Barriers to Voting Reduce Future Participation Evidence from Rejected Mail-in Ballots

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While voting by mail eliminates some of the costs associated with electoral participation, it also introduces new costs, including the need to complete the ballot correctly, sign the ballot envelope, and cure the ballot if any discrepancies arise. Election officials must validate mail-in ballots, and those with signature mismatches may be rejected unless successfully cured. However, the signature verification process for election administrators to validate mail-in ballots is arbitrary at best, and generates disparities in whose ballots are rejected due to signature mismatches. As mail-in voting becomes more prevalent across the states, ballot verification efforts can reintroduce institutional hurdles to electoral participation. We analyze the demographics of voters whose mail ballots are rejected in Washington and Colorado. We find that younger voters and voters of color are more likely to have their ballots rejected due to a non-matching signature; however, almost half of these rejections are ultimately incorrect and are cured by the voter. Then, we demonstrate that the experience of having a ballot rejected in one election, even if the issue is resolved through ballot curing, reduces the voter's likelihood of participating in subsequent elections. The negative effects on turnout are substantially larger for experienced voters who have previously voted by mail compared to first-time voters. Our findings raise concerns about the arbitrary of signature verification, a core feature of vote-by-mail, and its potential to undermine future electoral participation.

Elections | Voting Rights | Absentee Voting | Voting By Mail

Voting is a fundamental pillar of a democratic society, but how we vote, like the franchise itself, continues to evolve. Over the past two decades, and particularly since the COVID-19 pandemic, voting by mail and other forms of voting beyond in-person on election day (broadly referred to as convenience voting) have increased in popularity (Gronke et al., 2008). Voting by mail may make it easier for voters to participate in the electoral process by reducing the time cost of voting, making ballots more universally accessible, and eliminating challenges involving getting to one's polling place and waiting in line. However, voting by mail also introduces new burdens for the voter. When an individual casts a ballot at their polling place, they can be assured that their ballot has been received and will be counted, and any issues with their ballot can be resolved immediately.[1] When voting by mail, however, the voter must wait until their ballot has been delivered to their election administrator by the U.S. Postal Service or collected from a drop box and processed by the administrator, and then they can typically check their ballot status online. If their ballot of not accepted by the election administrator, the voter may be informed of the issue and then can take additional action to have their vote counted. These additional steps to cast a ballot increase the costs of voting among convenience voters.

While most voters can have their mail-in ballots counted in each election, hundreds of thousands are additionally burdened or fully disenfranchised by the administrative processes of validating mail-in ballots. According to the U.S. Election Assistance Commission, more than 500,000 mail-in ballots from voters were rejected in each of the 2020, 2022, and 2024 general elections.[2] Ballots are rejected for various reasons, including being received after the deadline, errors on the ballot return envelope, or missing information that prevents administrators from processing the ballots correctly. However, hundreds of thousands are rejected not due to any error on the part of the voter but instead due to the arbitrary process of signature verification. While signature verification is intended to protect the integrity of the voting process, it adds an administrative step for voters to have their ballots counted. Signature verification on mail-in ballots is similar to the role of other political institutions in shaping who can participate in an election, such as registration requirements (Erikson, 1981; Rosenstone and Wolfinger, 1978), age requirements (Meredith, 2009), residency requirements (Pettigrew and Stewart III, 2017), and, in some states, identification requirements (Grimmer and Yoder, 2022). These requirements shape the composition of the electorate, determining who can and cannot participate in elections.

States that have universal mail-in voting tend to have higher turnout rates than those that do not. Universal vote-by-mail sends a mail-in ballot to each registered voter

[1]While methods vary across localities, when voting in-person, the voter ultimately submits their ballot for processing, such as by completing an electronic ballot or by feeding a marked paper ballot into a scanning machine.

[2]2020, 2022, and 2024 Election Administration and Voting Surveys, https://www.eac.gov/research-and-data/studies-and-reports.

in the state. In states that implement all-mail voting, participation tends to rise since many of the associated barriers and costs of voting are eliminated (Southwell and Burchett, 2000). In states without universal mail-in voting, access to convenience voting is intended to increase turnout, and since its implementation, it has (McGhee, Paluch, and Romero, 2022; Alvarez and Li, 2024; Thompson et al., 2020). Mail-in voting has reduced turnout disparities in the aggregate composition of the electorate through providing an alternative to in-person voting (Southwell and Burchett, 2000; Thompson et al., 2020). Importantly, mail-in voting does not advantage partisans, which was a primary concern leading up to the 2020 election. If mail-in voting does not contribute to the success of one candidate over another, then ballot rejections could potentially skew the composition of the electorate if applied disproportionately. Disparities in mail-in ballot rejections mirror existing gaps in electoral participation. Examining the 2018 General Election, Shino, Suttmann-Lea, and Smith (2022) finds discrepancies in which ballots are most likely rejected due to the ballot being received later or an error on the return form. Racial and ethnic minority voters were more likely than White voters to have their timely ballots rejected. New registrants are more likely than habitual voters to have their ballots rejected, and younger voters are more likely than older voters to have their ballots rejected. However, rejections occur in less than 2% of the ballots. Not only does this pattern present for racial and ethnic minorities, language minorities, overseas military and civilians, but permanent absentee voters have been shown to cast invalid ballots at greater rates (Alvarez, Levin, and Sinclair, 2012).

This article makes three distinct contributions. First, using information on the signature verification process as implemented in Washington and Colorado, we argue that, conditional on observable demographic factors such as age, ballots rejected for non-matching signatures are essentially random; the voters whose ballots are rejected for non-matching signatures are rejected due to the random process of signature verification, not underlying factors associated with their likelihood to participate in elections. Second, we examine not only the voters disenfranchised by the signature verification process but also those whose ballots are rejected due to non-matching signatures and must undergo the additional administrative burden of curing their ballot to have their vote counted. These burdens make voting more difficult and time-consuming. Third, we demonstrate that the experience of having one's ballot rejected, regardless of whether the ballot is cured or not, reduces the likelihood of voting in the next election. This relationship is especially pronounced among experienced voters who cured their rejected ballots—individuals we would otherwise expect to be highly likely to continue voting in the future, were it not for the experience of having their ballots rejected. Our results demonstrate that in Colorado and Washington, even among the habitual voters, who are most likely to remain engaged, procedural and election administration-related barriers can have long-term consequences for electoral participation.

Importantly, these effects persist across voters types. One concern is that infrequent voters and new voters are qualitatively different. Infrequent voters have opted to participate occasionally and tend to have lower political efficacy compared to more frequent voters. However, new voters often lack the institutional knowledge to navigate the political process and are typically younger than infrequent voters. Both infrequent and new voters have yet to form habits that are pivotal to voting(Plutzer, 2002). We account for these differences through our models, including controls for age and past voting history when distinguishing between new and infrequent voters. This is a convention in studies of voter turnout (Gerber, Green, and Shachar, 2003; Verba, Schlozman, and Brady, 1995). Our models incorporate both demographic controls and robustness checks to ensure that omitted variable bias is minimized. In fact, we account for differences among women, men, younger, and older voters across states and election types. Our main question of inquiry is the potentially demobilizing effects of ballot rejections on future turnout, and thus, both new and old voters may be affected.

Voting as Habit

Voting is a behavior that can become habitual over time (Coppock and Green, 2016; Aldrich, Montgomery, and Wood, 2011). Seminal work in the study of electoral behavior, Campbell et al. (1960, pg. 92), says that voters "develops a general orientation towards politics he comes to incorporate either voting or non-voting as part of his normal behavior." This was further refined to illustrate the psychological underpinnings of voter turnout. Voters are most likely to cast a ballot in an election when the perceived benefits of voting outweigh its costs, a classic tenet of rational choice theory (Aldrich, 1993; Riker and Ordeshook, 1968). Due to the consistent timing of the general elections, when voters vote once, they are more likely to vote again in the future (Gerber, Green, and Shachar, 2003), and this effect can persist up to 20 years (Coppock and Green, 2016). Since voters have already borne the costs of participation in one election, prior voting affects the probability of future voting in subsequent elections. Some contingencies are present in the habit forming of voting due to the election context, and individual attributes, demonstrating both psychological and institutional challenges to voting (Dinas, 2012). Lower-salience elections typically have lower turnout due to the environmental context, which requires more effort from local organizations, campaigns, and election officials to encourage voter participation (Rogers et al., 2017). On the other hand, lower-propensity voters may be deterred by inconveniences that disrupt their voting habits.

