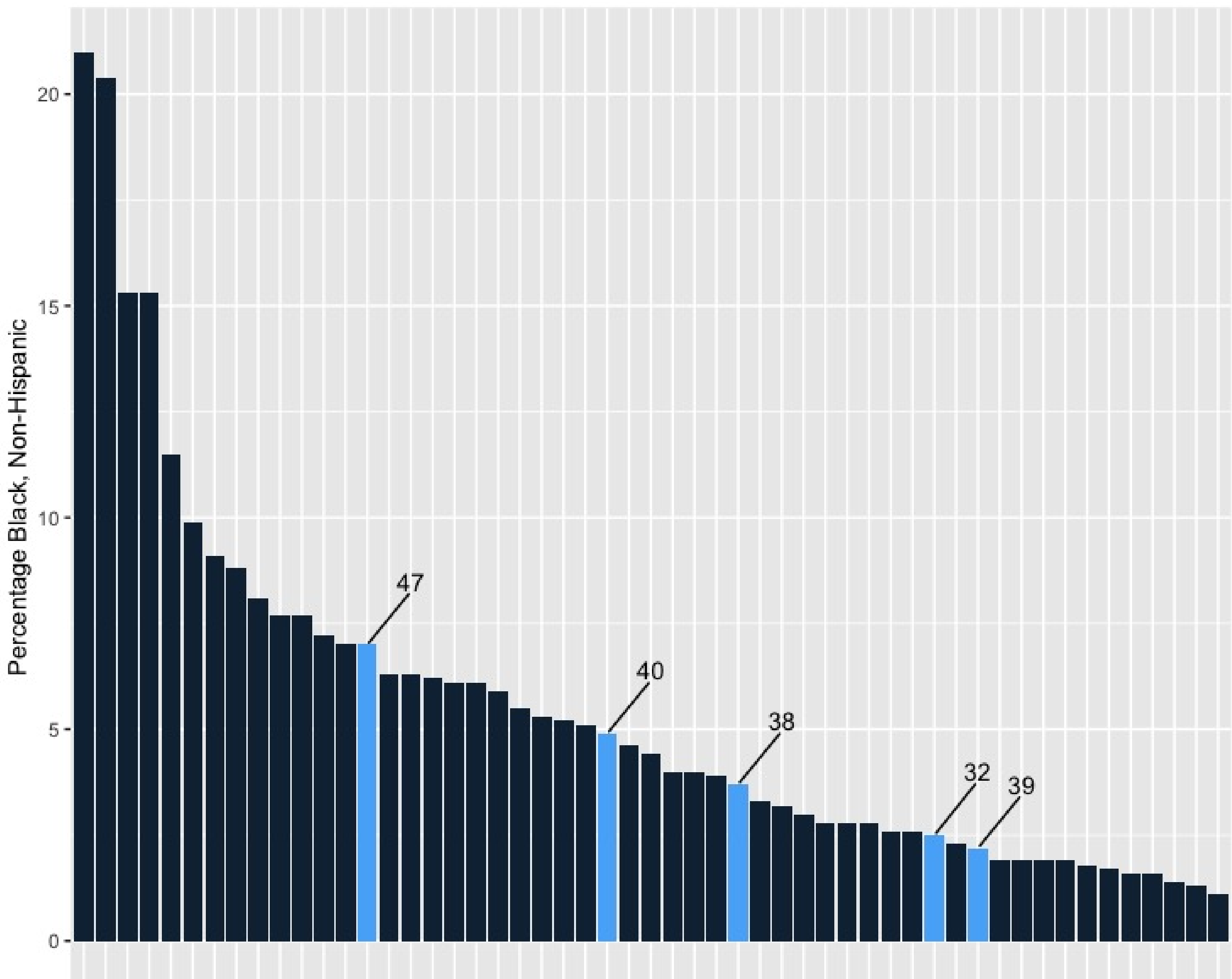
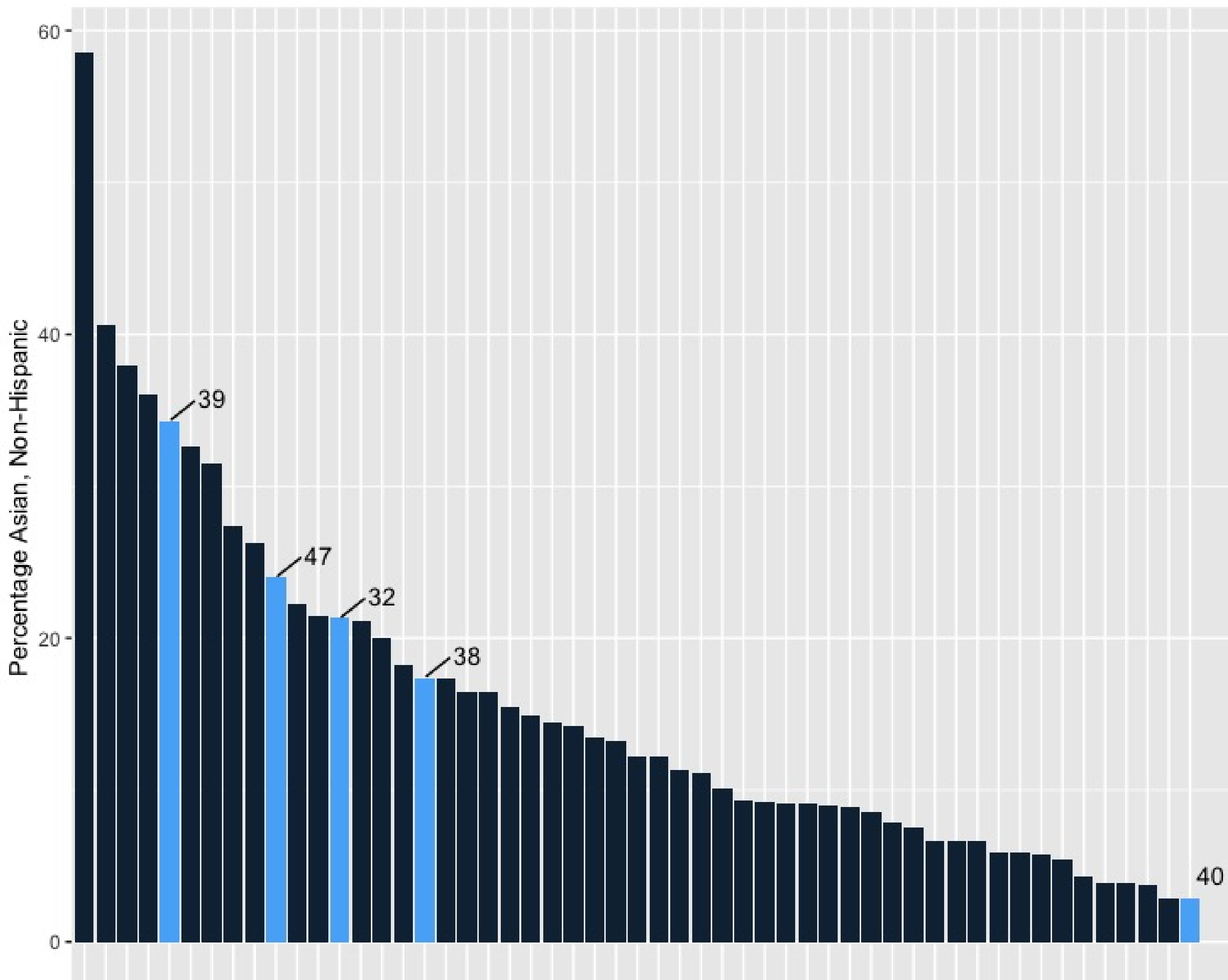
Figure SI.5: Percent Black, Non-Hispanic by 2020 California Congressional District



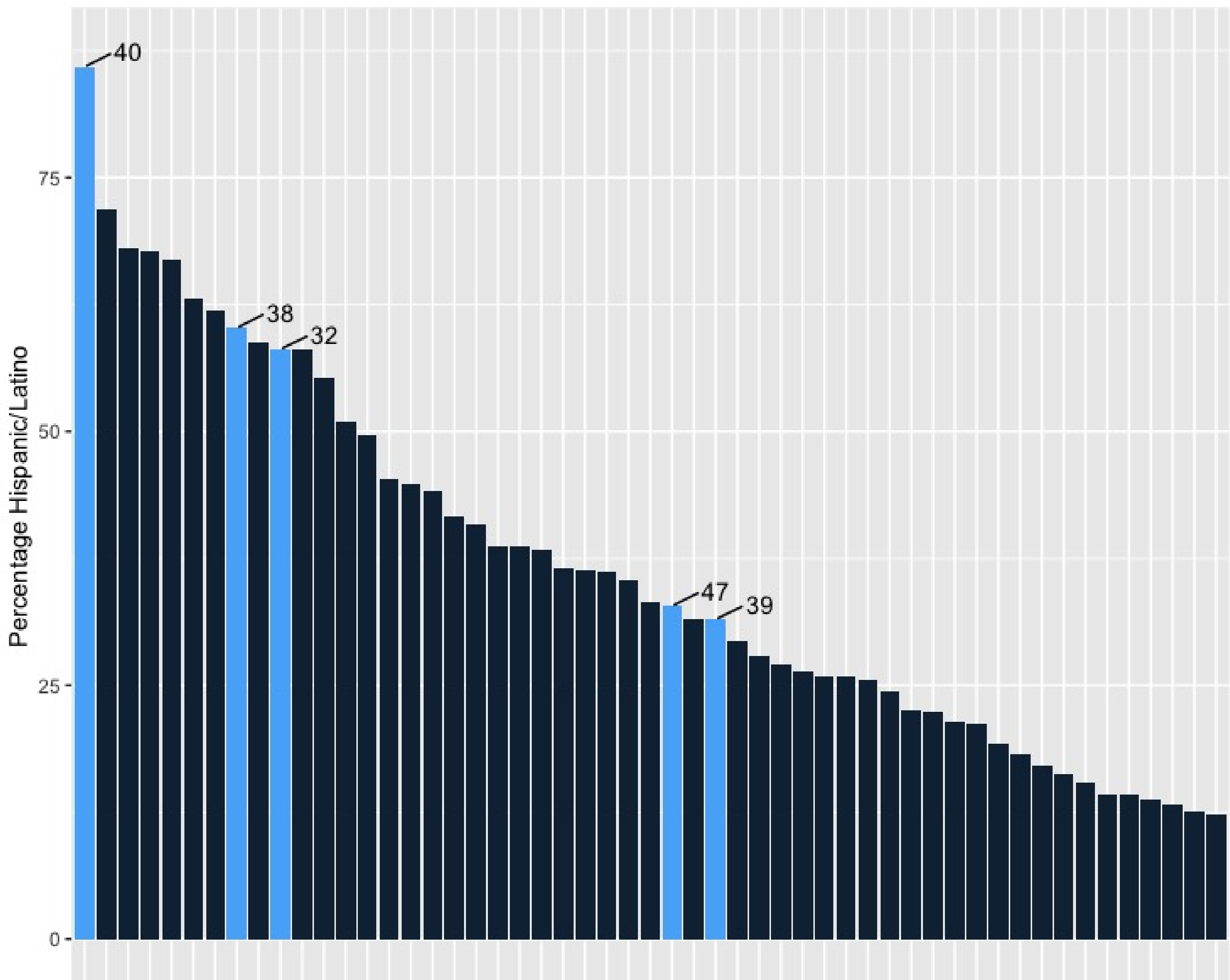
Note: This graph shows the percentage of population that is Black, non-Hispanic, in each of California's 53 congressional districts. The five congressional districts with treatment areas (32, 38, 39, 40, and 47) are in blue, and the other districts are in black. Districts are arrayed by the percentage of population that is Black, non-Hispanic, from high to low.

Figure SI.6: Percent Asian, Non-Hispanic by 2020 California Congressional District



Note:This graph shows the percentage of population that is Asian, non-Hispanic, in each of California's 53 congressional districts. The five congressional districts with treatment areas (32, 38, 39, 40, and 47) are in blue, and the other districts are in black. Districts are arrayed by the percentage of population that is Asian, non-Hispanic, from high to low.

Figure SI.7: Percent Hispanic by 2020 California Congressional District



Note: This graph shows the percentage of population that is Hispanic, in each of California's 53 congressional districts. The five congressional districts with treatment areas (32, 38, 39, 40, and 47) are in blue, and the other districts are in black. Districts are arrayed by the percentage of population that is Hispanic, from high to low.

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SI.4. Data

For voter demographic characteristics, age is computed using the date of birth in the voter file. Since gender and race/ethnicity were only provided by a subset of voters, we supplement voter-provided gender (either directly or via titles such as Mr., Mrs., Miss., and Ms.) and race/ethnicity by inferring a voter's gender and race/ethnicity based on their age, name, and address. In particular, we obtain a probabilistic assessment of a voter's gender based on their age and first name (or middle name if using first name is not feasible) using the *gender* package in R, and a probabilistic assessment of a voter's race/ethnicity based on their age, gender, party, and Census geography (Census block, or Census tract if using Census block is not feasible) using the *wru* package in R. For neighborhood socioeconomic characteristics, we obtain Census-block-group level information from the 2019 American Community Survey (ACS) 5-year estimates. The socioeconomic characteristics for some Census block groups are missing in the ACS due to privacy protections.

For identifying the congressional districts and state legislative districts in which voters reside, we match registration precincts to voting precincts using mapping created and maintained by California's *Statewide Database*.[3] We further match voting precincts to U.S. congressional districts and California's state senate and assembly districts using the Statement of Votes available on the Los Angeles County Registrar-Recorder/County Clerk website. For determining the latitude, longitude, and Census geography at which voters are located, we use the *censusxy* package in R as well as the Google Maps API. We calculate the distance from each registered voter's residential address to the boundary of universal and non-universal vote-by-mail districts using the *sf* package in R. The distribution of these distances is shown in Figure SI.8.

[3] See https://statewidedatabase.org/.