Even if voting is a formed habit, casting a ballot requires cognitive effort (Wolfinger and Rosenstone, 1980; Burden and Neiheisel, 2013). If voting isn't a formed habit, small logistical barriers can present an obstacle to voting (Bandura, 1977). Even so, if the performance context of habit is unstable - in our case, the circumstances in which one casts a ballot, this habit can decay over time (Aldrich, Montgomery, and Wood, 2011; Wood, Quinn, and Kashy, 2002). While voting is widely viewed as habit forming, logistical and psychological barriers can disrupt participation in future elections.

Inconveniences associated with voting are common barriers to participation, which can deter both lower- and higher-propensity voters from exercising their voting habit. The inconveniences of in-person voting include transportation to and from the polls, finding one's polling location, scheduling conflicts, and longer wait times. Psychological inconveniences include having a negative experience at a polling place (Pettigrew, 2020), such as an unanticipated wait. Long lines at the polling place can reduce future turnout, and in 2014, at the individual level, this resulted in nearly 1 percentage point of lost turnout for every additional hour of waiting (Pettigrew, 2020, pg.8). Informational gaps can also pose a psychological barrier to voting. The costs of participation are higher if voters lack the appropriate information about the voting process. This suggests that voting, while often understood as a habit-forming behavior (Gerber, Green, and Shachar, 2003), is susceptible to disruption when institutional or procedural barriers increase the cognitive or logistical effort required to participate in the process. Consequently, interventions that lower these barriers—such as mail-in voting, early voting, or same-day registration—are widely considered effective tools for sustaining and increasing turnout across the electorate.

Election administration-related changes also produce institutional barriers for participation. Changing the rules around voting can either mobilize or deter participation, especially for first-time, young, or novice voters (Holbein and Hillygus, 2020). Registering to vote is a multi-step process that requires forms of identification (Rosenstone and Wolfinger, 1978), which is a cost associated with voting. In addition, this requires prior planning, as many states lack same-day registration (Burden and Neiheisel, 2013), pre-registration for adolescents (Holbein and Hillygus, 2020), and other voter identification requirements (Alvarez, Bailey, and Katz, 2008), which can limit who can vote on Election Day. Local election officials and community organizations can mobilize individual voters who lack the motivation to secure information themselves. Local election officials (LEOs) and community-based organizations communicate voting deadlines, provide civic education, and offer other voting literacy resources. But procedural barriers, such as restrictive voter access policies, can limit participation even if informational gaps are overcome. In addition, changes in polling place locations can reduce turnout in elections (Brady and McNulty, 2011). States' legislatures have different motives when implementing restrictive voting access (Bentele and O'Brien, 2013). LEOs can discriminate in their response to inquiring voters, unequally providing information to those seeking to understand the voting process (White, Nathan, and Faller, 2015). Administrative decisions made by legislators can disrupt voter behavior, increase the costs of voting, and decrease the likelihood of turnout.

How Mail-in Voting Affects Participation

Notwithstanding the inefficiencies and burdens associated with in-person voting, mail-in voting — a form of convenience voting — has been adopted by several states as a strategy to reduce barriers to participation and increase voter turnout. However, signature verification on mail-in ballots poses a threat to the convenience of vote-by-mail. Vote by mail reduces the costs of voting, as voters fill out their ballots at their registered address rather than at their assigned polling place. Receiving a ballot in the mail prior to the election also serves as a reminder to vote in the upcoming election. Since the 1990s, more states have adopted mail-in voting under the premise that it expands participation among traditionally low-propensity voters (younger voters, non-White voters, students). Mail-in voting is expected to reduce costs by eliminating the need for time, money, and resources — such as figuring out transportation — to get to the polling place (Brady and McNulty, 2011). The political implications of these reforms are vast. Universal vote by mail increased turnout among *new* voters, more than shifting the behavior of established voters (Thompson et al., 2020). Thompson et al. (2020) finds that states adopting universal vote by mail do not have an advantage for one party. For the presidential and general elections, a large number of ballots are cast, and only a small percentage require resubmission. State analyses by NPR find that, on average, 1% of ballots were rejected during the 2022 general election. Despite representing a relatively small percentage of total ballots cast, ballot rejections can have significant consequences in closely contested elections. While vote-by-mail offers clear advantages to individuals with greater access to time, information, and institutional resources, it can inadvertently disadvantage those who are resource-poor (Berinsky, Adler, and Traugott, 2001). Voters with limited access to reliable mail service, voter education, or assistance navigating complex ballot instructions are more likely to make errors or miss deadlines, increasing the likelihood that their ballots will be rejected. As a result, the benefits of mail-in voting are not distributed evenly, potentially reinforcing existing inequalities in political participation.

Mail-in voting increased in popularity during the COVID-19 pandemic. States sought a solution to reduce in-person voting, limiting the spread of the novel coronavirus. At the height of the pandemic in 2020, several states eased restrictions on absentee voting to increase accessibility (McGhee, Paluch, and Romero, 2022). Connecticut, Delaware, Massachusetts, New Hampshire, New York, Virginia, and South Carolina enacted legislation to expand mail-in voting during the COVID-19 19-pandemic for the 2020 presidential election. However, not all states welcomed increased accessibility as the pandemic waned. States with more restrictive photo-identification policies, such as Texas, discouraged mail-in voting, requiring voters to deliver ballots to drop boxes. In 2020, over 33 laws were enacted to restrict access to voting and make mail-in voting more difficult. Most concerns were related to the potential of voter fraud and protecting the integrity of the voting process.

Despite the expansion of mail-in voting during the pandemic, more restrictions were place on mail-in voting among new states that adopted. According to the Brennan Center for Justice, Arizona, Idaho, Kansas, and Texas implemented new laws that imposed stricter signature requirements for mail-in ballots. Other states limited accessibility to mail-in ballots, restricted voters from receiving assistance in returning a mail-in ballot, shortened the deadline for receiving a mail-in ballot, and shortened the window for applying for a mail-in ballot (Brennan Center for Justice, 2020). With these benefits in mind, jurisdictions that offer mail-in voting have higher turnout (Larocca and Klemanski, 2011; Thompson et al., 2020; McGhee, Paluch, and Romero, 2022). All states, along with DC, offer the option of mail-in voting, though some require a valid reason why voters cannot engage in in-person voting (i.e. absentee voting).

While the COVID-19 pandemic increased mail-in voting in states that had not previously allowed it, other states have a longer history of voting by mail, and several have adopted an all-mail electoral system for all statewide elections. Figure 1a shows the different mail-in voting systems by state. Colorado and Washington are leaders in universal vote-by-mail, which has lowered participation costs for voters while also fostering voting as a habit. Mail-in voting makes voting more convenient (Gronke and Miller, 2012), which is associated with an increase in voting participation among younger voters, low-propensity (or infrequent) voters, and minority voters. This is important because registering to vote by mail is a multi-stage process in states that do not have universal mail voting. For states with universal vote-by-mail, each voter is sent a ballot to their registered address; however, states can vary locally in their election administration. For example, in Colorado, voters may submit completed ballots by mail or deposit them in drop boxes at designated drop-off locations. Local election officials can determine the prevalence and location of these drop-off boxes, which can have unintended consequences for when and how a ballot is counted and a signature is verified. Similarly, in Washington, voters can return ballots by mail or at a designated drop-off site. While universal mail-in voting offers the benefit of convenience, methods of returning the ballot, filling out the ballot without error (and assistance from poll-workers), and the timeliness of returning the ballot during the voting period can increase the costs of voting.

State laws govern the verification process for mail-in ballots, resulting in significant variation across the country. While signature verification is the most common requirement, used in 31 states, ten states require that the envelope be signed, but do not conduct verification. The remaining states require the signature of a witness in addition to the voter's signature or the envelope to be notarized.[3] Figure 1b shows the verification process by state. Each state with a signature verification requirement has its own process for examining signatures to ensure each matches the voter registration record. Ballots that fail this process are rejected because they have mismatched signatures. In two-thirds of the states, voters whose ballots are rejected (for signature matching or other issues) are notified, and given the opportunity to cure their ballot by submitting an affidavit, providing additional identification, or by other means.[4] Figure 1c shows the cure process by state.

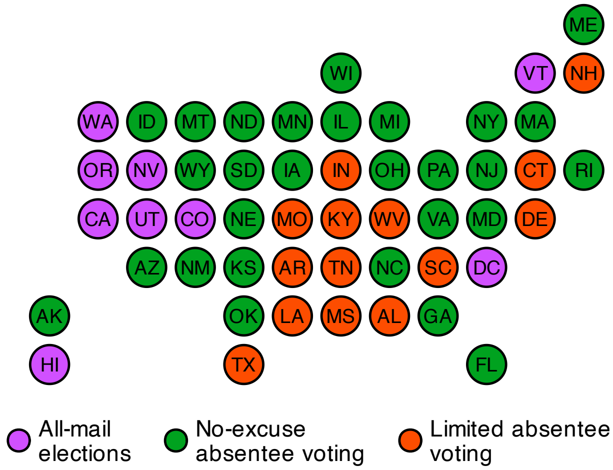
Here, we focus on the states of Washington and Colorado. Since 2011, Washington has had universal mail-in voting, and sends a ballot to every registered voter. Similarly, Colorado has conducted its elections by mail since 2013. In Colorado, all-mail-in voting is associated with decreasing turnout gaps between demographic groups (Bonica et al., 2021). Focusing on Washington and Colorado is advantageous for several reasons. Both states were leaders in adopting universal vote-by-mail, and are experienced in administering elections in this manner at all stages of the process, from distributing ballots to receiving and validating them. Voters in Washington and Colorado are similarly used to voting by mail. In contrast, the COVID-19 pandemic prompted many states to rapidly expand their vote-by-mail capacities, a new experience for both election administrators and voters. We, therefore, have multiple elections of consistently available data, established election laws and procedures, voters who understand the system, and procedures relatively unaffected by the pandemic.

The Process of Signature Verification

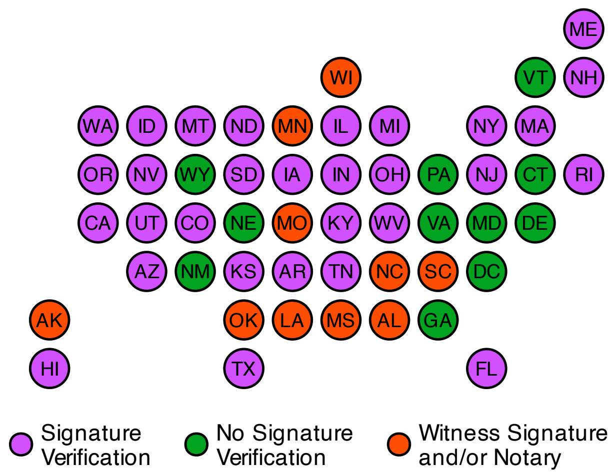
Data on the accuracy of signature verification is limited, and there is little evidence that the practice is accurate at all, let alone at the scale and speed necessary to process

[3] National Council of State Legislatures, "Voting Outside the Polling Place," https://www.ncsl.org/elections-and-campaigns/voting-outside-the-polling-place.

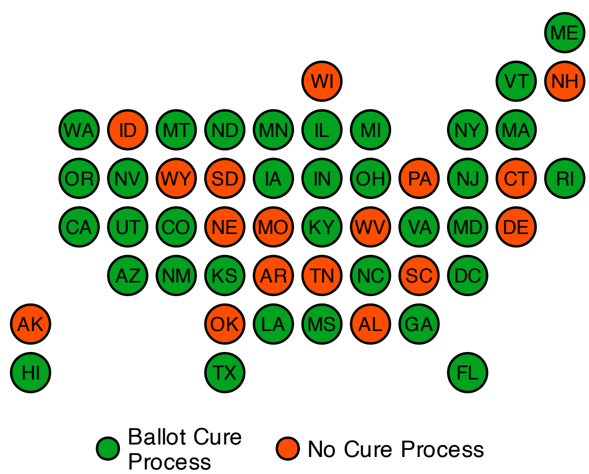
[4] The curing process and the length of time allowed to the voter to cure their ballot up to or after election day varies by state. See National Council of State Legislatures, https://www.ncsl.org/elections-and-campaigns/table-15-states-with-signature-cure-processes.



(a) Voting by mail protocols by state.



(b) Mail-in ballot verification protocols by state.



(c) Mail-in ballot cure process by state.

Fig. 1. Mail-in ballot voting, verification, and cure procedures by state. Source: National Conference of State Legislatures, *Voting Outside the Polling Place: Absentee, All-Mail and Other Voting at Home Options*, 2024.

mail-in ballots. A few stylized facts, often discussed in signature matching litigation, help illustrate this.

First, an individual's signature is not constant, and evolves and changes over time (Office of the Washington State Auditor, 2022; Baringer, Herron, and Smith, 2020; Caligiuri and Mohammed, 2012; Mohammed, 2019). This may happen throughout one's lifetime, as one's signature evolves in early adulthood, and then may change again decades later due to aging (Mohammed, 2019).

Second, signature matching, even when performed by experts, is not reliably accurate. In one case challenging the use of signature verification in Washington, *Vet Voice Foundation, et al., v. Hobbs*, the plaintiffs deposed one of the state's signature matching experts, a "retired Washington State Patrol forensic document examiner responsible for training Washington election officials in signature verification." The expert was asked to verify twelve signatures against a source list, of which nine were real and three were fraudulent. Of the nine real signatures, the expert accepted five and incorrectly rejected four, and incorrectly accepted all three fraudulent signatures, for an overall accuracy rate of 42%.[5]

Third, signature verification, as practiced in the election administration context, is fundamentally different from signature verification as done by professional forensic examiners (but, even then, it may not be very accurate). Professional examiners may need an hour to analyze a simple signature, and multiple hours for a more complicated signature (Mohammed, 2019). Election administrators must analyze signatures in seconds. For example, Washington Secretary of State Steve Hobbs stated that the average signature is verified in approximately three seconds.[6] This is far from sufficient to judge the accuracy of a signature reliably.

Fourth, professional signature matching experts do not validate a signature with a single reference, such as the signature a voter used when registering to vote, but with a larger sample of signatures from each person. Such a set of signatures reduces random variance and allows for more accurate comparisons (Mohammed, 2019). Altogether, the instability of an individual's signature, the unreliability of signature matching by experts, the rapid speed of signature matching, as done by election administrators and not signature verification professionals, during an election, and the lack of multiple signature references, suggest that there is a very high degree of variance in signature verification.

Figure 2 illustrates the challenge of validating signatures using six pairs of signatures from the Washington State Patrol's signature verification training for election

[5] *Voice Foundation, et al., v. Hobbs*, Plaintiffs' Omnibus Opposition To Defendants' Cross Motions For Summary Judgment And Reply In Support Of Plaintiffs' Motion For Summary Judgment, pp.11–12.

[6] *Voice Foundation, et al., v. Hobbs*, Plaintiffs' Omnibus Opposition To Defendants' Cross Motions For Summary Judgment And Reply In Support Of Plaintiffs' Motion For Summary Judgment, p.45

officials. According to the training materials, four pairs were written by the same person, and two by different people.[7] But, it is extremely difficult to determine which signatures are valid and which are fraudulent. In every pair, both commonalities suggest validity and major differences that suggest fraud.

Fig. 2. Pairs of signatures from the Washington State Patrol's signature verification training for election officials. Four pairs were written by the same person, and two by different people.[7]

Finally, and critically from the perspective of election integrity, the signature verification process does not lead to identifying cases of voter fraud or improving the security of elections. Across every ballot rejected for non-matching signatures in both the Washington and Colorado cases, neither the plaintiffs nor the state defendants were able to identify a single case where the person casting the ballot was convicted of or plead guilty to voter fraud. While election administrators referred a very small number of suspicious ballots in Washington to prosecutors for investigation, none led to convictions or guilty pleas.[8] Additionally, the experiences of the District of Columbia, Georgia, Maryland, Nebraska, New Mexico, Pennsylvania, Vermont, Virginia and Wyoming, which have no-excuse absentee voting and no signature verification requirement, show that it is possible to administer elections without this burden on voters.

Who Gets Rejected for Non-Matching Signatures?

Analyzing the individuals whose ballots get rejected for non-matching signatures or other issues is challenging, as most administrative data on election participation, including state voter history files and national voter files compiled by various vendors, do not include this information. Individuals whose ballots were initially rejected and then cured are recorded as voting, while those whose ballots were rejected and not cured are recorded as not voting. Measures of voter participation, then, ignore these attempted voters.

We were able to access individual-level records on ballot rejections and cures for Washington and Colorado through civil litigation challenging signature matching procedures in both states.[9] Both states conduct elections using universal voting by mail, where ballots are mailed to all voters. During each election, both states maintain datasets of the ballots mailed to voters, ballots returned, if the returned ballots have been accepted or rejected, and rejection reasons. Colorado maintains additional data on cured ballots, while in Washington, we were able to identify cured ballots using daily ballot status changes to see if previously rejected ballots were later accepted. We focus on the 2020, 2022, and 2024 general elections.