Figure SI.8: Distribution of Distances to the Boundary of Universal and Non-Universal Vote-by-Mail Districts

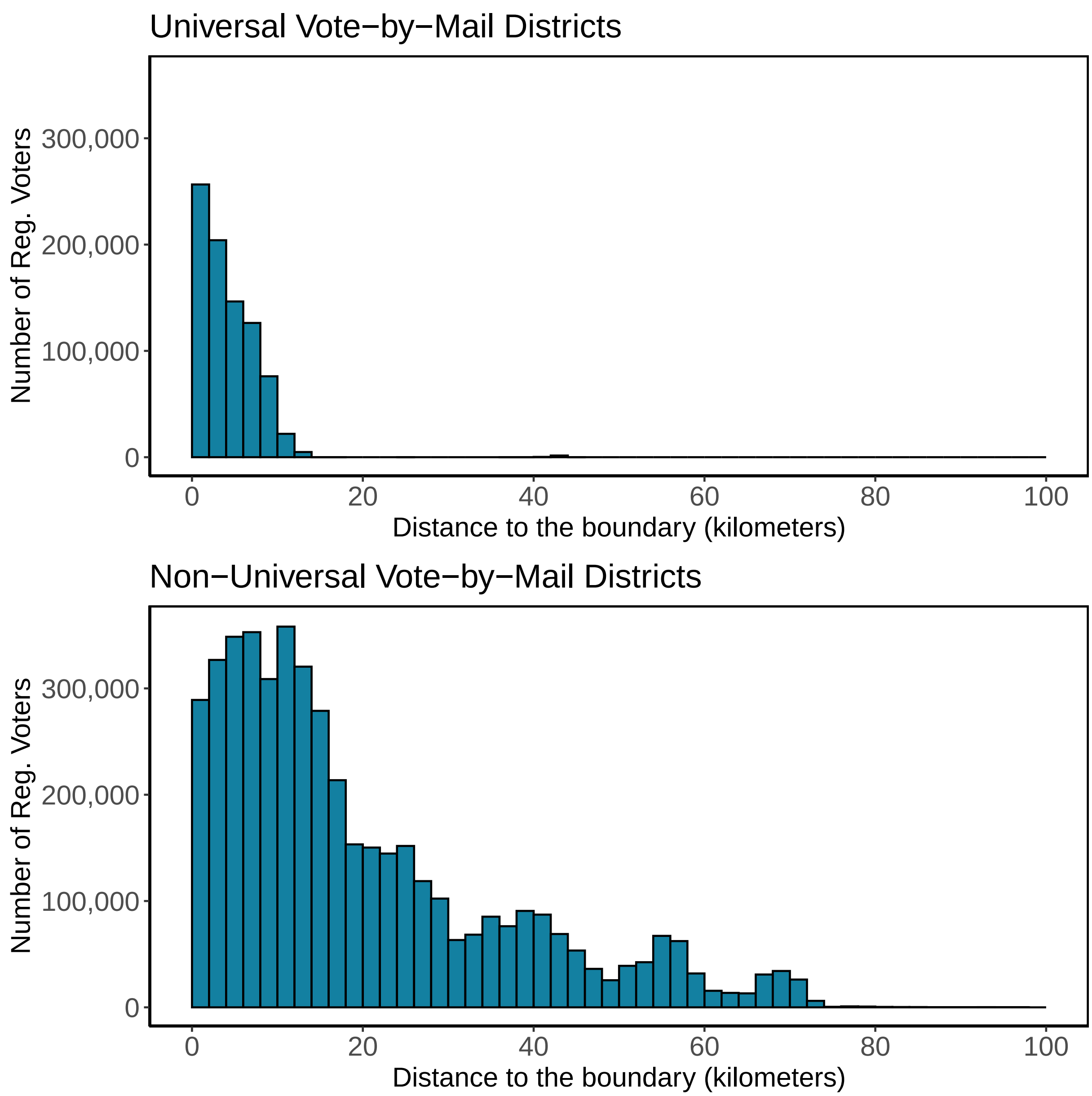


Table SI.3: Demographic composition of Control and Treated Areas

	Estimate			Standard Error		
	Control	Treated	Diff.	Control	Treated	Diff.
Age:						
18 to 29	21.4	20.8	-0.6	0.0	0.0	0.0
30 to 44	27.1	26.1	-1.0	0.0	0.0	0.1
45 to 64	31.1	32.0	0.9	0.0	0.1	0.1
65 or older	20.4	21.1	0.7	0.0	0.0	0.0
Gender:						
Female	52.9	53.2	0.3	0.0	0.1	0.1
Race/Ethnicity:						
White	37.5	29.5	-8.0	0.0	0.0	0.1
Black	12.4	6.9	-5.5	0.0	0.0	0.0
Hispanic	36.4	44.8	8.4	0.0	0.1	0.1
Asian	10.6	15.8	5.3	0.0	0.0	0.0
Other	3.1	3.0	-0.2	0.0	0.0	0.0

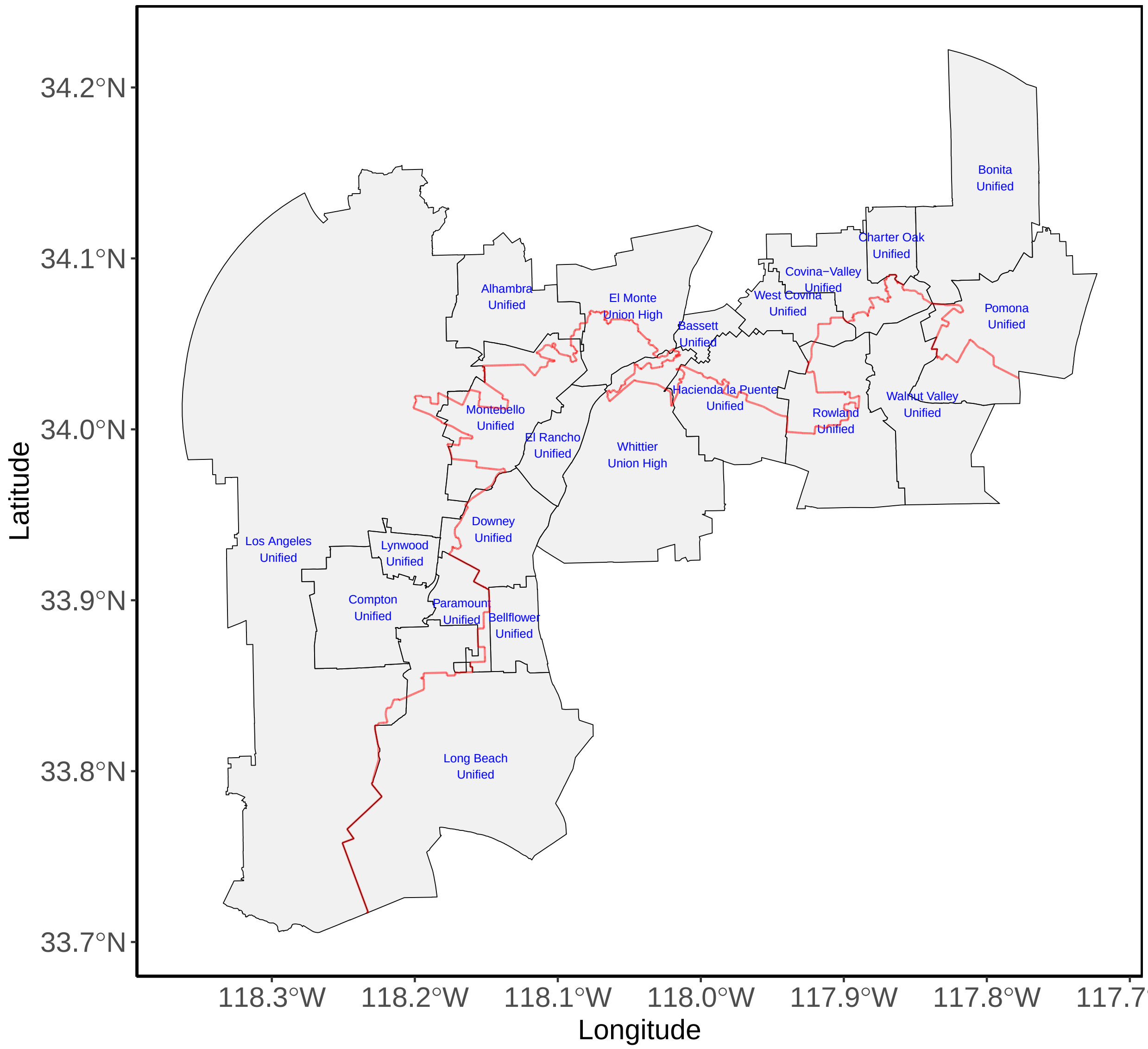
Note: For all registered voters, age is computed using the date of birth in the voter file. For registered voters who did not provide a gender or title in their voter registration, we obtained a probabilistic assessment of their gender based on their name and age using the *gender* package in R. For registered voters who did not provide a race/ethnicity in their voter registration, we obtained a probabilistic assessment of their race/ethnicity based on their name, age, gender, party, and Census geography using the *wru* package in R. The proportions reported in the table are aggregations of the probabilistic assessments.