We combine these data sets on ballot status with the state voter registration files to also identify all registered non-voters in each election. We used the residential zip code of each voter and their surnames to estimate race and ethnicity probabilities for each voter using the `birdie` package (McCartan et al., 2024; Imai and Khanna, 2016).[10] The voter registration files also include gender, and we calculate age using the year of the election and the voter's birth year.

Disparities in Rejections for Non-Matching Signatures

Overall, 235,230 voters (1.2%) had their ballots initially rejected for a non-matching signature in Colorado and Washington in the 2020 and 2022 primary and general elections.[11] Of these, about half cured their ballots and

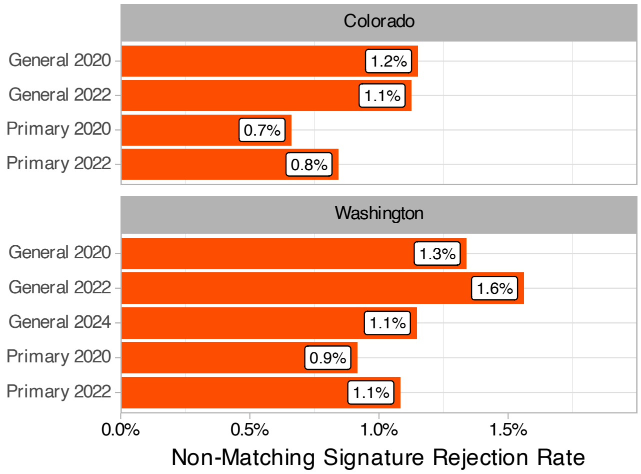
[7] Signatures (a), (b), (d), and (e) were written by the same person and signatures (c) and (f) were written by different people.

[8] *Voice Foundation, et al., v. Hobbs*, Plaintiffs' Omnibus Opposition To Defendants' Cross Motions For Summary Judgment And Reply In Support Of Plaintiffs' Motion For Summary Judgment, pp.4–10.

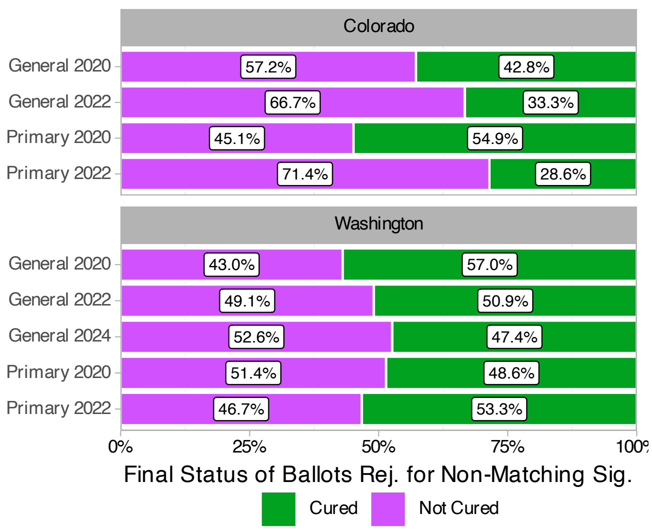
[9] *Vet Voice Foundation, et al., v. Hobbs, et al.* (No. 22-2-19384-1 SEA), King County Superior Court, Washington and *Vet Voice Foundation, et al., v. Griswold* (No. 2022CV033456), District Court, City and County of Denver, State of Colorado. Palmer submitted expert reports and testified by deposition in both matters.

[10] The probability that each voter was White, Black, Hispanic, AAPI, or Other. We do not classify individual voters into a single racial group, but, following best practices, rely on these probabilities in our estimates (DeLuca and Curiel, 2023). When we estimate the number of voters by race, we do so by aggregating probabilities across voters. We used a variety of data to estimate the race of each voter, including geocoding the residential addresses of each voter to their census blocks, and including first names, birthdates, and gender. The selection of variables did not substantially affect our race estimates or results.

[11] We do not have data on rejections and cure statuses for Colorado in 2024, as the state only produces data on the final outcome of each ballot (not initial rejections).



(a) Voting by mail protocols by state.



(b) Mail-in ballot verification protocols by state.

Fig. 3. Overall rejection rates and cure rates for non-matching signatures.

had their votes ultimately counted and the signature matching process disenfranchised half. Figure 3 shows the ballot rejection and cure rates for each election where we have complete data on initial and final ballot rejections in each state.

We measure disparities in rejections by comparing the rejection rate for each demographic group to the average rejection rate (for initially rejected ballots, cured ballots, and uncured ballots). Comparing the ratios of the group rejection rate to the average rejection rate makes it easy to analyze relative disparities across groups, as well as across separate states and elections, where baseline rates will vary.

Figure 4 presents disparities in who gets rejected for a ballot with mismatched signatures by age, voter experience, race, and gender for the 2020 general election. For each variable, there are three panels. The upper panel shows the distributions of the initial rejections, which include voters who eventually cure their ballots and those who do not. The lower panels divide the rejections by the final rejection status. Each bar corresponds to the relative rejection rate for the group compared to the statewide average, such that bars below one indicate that voters in the group are *less* likely to have their ballots rejected for mismatched signatures, and bars above one indicate that voters are *more* likely to have their ballots rejected.

We find significant differences in initial rejection rates by race, previous voting experience, age, and gender.[12] Black, Hispanic, Asian, and Other voters are all more likely to have their ballots rejected for non-matching signatures than White voters. In the 2020 general election, voters of color were more than one-and-a-half times as likely to have their ballots rejected as White voters. As a result, they are disproportionately represented among the voters whose ballots were rejected; voters of color made up 23.4% of all voters, but 31.9% of voters with ballots rejected for non-matching signatures.

We find even larger disparities across age groups. Younger voters are much more likely to have their ballots rejected for non-matching signatures than older voters. In the 2020 general election, voters aged 18 to 21 were 3.7 times more likely, voters aged 22-30 were 2.2 times more likely, and voters aged 31-40 were 1.3 times more likely to have their ballots rejected than voters over 40. Overall, in the 2020 general election, voters 40 and under were more than four times as likely to have their ballots initially rejected as voters over 40; voters 40 and under made up 35.6% of voters with accepted ballots, but 70.2% of voters with ballots rejected for non-matching signatures.

We also find significant disparities based on previous voting experience (i.e. first-time or established voters). Voters who successfully cast a ballot in at least one previous election were significantly less likely to have their ballots rejected for non-matching signatures. Across Washington and Colorado, new voters made up 11.3% of voters with accepted ballots, but 39.4% of voters with ballots rejected for non-matching signatures. While voter experience is strongly correlated with age, disparities persist by experience, conditional on age group, and by age, conditional on experience.

Finally, we find smaller, yet statistically and substantively significant, differences by gender. While the differences in relative rates of rejection are much smaller than those we find for age and experience, and somewhat smaller than the racial disparities, male voters were 1.3 times more likely to have their ballots rejected than female voters.

[12] All differences discussed here are statistically significant. Logistic regression results, where we predict having a ballot rejected due to a mismatched signature, are presented in Tables SI2–SI3. These results include predicted race probabilities, age, previous voting experience, gender, and county fixed effects for each state and election.

Fig. 4. Relative rejection rates in ballots rejected for non-matching signatures by voter demographics in the 2020 general election. Bars above one indicate higher rates of rejection for the group relative to the average, and bars below one indicate lower rates of rejection.

The lower panels of Figure 4 divide the rejections into two groups: voters who cured their ballots and voters who did not cure their ballots. Across all four panels, the observed disparities remain; voters of color, younger voters, new voters, and men are much more likely to have their ballots rejected for non-matching signatures, regardless of whether they cured their ballots or not. However, the magnitude of the disparities is reduced among those who cured their ballots relative to those who did not. The burden of having to cure their ballots to have their votes counted still fell disproportionately on voters of color, young people, and new voters. However, the disparities among those voters who cured their ballots after an initial rejection are much larger among those whose ballots were ultimately rejected by the signature matching process. For example, the youngest voters (age 19-21) likely participating in their first election, show a wide gap between those who cure and don't cure their ballot. The same is evident for first-time voters across the age continuum. The panel in Figure 4 labeled "Cured: Experience" and "Not Cured: Experience," we observe that a greater share of new voters, more than previous voters, fail to cure their ballot. Similarly, in the bottom panel of Figure 4 labeled "Cured: Race" and "Not Cured: Race" we observe that more voters, relative to White voters, do not cure their rejected ballot. For some, rejected ballots are not rectified, and these disparities vary by demographic characteristics such as age, race, and gender, but also between habitual and new voters.

In addition to these demographic differences, we find differences in rejection rates based on the individual's name. Voters with longer first and last names (as measured by the number of characters) are more likely to be rejected for non-matching signatures. We also measure the frequency of each first and last name by examining the number of voters participating in the election for each state. For each name, we calculate a percent rank of the frequency of the name, ranging from 0 (very few voters have this name) to 1 (the most common name). We find significant negative correlations between first name rank and rejections; the more common a voter's first name, the less likely they are to be rejected. However, we find no such correlation for surnames. Given the strong relationship between first names and rejections, we also estimated a model using first name fixed effects for the most common (percent rank greater than .9) first names. Even controlling for first names, the demographic disparities in rejection rates remain.

Who Cures Rejected Ballots?

Interpreting differences in disparities between voters who cured and did not cure their ballots is complicated by the problem of self-selection: conditional on having one's ballot rejected for a non-matching signature, which voters choose to complete the cure process to have their ballots counted? For example, older voters are much less likely to have their ballots rejected for a non-matching signature. But, once rejected, they are more likely to cure their ballots. Figure 5 presents the average marginal effects of a logistic regression predicting which voters cured their ballots in the 2020 general election following a rejection for a non-matching signature.[13]

First, we find that voters who are 31 or older are more likely to cure their ballots than those aged 18 to 30. Across both states, older voters are more likely to rectify rejected signatures than younger voters. Overall, the average marginal effect is positive, and voters aged 50+ reliably cure their ballots more than younger voters.

Second, experienced voters are more likely to cure their ballots than new voters. The second panel in Figure 5 demonstrates a nearly 10% decrease in curing among new voters relative to experienced voters.

Regarding race, we find significant differences between White voters and voters of color. The third panel of Figure 5 demonstrates that voters who are Black, Hispanic, Asian, or Other are less likely to cure their ballots than White voters.

Lastly, female voters are more likely to cure than male voters. However, this is a substantively small difference between women and men. The largest gaps occur between age groups, race, and previous experience. To what extent do these disparities linger to shape future participation in the *next* electoral cycle?

Future Participation

The political science and election administration literature, largely based on aggregate data or estimated voter burdens (Biggers and Smith, 2020), suggests that facing a barrier to voting discourages future participation. In this section, we utilize turnout data from 2018 to 2024 to estimate the impact of having one's ballot rejected in a prior election on turnout in a subsequent election. For Washington, we examine the effects of rejection in 2020

[13]Table SI4 presents the full logistic regression results, and Table SI5 presents the average marginal effects.

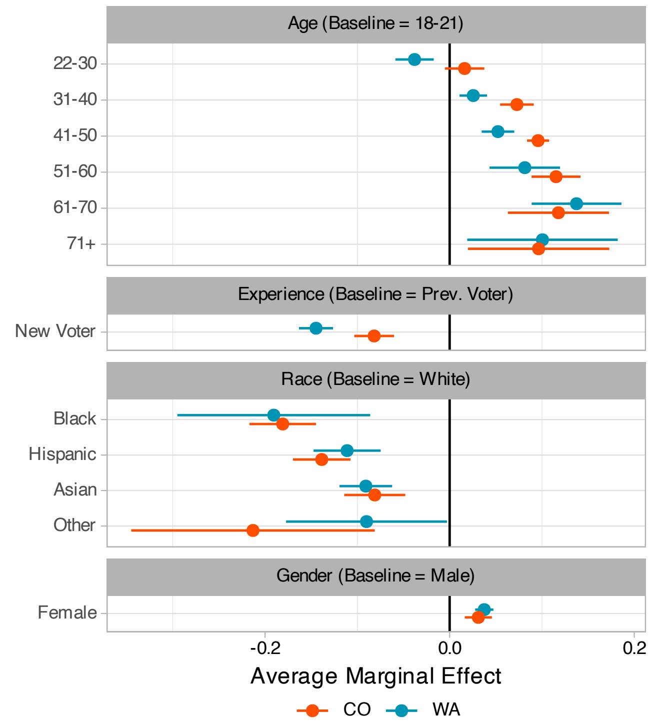


Fig. 5. Average marginal effects of demographic variables predicting curing a ballot, conditional on a rejection for a non-matching signature, for the 2020 general election. Standard errors clustered by county; county fixed effects omitted.

or 2022 on subsequent on participation, and for Colorado we examine the effects of rejection in 2018, 2020, or 2022.

To examine the potential effects of ballot rejections on future voting, we estimate models that examine the participation of voters who attempted to participate in an election at time t_1 and their participation in a subsequent election at time t_2. To do so, we focus only on the voters from election t_1 who remain registered to vote at t_2, excluding voters who have moved away, died, or been removed from the voter registration file for any other reason, as well as any new voters since time t_1 from the analysis. We include controls for age, predicted race probabilities, gender, and past voting experience, defined as voting in an election prior to t_1. We also estimate separate models for new voters and voters with past voting experience. Tables SI6–SI8 presents the full logistic regression results, and Figure 6 and Table SI9 shows the average marginal effects of having to cure a ballot for a non-matching signature or having a ballot rejected for a non-matching signature in the previous election on voting in the next election.

Figure 6 shows that both kinds of ballot rejections are negatively associated with future election participation. In the 2020 general election in Washington, voters who cured their ballots for a non-matching signature, despite having their ballots ultimately counted, were 4.7 percentage points less likely to vote in the next election than voters whose ballots are immediately accepted. Those who did not cure their ballots were 22.6 percentage points less likely to vote in the next election. Similarly, in the 2020 general election in Colorado, voters who cured their ballots were 2.2 percentage points less likely to vote in the next election than voters whose ballots are immediately accepted. Those who did not cure their ballots were 18.3 percentage points less likely to vote in the next election. These findings demonstrate that having a ballot requiring curing initially decreases the likelihood of voting in future elections. Negative experiences with casting a ballot can discourage completing future ballots.

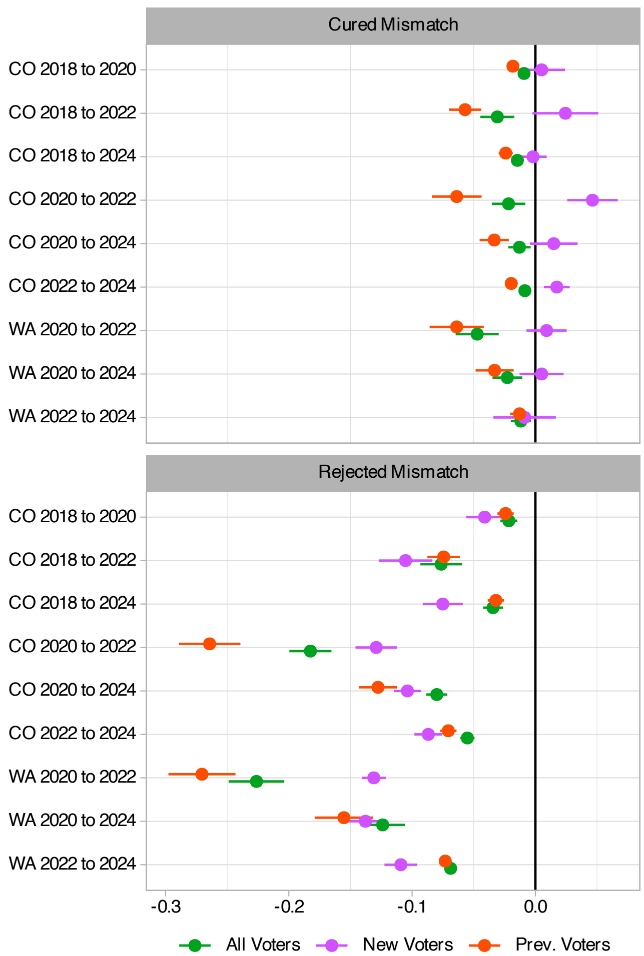


Fig. 6. Average marginal effects of ballots rejected for non-matching signatures on voting in the next election. Logit models include controls for age, predicted race probabilities, voter experience (for all voters model), gender, and county fixed effects. Standard errors clustered by county.