Table SI.4: Socioeconomic Composition of Control and Treated Areas

	Estimate			Standard Error		
	Control	Treated	Diff.	Control	Treated	Diff.
Education:						
No High School	21.4	17.9	-3.5	0.1	0.2	0.2
High School	20.3	22.6	2.3	0.1	0.2	0.2
Some College	25.3	29.9	4.6	0.1	0.2	0.2
Bachelor	21.4	20.2	-1.2	0.1	0.2	0.2
Postgraduate	11.7	9.5	-2.1	0.1	0.1	0.1
HH. Income:						
Less than 35k	27.4	23.1	-4.3	0.1	0.3	0.3
35k to 75k	27.0	27.7	0.8	0.1	0.3	0.3
75kto 125k	21.1	24.8	3.7	0.1	0.3	0.3
125k or more	24.5	24.4	-0.1	0.1	0.2	0.3
Rent:						
Less than 1000	19.5	16.9	-2.6	0.2	0.6	0.6
1000 to 1499	32.8	37.5	4.6	0.2	0.5	0.5
1500 to 1999	24.0	26.1	2.1	0.1	0.4	0.4
2000 or more	23.6	19.5	-4.1	0.2	0.4	0.5
House Value:						
Less than 500k	39.6	41.4	1.8	0.3	0.5	0.6
500k to 750k	28.3	40.8	12.5	0.1	0.3	0.4
750k to 1m	13.1	11.6	-1.5	0.1	0.2	0.2
1m or more	18.9	6.2	-12.8	0.1	0.2	0.3

Note: We obtained Census-block-group level information from the 2019 American Community Survey (ACS) 5-year estimates. The proportions for the control (treatment) area reported in the table are population-weighted aggregations of all Census block groups in the control (treatment) area. 43 (out of over 6,400) Census blocks containing both treatment and control areas are split and added to each area based on the proportion of registered voters in each area.

Figure SI.9: School Districts Close to the Boundary



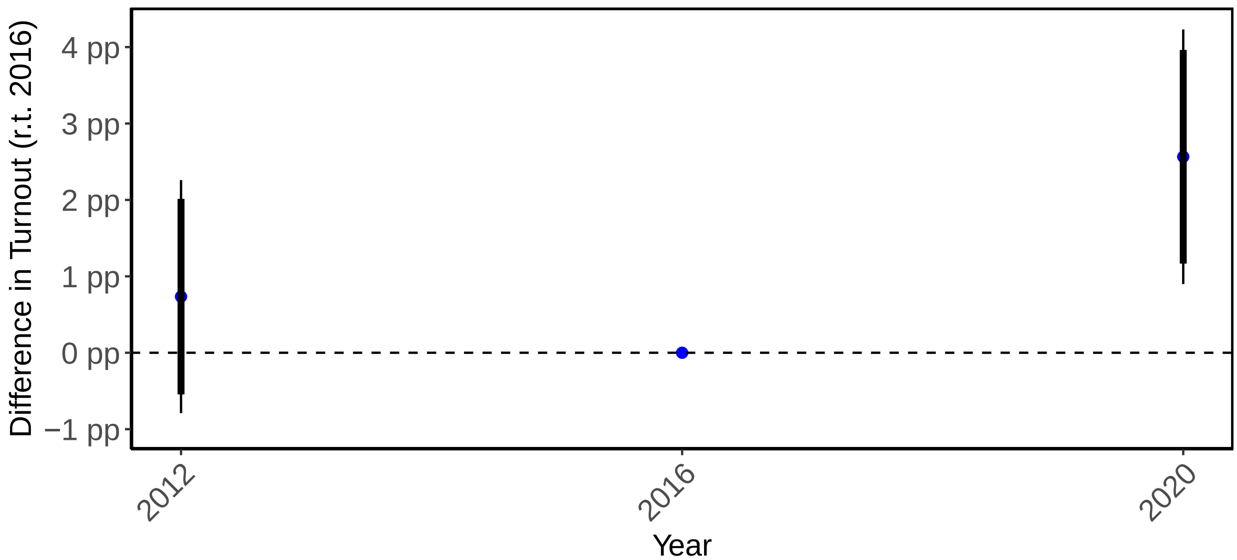
Note: This graph shows the school districts (unified school districts or high school districts) close to the boundary of universal and non-universal vote-by-mail districts (red line). Areas of Los Angeles Unified School District and Bonita Unified School District far from the boundary are not shown in order to keep the map easy to view. The table on the next page displays the number of registered voters in each school district.

School District	Treatment Area	Control Area
Alhambra Unified	99,617	0
Bassett Unified	15,631	0
Bellflower Unified	0	60,710
Bonita Unified	52,413	0
Charter Oak Unified	28,346	0
Compton Unified	108,920	0
Covina Valley Unified	53,347	2,846
Downey Unified	3,440	81,007
El Monte Union High	74,828	11,092
El Rancho Unified	0	40,304
Hacienda La Puente Unified	36,186	37,348
Long Beach Unified	55,578	378,736
Los Angeles Unified	3,180,626	1,041
Lynwood Unified	36,640	0
Montebello Unified	44,732	48,256
Paramount Unified	40,150	8,445
Pomona Unified	87,066	16,091
Rowland Unified	14,252	49,107
Walnut Valley Unified	0	41,194
West Covina Unified	37,573	3,411
Whittier Union High	2,851	151,578

Note: This table displays the number of registered voters in each school district (unified school districts or high school districts) close to the boundary of universal and non-universal vote-by-mail districts.

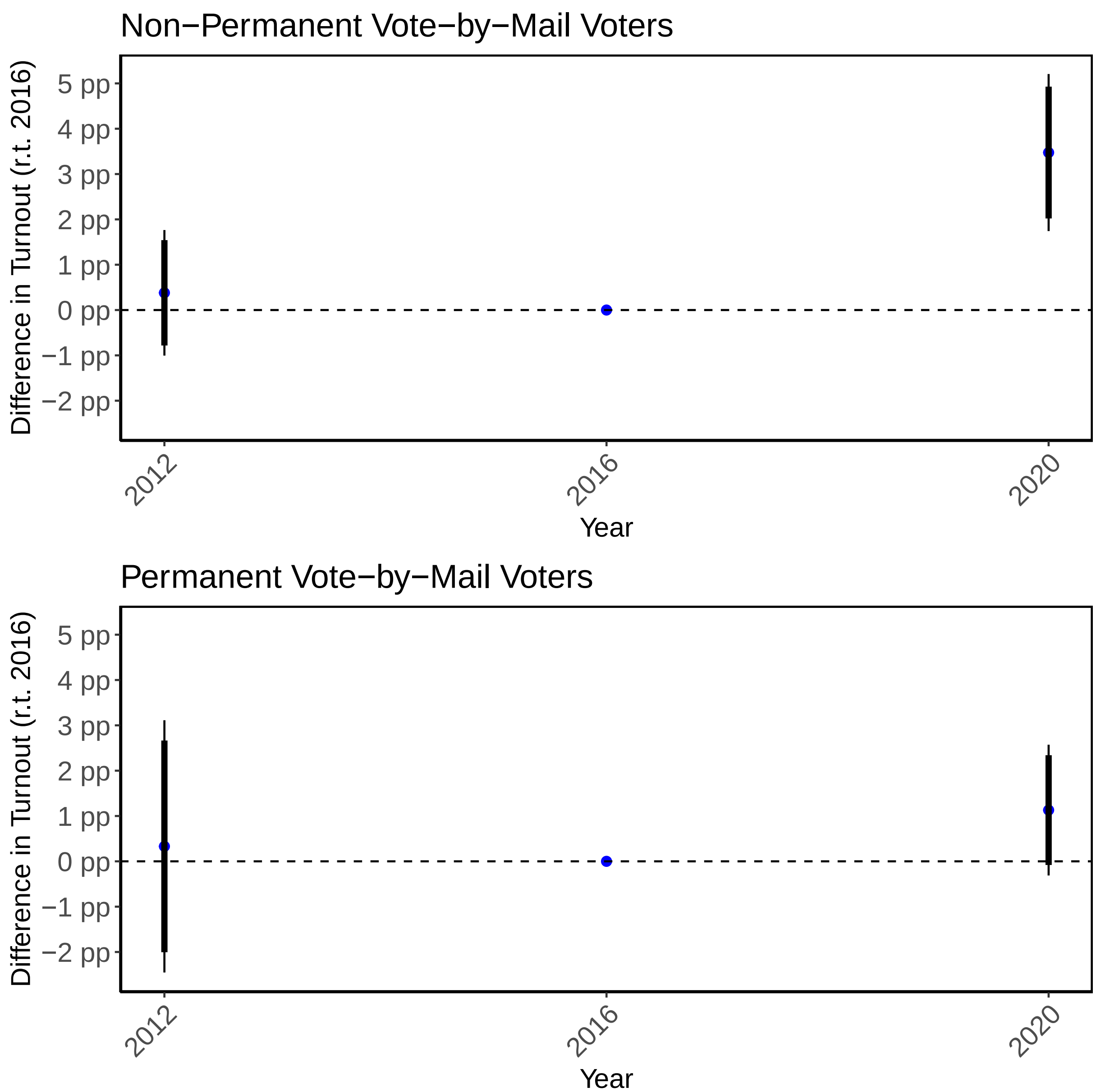
SI.5. Parallel Trends Tests

Figure SI.10: Testing Parallel Trends Assumption



Note: Estimates correspond to γ_{2012} and γ_{2020} from the model Turnout $= \alpha + \beta_{\text{UVBM}}\text{I(UVBM)} + \beta_{2012}\text{I}(2012) + \beta_{2020}\text{I}(2020) + \gamma_{2012}\text{I(UVBM)I}(2012) + \gamma_{2020}\text{I(UVBM)I}(2020) + \epsilon$, estimated via weighted least squares with precinct-level voter turnout. Points, thinner lines, and thicker lines correspond to point estimates, 95% confidence intervals, and 90% confidence intervals, respectively. Standard errors are clustered at the (congressional and state legislative) district level. Numbers in the figure are percentage points.

Figure SI.11: Testing Parallel Trends Assumption by Permanent Absentee Status



Note: Estimates correspond to γ_{2012} and γ_{2020} from the model Turnout $= \alpha + \beta_{\text{UVBM}}\text{I(UVBM)} + \beta_{2012}\text{I}(2012) + \beta_{2020}\text{I}(2020) + \gamma_{2012}\text{I(UVBM)I}(2012) + \gamma_{2020}\text{I(UVBM)I}(2020) + \epsilon$, estimated via ordinary least squares with individual-level voter turnout. The top and bottom panels show the results from registered non-permanent absentee voters and registered permanent absentee voters since 2012, respectively (results are similar using the permanent absentee status as of the 2018 general election). Points, thinner lines, and thicker lines correspond to point estimates, 95% confidence intervals, and 90% confidence intervals, respectively. Standard errors are clustered at the (congressional and state legislative) district level. Numbers in the figure are percentage points.

SI.6. Results from Difference-in-Differences Designs

Table SI.5: Effects on Percent Voting by Mail, Los Angeles County

Dependent Variable: Voting by Mail (Indicator)				
	2016	2020	Difference	Diff-in-Diffs
Non-Permanent VBM Voters (N = 1,599,466 Voter × Year)				
Universal VBM Districts	15.1	52.7	37.6	26.1
			(0.31)	(0.43)
Non-Universal VBM Districts	16.2	27.7	11.5	
			(0.30)	
Permanent VBM Voters (N = 1,123,247 Voter × Year)				
Universal VBM Districts	72.2	83.6	11.4	1.3
			(0.44)	(0.58)
Non-Universal VBM Districts	71.7	81.8	10.1	
			(0.37)	
Non-Perm. And Perm. VBM Voters (N = 2,722,713 Voter × Year)				
Universal VBM Districts	38.2	65.2	27.0	15.0
			(0.48)	(0.60)
Non-Universal VBM Districts	38.6	50.6	12.0	
			(0.36)	

Note: Difference-in-differences estimates are from models $\text{I(Voting by Mail)} = \alpha + \beta_{\text{UVBM}}\text{I(UVBM)} + \beta_{2020}\text{I(2020)} + \beta_{DiD}\text{I(UVBM)I(2020)} + \epsilon$. In parentheses are standard errors clustered at the (congressional and state legislative) district level. Numbers in the table are percentage points.

Table SI.6: Effects on Turnout, Los Angeles County

Dependent Variable: Turnout (Indicator)				
	2016	2020	Difference	Diff-in-Diffs
Non-Permanent VBM Voters (N = 4,700,210 Reg. Voter × Year)				
Universal VBM Districts	34.7	34.8	0.0	3.2
			(0.62)	(0.88)
Non-Universal VBM Districts	35.5	32.3	-3.2	
			(0.62)	
Permanent VBM Voters (N = 2,382,124 Reg. Voter × Year)				
Universal VBM Districts	46.1	46.2	0.1	0.7
			(0.57)	(0.86)
Non-Universal VBM Districts	47.7	47.0	-0.6	
			(0.64)	
Non-Perm. and Perm. VBM Voters (N = 7,082,334 Reg. Voter × Year)				
Universal VBM Districts	38.6	38.6	0.1	2.4
			(0.60)	(0.87)
Non-Universal VBM Districts	39.6	37.3	-2.3	
			(0.63)	

Note: Difference-in-differences estimates are from models $\text{I(Turnout)} = \alpha + \beta_{\text{UVBM}}\text{I(UVBM)} + \beta_{2020}\text{I(2020)} + \beta_{DiD}\text{I(UVBM)I(2020)} + \epsilon$. In parentheses are standard errors clustered at the (congressional and state legislative) district level. Numbers in the table are percentage points.