We expected this negative effect of ballot rejections to be concentrated among new voters, considering these voters have not participated in elections before, and the additional steps to cast a ballot are particularly demobilizing and discouraging. However, we find smaller negative effects among new voters than among experienced voters. That is, there is a larger negative effect on the future participation of experienced voters. One explanation is the substantial drop-off among all new voters between the 2020 and 2022 general elections. Among first-time voters in 2020, only 33% voted in 2020, compared to 76% of experienced voters in 2020. Additionally, the null results on cured ballots for new voters may be due to the smaller share of new voters who cured their ballots. Among new voters, only 45% of those with rejected ballots cured their ballots, compared to 63% of experienced voters.[14]

What explains the decline among experienced voters? The larger effects on experienced voters are particularly interesting because, as a population with a history of voting, we would expect them to continue voting in the future and be less likely to be deterred than new voters. Voting is habit forming (Gerber, Green, and Shachar, 2003; Plutzer, 2002). Our results suggest that voting habit formation may hinge on the same method of voting, and not a process that varies in a changing electoral administrative landscape. If how a voter casts a ballot shifts, can we count on the habit of voting to persist? Fujiwara, Meng, and Vogl (2016) shows that rainy days serve as a transitory shock, increasing the costs of voting, decreasing participation. Similarly, the type of election may disrupt voting habits. Voters tend to be less enthusiastic in less competitive elections, which can result in lower overall turnout. This disrupts the formation of voting habits among experienced voters (Franklin and Hobolt, 2011). The additional step of ballot curing can be especially disruptive for voters who have not previously done so.

Furthermore, the negative effect of ballot rejections, for experienced voters and all voters overall, is durable across multiple elections. In Colorado, we find that voters whose ballots were rejected for a mismatched signature in

[14]The positive coefficient on new voters who cured their ballots in 2020 in Colorado voting at higher rates in 2022 is puzzling. This may be partially due to the very low baseline participation of new voters in 2020, participating in the 2022 election overall, but this result is still the opposite of what we would expect.

2018 voted at lower rates in the 2020, 2022, and 2024 general elections than voters whose ballots were not rejected. Even among Colorado voters who cured their rejected ballots in 2018 we find a small but durable negative effect across the three subsequent elections. Similarly, in Washington, we find that voters whose ballots were rejected in 2020 were 22.6 percentage points less likely to vote in 2022 and 12.4 percentage points less likely to vote in 2024.[15]

Ballot rejections for non-matching signatures are not purely random, as they correlate with age, race, gender, and voter experience. There may be other unobservable characteristics of some voters that increase their likelihood of having their ballots rejected due to non-matching signatures and reduce their probability of voting in future elections. However, the negative results for experienced voters who cured their ballots, even after controlling for age, race, and gender, suggest that this is unlikely to be the case. This population is distinctive because they are high propensity voters. They have voted in the past, even before the introduction of universal vote-by-mail. Not only did these voters attempt to vote in 2020, but, after having their ballots rejected, they submitted the additional paperwork to have their ballots successfully cured. In comparison to the voters whose ballots were accepted immediately, the voters in the group should be at least as likely, if not more likely, to be voters in the future based on the effort they expended to vote in the 2020 election. Similarly, the negative results for experienced voters who did not cure their ballots are also interesting because they represent a population who were also high-propensity voters. However, our results have demonstrated that ballot curing limits the participation of returning voters, as those who cured their rejected ballots are less likely to participate. This additional effort of curing the rejected ballot can demobilize and reduce future participation.

Conclusion

Signature verification is a largely arbitrary process that, by its nature and the sheer scale of the task for election administrators, necessarily has a high degree of randomness. While there is no evidence that signature verification reduces voter fraud, our results demonstrate a clear cost to the verification process. Signature verification, conducted by election officials, and ballot curing, which requires voter action, can create burdens that ultimately discourage participation in future elections. Regarding signature verification, administrative bias towards mismatched or nearly identical signatures can lead to the rejection of a mail-in ballot, which in turn deters future participation. This rejection occurs at the nexus of institutional and psychological barriers to participation, as voters who fail to rectify an error tend to withdraw from formal political participation overall. These disparities in ballot curing and ballot rejection reflect broader patterns of administrative barriers, wherein individuals with fewer informational and institutional resources are more likely to be disqualified from the political process.

This paper makes several contributions to understanding the implementation and administration of mail-in voting. In sum, our findings highlight the long-term consequences of institutional barriers introduced by the signature verification process in universal mail-in voting systems in Colorado and Washington. The paper shows that ballot rejections for non-matching signatures are, conditional on observable demographics such as age, essentially random, reflecting the subjectivity and inconsistency of the verification process rather than underlying differences in voter behavior. Voter error is not the primary cause of rejection, but the verification process rejects voters at random. Due to this, voters have to take additional steps to remedy the rejection. This burden of curing a rejected ballot imposes additional administrative costs on voters, making the act of voting more onerous and time-consuming. Crucially, we find that the experience of ballot rejection—regardless of whether the voter ultimately cures the ballot—reduces the likelihood of future electoral participation. This deterrent effect is especially pronounced among experienced voters who have historically been reliable participants in elections. These results underscore the need to reassess the implementation and consequences of signature verification procedures, as they may produce unintended effects. Even among habitual voters, administrative barriers can erode engagement and have lasting effects on turnout, raising questions about the effectiveness of current vote-by-mail practices in enhancing democratic access and participation. Voting begets voting; therefore, habitual voters should have been less likely to withdraw due to changes in the electoral process (Aldrich, Montgomery, and Wood, 2011). These long-term costs, as well as the costs of curing ballots, have been overlooked by prior studies of rejected mail-in ballots, suggesting that the costs of signature matching may be substantially understated.

Our paper highlights the disparities in the applicability of the curing process in Washington and Colorado between 2020 and 2024. Texas voters experienced a decline in participation went their ballots were rejected due to changes in SB1 (Miller et al., 2024), and so did voters in Georgia (Shino, Suttmann-Lea, and Smith, 2022). We find that even when voters are offered the opportunity

[15] We confirm these results using a matching analysis. Using coarsened exact matching, we define the treatment as being rejected for a non-matching signature in the previous election, and the outcome as voting in the subsequent election, and match on age, predicted race probabilities, voter experience, and either county or zipcode. Given the large population of untreated units (voters whose ballots were accepted), we can achieve a highly balanced sample on all variables for more than 95% of our treated voters in each state and election. We then estimate logistic regressions, interacting treatment with all matched variables. We find treatment effects consistent with the logistic regressions in Table SI6.

to cure ballots, the process of rejection decreases participation in future elections. Further, our paper examines convenience voting in states that were not previously subject to clearance under the Voting Rights Act of 1965. The emphasis on states with a prior history of discrimination is important, yet it may not be generalizable to non-Section 5 states. By focusing on fraud prevention or the uptake of mail-in voting, prior studies often overlook how the experience of ballot rejection—and the subsequent requirement to engage in the curing process—can erode trust in the electoral system, especially among first-time or low-propensity voters. The emotional and psychological toll of having one's vote discounted, combined with the bureaucratic hurdles required to validate it after rejection, can discourage future participation and amplify feelings of disenfranchisement.

This disparity in ballot curing and decrease in future participation among previously rejected voters produces a gap in participation among voters that community organizations are left to resolve. Voters who lack access to timely notifications, digital literacy, or adequate voter education are more likely to be unaware that their ballot has been rejected, let alone understand how to cure it within the deadline. As a result, the true costs of signature matching procedures extend beyond a single election cycle, potentially depressing turnout over time and entrenching participatory inequalities. Thus, studies that assess the cost-benefit calculus of vote-by-mail reforms without accounting for these downstream effects risk substantially understating the harms introduced by signature verification policies. Community-based organizations and local election officials are already overburdened, with responsibilities and limited capacity, which may deprioritize their ability to engage in comprehensive civic education. This highlights the need for additional resources to address a potential area of voter disenfranchisement. As partisan polarization and political competitiveness increase, new tactics to sway the electorate can emerge through electoral administration practices. While not all election administration rule changes have an impact on the election winner (Grimmer and Hersh, 2024), the demobilizing effects for experienced voters, including those who cast their ballots, suggest that the process may increase the cost of voting and reduce electoral participation.

Building on these findings, it is crucial to consider how the process of signature verification in states with universal vote-by-mail can reintroduce disparities among groups in American electoral politics. As vote-by-mail expands through the states, electoral reforms aimed at increasing access through vote-by-mail may unintentionally reproduce structural barriers if the verification and curing processes are not simultaneously reformed. Addressing these disparities of signature verification requires greater transparency, uniform standards for signature matching, and proactive voter outreach to ensure that the benefits of mail-in voting are equitably realized. Ultimately, our results demonstrate that the verification process can have deleterious effects on future participation. The mechanism producing this drop-off is likely a decrease in political efficacy, trust, and voter confidence. Voters who lack trust in the political process can erode their overall feelings of satisfaction with the democratic process (Norris, 2014).