Table SI.7: Difference-in-Differences with Covariate-Specific Fixed Effects

	Non-Perm. VBM Voters			Perm. VBM Voters		
Intercept	35.5	35.2	23.1	47.6	40.4	28.5
	(0.71)	(0.81)	(1.04)	(0.95)	(0.91)	(1.33)
Universal VBM	-0.8	-0.2	-0.5	-1.6	-0.5	-0.5
	(0.99)	(0.65)	(0.75)	(1.72)	(1.03)	(1.08)
2020	-3.2	-3.4	-3.8	-0.6	-0.6	-0.9
	(0.62)	(0.65)	(0.69)	(0.64)	(0.66)	(0.69)
Universal VBM x 2020	3.2	3.3	3.8	0.7	0.6	1.1
	(0.88)	(0.90)	(0.91)	(0.86)	(0.87)	(0.86)
Age: 30 - 44		-1.9	-2.2		4.1	3.7
		(0.30)	(0.30)		(0.51)	(0.57)
Age: 45 - 64		7.3	6.6		14.3	13.8
		(0.50)	(0.46)		(0.52)	(0.50)
Age: 65 or older		14.6	14.1		26.6	26.1
		(0.82)	(0.80)		(0.81)	(0.78)
Female		3.6	3.7		2.6	2.7
		(0.27)	(0.28)		(0.23)	(0.23)
Black		-8.6	-4.3		-6.3	-2.2
		(1.11)	(0.88)		(1.10)	(0.91)
Hispanic		-8.6	-3.2		-11.6	-5.8
		(0.57)	(0.40)		(0.38)	(0.39)
Asian		-13.3	-11.8		-13.3	-12.0
		(0.85)	(0.89)		(0.88)	(0.94)
Other		-11.9	-6.3		-10.2	-5.0
		(1.02)	(0.70)		(0.95)	(0.79)
Census % w. Bachelor's degree			0.2			0.2
			(0.02)			(0.01)
Census median HH income			4.4			2.2
(100,000 dollars)			(0.66)			(0.68)
Census median house value			1.9			2.6
(million dollars)			(1.12)			(1.37)
Observations	4.70m	4.12m	2.97m	2.38m	2.08m	1.49m
Adjusted R^2	$<$0.01	0.03	0.04	$<$0.01	0.06	0.07

Note: In parentheses are standard errors clustered at the (congressional and state legislative) district level. Numbers in the table are percentage points.

Table SI.8: Effects on Turnout by Party Registration, Los Angeles County

	Dependent Variable: Turnout (Indicator)								
	DEM Voters			REP Voters			NPA Voters		
	2016	2020	DiD	2016	2020	DiD	2016	2020	DiD
Non-PVBM Voters	**N = 2,514,438**			**N = 838,878**			**N = 1,110,642**		
UVBM Districts	42.3	40.0	2.6	32.6	38.5	5.0	22.8	22.2	2.3
			(0.93)			(0.92)			(0.89)
Non-UVBM Districts	43.4	38.6		31.5	32.4		23.5	20.5	
PVBM Voters	**N = 1,230,546**			**N = 440,688**			**N = 613,730**		
UVBM Districts	54.5	51.7	0.0	50.2	54.8	1.1	30.4	31.5	0.9
			(0.89)			(0.84)			(1.15)
Non-UVBM Districts	55.8	53.1		49.4	52.9		32.3	32.5	
Non-PVBM and PVBM	**N = 3,744,984**			**N = 1,279,566**			**N = 1,724,372**		
UVBM Districts	46.2	43.8	1.7	38.7	44.2	3.7	25.7	25.7	1.9
			(0.91)			(0.87)			(0.98)
Non-UVBM Districts	47.5	43.4		37.7	39.5		26.6	24.7	

Note: Difference-in-differences estimates are from models $\text{I(Turnout)} = \alpha + \beta_{\text{UVBM}}\text{I(UVBM)} + \beta_{2020}\text{I(2020)} + \beta_{DiD}\text{I(UVBM)I(2020)} + \epsilon$. In parentheses are standard errors clustered at the (congressional and state legislative) district level. Numbers in the table are percentage points.

SI.7. Voter Composition and Comparison near the Boundary

Table SI.9: Demographic Composition of Voters Residing within Specified Distance of the Boundary of Universal and Non-Universal Vote-by-Mail Districts

	All	10km	5km	2km	1km	500m
Age:						
18 to 29	21	24	24	24	25	25
30 to 44	27	27	26	26	26	26
45 to 64	31	30	30	30	30	29
65 or older	21	20	20	20	20	20
Gender:						
Female	53	53	53	54	54	54
Race/Ethnicity:						
White	36	21	16	15	14	13
Black	12	9	7	6	7	7
Hispanic	38	51	58	60	61	62
Asian	11	15	15	16	16	15
Other	3	4	3	3	3	3

Note: For all registered voters, age is computed using the date of birth in the voter file. For registered voters who did not provide a gender or title in their voter registration, we obtained a probabilistic assessment of their gender based on their name and age using the *gender* package in R. For registered voters who did not provide a race/ethnicity in their voter registration, we obtained a probabilistic assessment of their race/ethnicity based on their name, age, gender, party, and Census geography using the *wru* package in R. The proportions reported in the table are aggregations of the probabilistic assessments.

Table SI.10: Socioeconomic Composition of Voters Residing within Specified Distance of the Boundary of Universal and Non-Universal Vote-by-Mail Districts

	All	10km	5km	2km	1km	500m
Education:						
No High School	19	26	27	27	27	27
High School	20	23	24	25	25	25
Some College	27	26	27	27	27	27
Bachelor	22	17	15	16	15	15
Postgraduate	12	8	6	6	5	5
HH. Income:						
Less than 35k	25	27	27	26	26	26
35k to 75k	27	29	30	30	30	30
75kto 125k	22	23	23	24	25	25
125k or more	26	21	20	20	19	18
Rent:						
Less than 1000	16	19	19	19	20	21
1000 to 1499	29	33	34	33	32	32
1500 to 1999	23	24	24	24	26	28
2000 or more	32	24	23	24	22	19
House Value:						
Less than 500k	42	55	60	58	61	64
500k to 750k	30	31	31	32	31	29
750k to 1m	12	9	6	7	5	5
1m or more	15	5	3	3	3	2

Note: We obtained Census-block-group level information from the 2019 American Community Survey (ACS) 5-year estimates. The proportions for each area reported in the table are population-weighted aggregations of all Census block groups in the area.

Table SI.11: Demographic Comparison between Universal and Non-Universal VBM Districts as a Function of Distance

	All	10km	5km	2km	1km	500m
Non-PVBM Voters:						
χ^2 Statistic	46,694	40,461	30,827	12,766	5,189	2,414
UVBM sample size	508,735	491,592	329,063	156,901	86,994	44,654
Non-UVBM sample size	2,874,771	1,031,335	498,552	183,181	99,537	55,259
PVBM Voters:						
χ^2 Statistic	13,234	10,979	9,091	4,041	1,777	901
UVBM sample size	125,770	121,147	79,083	38,224	20,647	10,381
Non-UVBM sample size	685,460	223,620	106,190	39,770	21,845	12,248

Note: The metric is the χ^2 test statistic from a global balance test applied to demographic covariates, including age, gender, and race/ethnicity. For all registered voters, age is computed using the date of birth in the voter file. For registered voters who did not provide a gender or title in their voter registration, we obtain a probabilistic assessment of their gender based on their name and age using the *gender* package in R. For registered voters who did not provide a race/ethnicity in their voter registration, we obtain a probabilistic assessment of their race/ethnicity based on their name, age, gender, party, and Census geography using the *wru* package in R.

Table SI.12: Demographic Comparison between Universal and Non-Universal VBM Districts Using Placebo RD

	Non-Perm. VBM Voters		Permanent VBM Voters	
	Estimate	Clustered SE	Estimate	Clustered SE
Age:				
18 to 29	-0.3	0.7	-2.8	1.8
30 to 44	-1.6	1.0	-2.8	1.2
45 to 64	1.1	0.8	2.3	1.1
65 or older	1.1	1.0	3.8	1.6
Gender:				
Female	0.0	0.3	-0.9	0.5
Race/Ethnicity:				
White	4.8	1.8	5.4	2.4
Black	-0.2	1.2	0.6	1.8
Hispanic	-8.3	4.8	-12.7	6.8
Asian	4.9	2.8	7.3	4.1
Other	-0.5	0.3	-0.4	0.4

Note: All results are estimated with the *rdrobust* package in R. Standard errors are clustered at the (congressional and state legislative) district level. Numbers in the figure are percentage points. For all registered voters, age is computed using the date of birth in the voter file. For registered voters who did not provide a gender or title in their voter registration, we obtained a probabilistic assessment of their gender based on their name and age using the *gender* package in R. For registered voters who did not provide a race/ethnicity in their voter registration, we obtained a probabilistic assessment of their race/ethnicity based on their name, age, gender, party, and Census geography using the *wru* package in R.

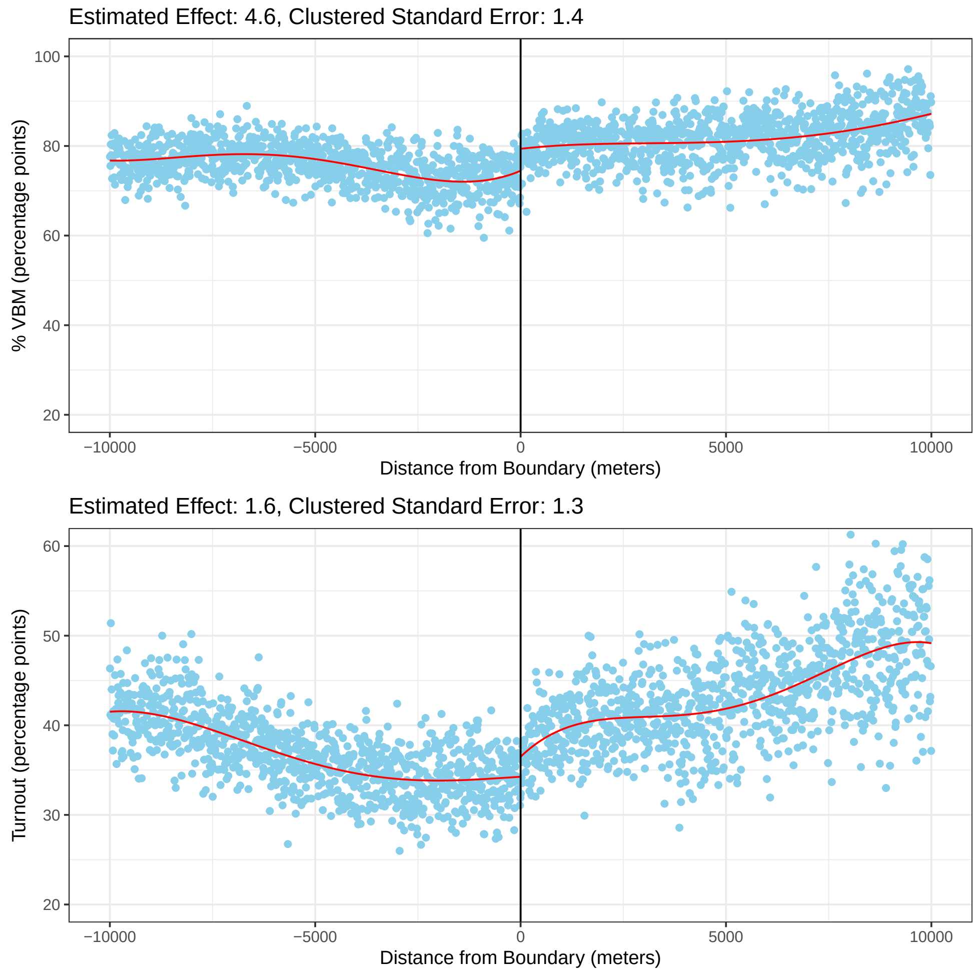
Table SI.13: Balance in Neighborhood Median House Value Before and After Matching

	Non-Perm. VBM Voters		Perm. VBM Voters	
	Treatment	Control	Treatment	Control
Before matching				
10km	547,404	491,670	567,793	513,395
5km	526,358	452,302	542,747	459,568
2km	530,408	452,390	545,087	460,353
1km	509,733	439,826	519,588	446,810
500m	498,060	426,523	506,918	432,403
After matching (demos + house value)				
10km	544,711	542,431	564,186	562,449
5km	524,062	522,356	533,851	528,883
2km	526,351	524,952	532,071	527,659
1km	499,443	497,822	509,283	507,298
500m	493,087	489,833	499,615	496,087
After matching (demos + house value + school districts)				
10km	495,513	488,660	485,248	474,422
5km	482,428	471,237	479,594	476,594
2km	477,487	478,514	482,856	478,809
1km	467,744	466,744	469,032	466,994
500m	447,190	444,387	457,209	449,975

Note: We obtained Census-block-group level median house value from the 2019 American Community Survey (ACS) 5-year estimates. The top panel shows the average neighborhood median house value before matching in treatment and control areas. The middle panel shows the average neighborhood median house value after matching demographics (exact matching) and neighborhood median house value (coarsened exact matching) in treatment and control areas. The bottom panel shows the average neighborhood median house value after matching demographics (exact matching), neighborhood median house value (coarsened exact matching), and school districts (exact) in treatment and control areas.