As there is little evidence to suggest that including signature verification enhances election integrity or voter turnout, it is worthwhile to reevaluate the necessity of this verification process. Such additional costs of voting are not necessary for effective election administration and voting by mail. Eleven states, including electoral battlegrounds such as Pennsylvania and Virginia, process their mail-in ballots without validating voter signatures, and we are aware of no evidence that voter fraud is higher in these states as a result. If the signature matching process burdens, disenfranchises, and discourages voters, without providing a clear benefit to election integrity or the voting process, then it may be time to reconsider its role in voting by mail.

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Supplemental Information

Table SI1: Ballots Rejected for Non-Matching Signatures

State	Election	Initial Rejection Rate	Final Rejection Rate	Cure Rate
Colorado	General 2018	0.71%	0.49%	30.66%
Colorado	Primary 2018	—	0.48%	—
Colorado	Coordinated 2019	0.57%	0.42%	26.40%
Colorado	General 2020	1.15%	0.66%	42.78%
Colorado	Presidential Primary 2020	0.99%	0.65%	34.61%
Colorado	Primary 2020	0.66%	0.30%	54.90%
Colorado	Coordinated 2021	0.76%	0.57%	25.26%
Colorado	General 2022	1.13%	0.75%	33.33%
Colorado	Primary 2022	0.84%	0.60%	28.56%
Washington	General 2020	1.34%	0.58%	56.99%
Washington	Primary 2020	0.92%	0.47%	48.56%
Washington	General 2022	1.56%	0.77%	50.95%
Washington	Primary 2022	1.08%	0.51%	53.29%
Washington	General 2024	1.15%	0.60%	47.39%

Table SI2: Logistic Regressions Predicting Initial Rejections for Non-Matching Signatures, General Elections

	Colorado			Washington		
	General 2020	General 2022	General 2024	General 2020	General 2022	General 2024
Prob. Black	0.461	0.409	0.618	0.534	0.307	0.464
	(0.053)	(0.049)	(0.086)	(0.080)	(0.044)	(0.099)
Prob. Hispanic	0.366	0.302	0.443	0.323	0.267	0.317
	(0.057)	(0.031)	(0.086)	(0.034)	(0.038)	(0.041)
Prob. Asian	0.507	0.425	0.519	0.400	0.298	0.371
	(0.055)	(0.047)	(0.086)	(0.026)	(0.014)	(0.027)
Prob. Other	-0.025	0.046	0.344	-0.252	0.087	0.236
	(0.249)	(0.302)	(0.153)	(0.126)	(0.091)	(0.106)
Age 22-30	-0.251	-0.534	-0.519	-0.244	-0.430	-0.317
	(0.031)	(0.077)	(0.076)	(0.033)	(0.057)	(0.021)
Age 31-40	-0.623	-1.042	-1.099	-0.683	-0.945	-0.876
	(0.046)	(0.086)	(0.056)	(0.038)	(0.050)	(0.028)
Age 41-50	-0.963	-1.429	-1.403	-1.050	-1.352	-1.269
	(0.054)	(0.084)	(0.053)	(0.043)	(0.040)	(0.044)
Age 51-60	-1.487	-1.883	-1.847	-1.513	-1.819	-1.696
	(0.063)	(0.066)	(0.048)	(0.042)	(0.054)	(0.068)
Age 61-70	-1.953	-2.463	-2.348	-2.113	-2.482	-2.310
	(0.091)	(0.073)	(0.064)	(0.069)	(0.071)	(0.077)
Male	0.329	0.305	0.435	0.275	0.271	0.287
	(0.029)	(0.023)	(0.015)	(0.026)	(0.040)	(0.034)
New Voter	1.470	1.594	1.596	0.760	0.593	1.123
	(0.047)	(0.029)	(0.062)	(0.071)	(0.082)	(0.054)
First Name Length	0.016	0.012	0.015	0.015	0.016	0.016
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.007)
Surname Length	0.020	0.021	0.022	0.020	0.011	0.016
	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)
First Name Rank	-0.229	-0.243	-0.244	-0.247	-0.199	-0.241
	(0.041)	(0.031)	(0.041)	(0.029)	(0.037)	(0.045)
Surname Rank	-0.002	-0.010	0.034	-0.028	-0.033	-0.021
	(0.020)	(0.021)	(0.018)	(0.011)	(0.013)	(0.011)
N	3,301,479	2,551,373	3,266,661	4,079,168	3,079,262	3,992,705
Pseudo R2	0.135	0.162	0.174	0.088	0.093	0.122

Table SI3: Logistic Regressions Predicting Initial Rejections for Non-Matching Signatures, Primary Elections

	Colorado		Washington	
	Primary 2020	Primary 2022	Primary 2020	Primary 2022
Prob. Black	0.262	0.175	0.440	0.202
	(0.064)	(0.069)	(0.096)	(0.090)
Prob. Hispanic	0.215	0.294	0.314	0.296
	(0.067)	(0.062)	(0.035)	(0.044)
Prob. Asian	0.200	0.207	0.485	0.255
	(0.205)	(0.102)	(0.045)	(0.019)
Prob. Other	0.115	0.027	-0.004	0.145
	(0.293)	(0.618)	(0.137)	(0.235)
Age 22-30	-0.281	-0.543	-0.342	-0.526
	(0.052)	(0.096)	(0.058)	(0.090)
Age 31-40	-0.619	-1.040	-0.881	-1.123
	(0.092)	(0.090)	(0.056)	(0.064)
Age 41-50	-0.882	-1.480	-1.297	-1.486
	(0.101)	(0.093)	(0.053)	(0.069)
Age 51-60	-1.340	-2.027	-1.840	-2.029
	(0.114)	(0.061)	(0.076)	(0.073)
Age 61-70	-1.757	-2.626	-2.448	-2.662
	(0.214)	(0.044)	(0.068)	(0.091)
Male	0.288	0.386	0.310	0.274
	(0.024)	(0.029)	(0.017)	(0.025)
New Voter	1.525	1.504	0.218	0.282
	(0.131)	(0.042)	(0.066)	(0.101)
First Name Length	0.009	0.026	0.016	0.017
	(0.006)	(0.005)	(0.007)	(0.003)
Surname Length	0.013	0.033	0.021	0.020
	(0.006)	(0.003)	(0.005)	(0.006)
First Name Rank	-0.230	-0.286	-0.243	-0.187
	(0.049)	(0.032)	(0.034)	(0.044)
Surname Rank	-0.002	0.005	-0.044	0.006
	(0.034)	(0.017)	(0.014)	(0.018)
N	1,606,949	1,232,463	2,526,100	1,952,148
Pseudo R2	0.141	0.157	0.088	0.093

Table SI4: Logistic Regressions Predicting Curing Rejection for Non-Matching Signatures

	Colorado		Washington		
	General 2020	General 2022	General 2020	General 2022	General 2024
Prob. Black	-0.934	-0.925	-0.836	-0.537	-0.739
	(0.108)	(0.186)	(0.242)	(0.066)	(0.161)
Prob. Hispanic	-0.689	-0.505	-0.484	-0.367	-0.329
	(0.083)	(0.096)	(0.080)	(0.070)	(0.040)
Prob. Asian	-0.405	-0.124	-0.396	-0.315	-0.373
	(0.086)	(0.062)	(0.062)	(0.081)	(0.034)
Prob. Other	-1.139	-0.520	-0.393	-0.312	-0.445
	(0.428)	(0.424)	(0.193)	(0.244)	(0.183)
Age 22-30	0.080	0.144	-0.163	0.083	0.001
	(0.054)	(0.037)	(0.045)	(0.048)	(0.045)
Age 31-40	0.356	0.454	0.111	0.373	0.188
	(0.047)	(0.069)	(0.033)	(0.076)	(0.045)
Age 41-50	0.468	0.473	0.229	0.467	0.176
	(0.030)	(0.075)	(0.040)	(0.046)	(0.037)
Age 51-60	0.564	0.478	0.360	0.613	0.325
	(0.067)	(0.051)	(0.089)	(0.045)	(0.059)
Age 61-70	0.577	0.763	0.625	0.889	0.470
	(0.139)	(0.101)	(0.123)	(0.054)	(0.075)
Male	-0.153	-0.145	-0.166	-0.068	-0.097
	(0.037)	(0.028)	(0.023)	(0.028)	(0.018)
New Voter	-0.399	-0.197	-0.622	-0.382	-0.297
	(0.055)	(0.042)	(0.039)	(0.064)	(0.070)
N	37,558	28,245	54,652	48,095	45,779

Table SI5: Average marginal effects for curing ballots for non-matching signatures, 2020 general election. County fixed effects omitted. Standard errors clustered by county.