SI.8. Results from Geographic Boundary-Based Designs

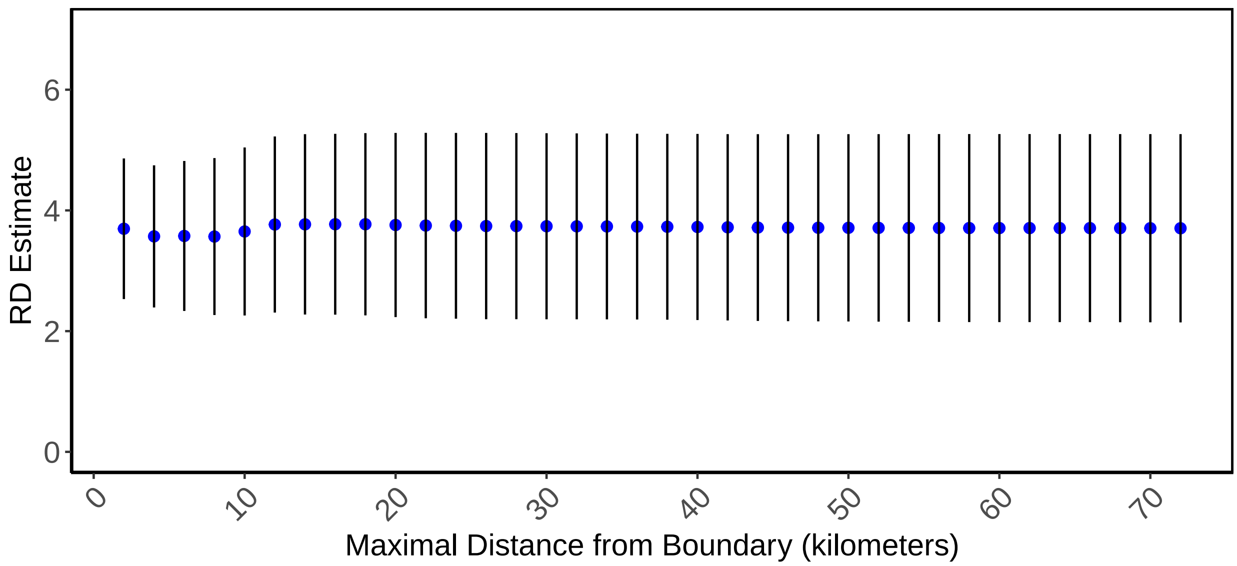
Figure SI.12: RD Estimates (Permanent Absentee Voters)



Note: RD plots and estimates from R package *rdrobust*.

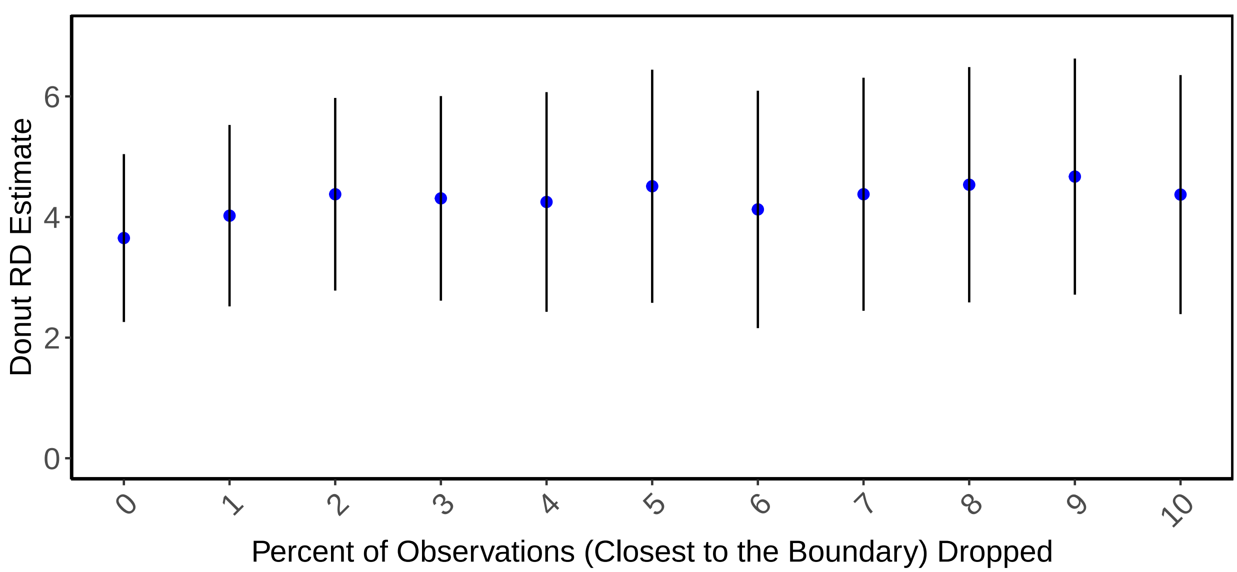
https://doi.org/10.33774/apsa-2021-z1hnm-v2 **ORCID:** https://orcid.org/0000-0003-3855-0756

Figure SI.13: Sensitivity Analysis - Maximal Distance



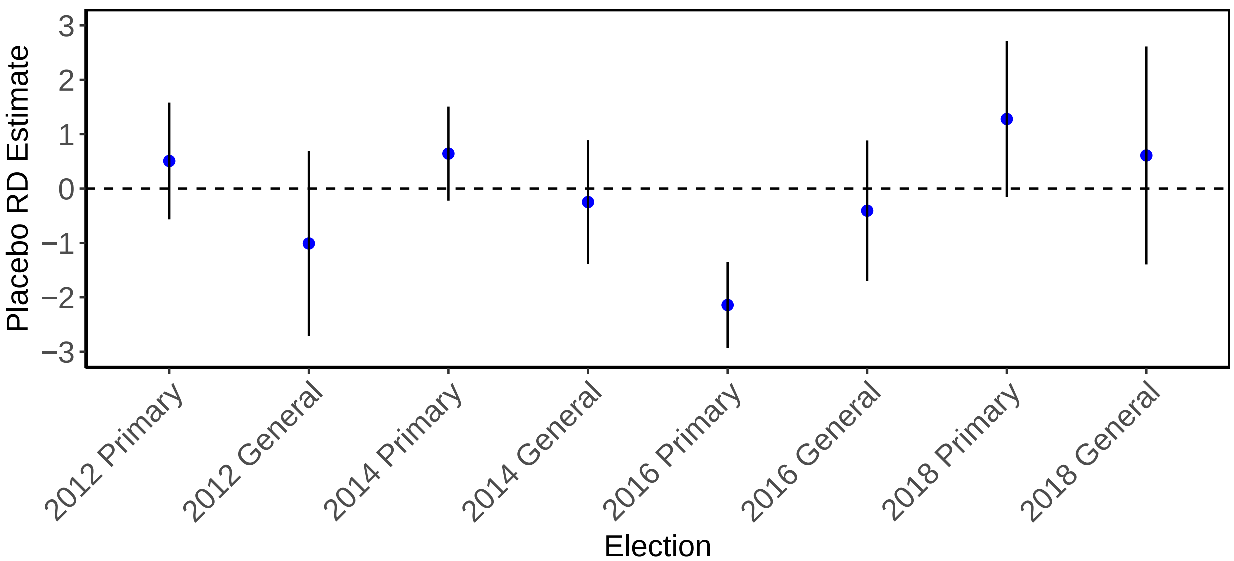
Note: RD estimates from R package *rdrobust*.

Figure SI.14: Sensitivity Analysis - Donut RD



Note: RD estimates from R package *rdrobust*.

Figure SI.15: Sensitivity Analysis - Placebo RD



Note: RD estimates from R package *rdrobust*.