	Colorado		Washington	
Term	Estimate	95% CI	Estimate	95% CI
Age (Baseline = 18-21)				
22-30	0.0162	(-0.005, 0.038)	-0.038	(-0.059, -0.017)
31-40	0.0729	(0.055, 0.091)	0.0256	(0.011, 0.040)
41-50	0.0958	(0.084, 0.108)	0.0523	(0.035, 0.070)
51-60	0.1153	(0.089, 0.142)	0.0814	(0.043, 0.120)
61-70	0.1179	(0.063, 0.173)	0.1375	(0.089, 0.186)
71+	0.0964	(0.020, 0.173)	0.1006	(0.019, 0.182)
Experience (Baseline = Prev. Voter)				
New Voter	-0.0818	(-0.103, -0.060)	-0.1448	(-0.163, -0.126)
Race (Baseline = White)				
Asian	-0.0811	(-0.114, -0.048)	-0.0908	(-0.119, -0.062)
Black	-0.1809	(-0.217, -0.145)	-0.1906	(-0.295, -0.086)
Hispanic	-0.1386	(-0.170, -0.107)	-0.1111	(-0.147, -0.075)
Other	-0.2131	(-0.345, -0.081)	-0.0901	(-0.177, -0.003)
Gender (Baseline = Male)				
Female	0.0311	(0.016, 0.046)	0.0375	(0.028, 0.047)

Table SI6: Logistic Regressions Predicting Future Voting After Ballot Rejection for Non-Matching Signatures — All Voters

	Colorado						Washington		
	2018 to 2020	2018 to 2022	2018 to 2024	2020 to 2022	2020 to 2024	2022 to 2024	2020 to 2022	2020 to 2024	2022 to 2024
Cured Mismatch	-0.294***	-0.262***	-0.242***	-0.145**	-0.158**	-0.221***	-0.263***	-0.199***	-0.196**
	(0.039)	(0.057)	(0.030)	(0.045)	(0.052)	(0.044)	(0.048)	(0.052)	(0.063)
Rejected Mismatch	-0.599***	-0.590***	-0.511***	-1.029***	-0.785***	-1.001***	-1.137***	-0.885***	-0.865***
	(0.071)	(0.059)	(0.054)	(0.044)	(0.032)	(0.039)	(0.047)	(0.043)	(0.017)
Prob. Black	-0.971***	-1.112***	-1.167***	-1.129***	-1.199***	-0.990***	-1.095***	-1.124***	-0.770***
	(0.050)	(0.045)	(0.058)	(0.023)	(0.033)	(0.063)	(0.026)	(0.077)	(0.049)
Prob. Hispanic	-0.735***	-1.005***	-0.873***	-1.024***	-0.878***	-0.650***	-0.985***	-0.712***	-0.430***
	(0.066)	(0.079)	(0.072)	(0.085)	(0.079)	(0.056)	(0.058)	(0.042)	(0.033)
Prob. Asian	-0.475***	-0.810***	-0.896***	-0.882***	-0.920***	-0.708***	-0.842***	-0.702***	-0.458***
	(0.073)	(0.068)	(0.070)	(0.054)	(0.062)	(0.085)	(0.022)	(0.032)	(0.022)
Prob. Other	-1.035***	-0.752***	-0.998***	-0.997***	-1.120***	-0.976***	-0.940***	-0.999***	-0.797***
	(0.146)	(0.184)	(0.119)	(0.191)	(0.147)	(0.109)	(0.058)	(0.061)	(0.124)
Age 22-30	0.113	0.347***	0.375***	0.127	0.128**	0.288***	-0.078	-0.031	-0.044*
	(0.064)	(0.058)	(0.055)	(0.065)	(0.047)	(0.052)	(0.050)	(0.016)	(0.022)
Age 31-40	0.784***	0.852***	0.931***	0.543***	0.558***	0.903***	0.350***	0.361***	0.459***
	(0.058)	(0.043)	(0.060)	(0.048)	(0.049)	(0.056)	(0.033)	(0.025)	(0.022)
Age 41-50	1.163***	1.172***	1.211***	0.823***	0.798***	1.154***	0.669***	0.620***	0.748***
	(0.053)	(0.040)	(0.060)	(0.039)	(0.056)	(0.057)	(0.027)	(0.023)	(0.039)
Age 51-60	1.344***	1.564***	1.417***	1.194***	1.020***	1.303***	1.016***	0.841***	0.900***
	(0.058)	(0.047)	(0.065)	(0.043)	(0.062)	(0.053)	(0.036)	(0.030)	(0.024)
Age 61-70	1.570***	1.990***	1.644***	1.705***	1.343***	1.575***	1.466***	1.155***	1.150***
	(0.070)	(0.048)	(0.067)	(0.049)	(0.066)	(0.058)	(0.056)	(0.059)	(0.038)
Male	-0.152***	0.042***	-0.117***	0.050***	-0.100***	-0.172***	0.076***	-0.038*	-0.099***
	(0.016)	(0.013)	(0.013)	(0.014)	(0.012)	(0.012)	(0.015)	(0.015)	(0.014)
New Voter	-0.803***	-0.626***	-0.656***	-1.216***	-0.977***	-0.586***	-1.401***	-1.139***	-0.949***
	(0.042)	(0.033)	(0.036)	(0.021)	(0.018)	(0.046)	(0.022)	(0.029)	(0.032)
N	2,410,106	2,201,475	2,100,679	2,947,409	2,808,710	2,394,754	3,929,467	3,646,784	2,970,684
Adj. R2									

* p < 0.05, ** p < 0.01, *** p < 0.001

Table SI7: Logistic Regressions Predicting Future Voting After Ballot Rejection for Non-Matching Signatures — Previous Voters

	Colorado						Washington		
	2018 to 2020	2018 to 2022	2018 to 2024	2020 to 2022	2020 to 2024	2022 to 2024	2020 to 2022	2020 to 2024	2022 to 2024
Cured Mismatch	-0.594***	-0.481***	-0.413***	-0.422***	-0.430***	-0.491***	-0.356***	-0.317***	-0.227***
	(0.043)	(0.049)	(0.038)	(0.060)	(0.059)	(0.050)	(0.060)	(0.070)	(0.066)
Rejected Mismatch	-0.736***	-0.604***	-0.524***	-1.434***	-1.216***	-1.240***	-1.320***	-1.132***	-0.946***
	(0.067)	(0.043)	(0.046)	(0.057)	(0.042)	(0.037)	(0.054)	(0.055)	(0.016)
Prob. Black	-0.929***	-1.112***	-1.167***	-1.127***	-1.191***	-0.996***	-1.062***	-1.108***	-0.764***
	(0.062)	(0.046)	(0.075)	(0.027)	(0.044)	(0.066)	(0.025)	(0.072)	(0.039)
Prob. Hispanic	-0.749***	-1.011***	-0.897***	-1.031***	-0.909***	-0.658***	-0.992***	-0.761***	-0.449***
	(0.062)	(0.077)	(0.073)	(0.082)	(0.076)	(0.056)	(0.060)	(0.046)	(0.033)
Prob. Asian	-0.546***	-0.843***	-0.956***	-0.875***	-0.924***	-0.769***	-0.840***	-0.748***	-0.519***
	(0.065)	(0.062)	(0.076)	(0.060)	(0.077)	(0.082)	(0.022)	(0.034)	(0.021)
Prob. Other	-1.039***	-0.670**	-0.972***	-0.966***	-1.135***	-0.889***	-0.924***	-0.983***	-0.781***
	(0.147)	(0.212)	(0.129)	(0.203)	(0.144)	(0.133)	(0.066)	(0.089)	(0.137)
Age 22-30	0.283***	0.408***	0.560***	0.156**	0.260***	0.374***	0.072	0.180***	0.138***
	(0.039)	(0.037)	(0.037)	(0.049)	(0.031)	(0.031)	(0.044)	(0.012)	(0.019)
Age 31-40	1.048***	0.948***	1.169***	0.626***	0.779***	1.042***	0.529***	0.641***	0.673***
	(0.043)	(0.035)	(0.052)	(0.042)	(0.046)	(0.046)	(0.031)	(0.025)	(0.017)
Age 41-50	1.425***	1.271***	1.448***	0.925***	1.052***	1.300***	0.869***	0.930***	0.971***
	(0.039)	(0.037)	(0.053)	(0.038)	(0.057)	(0.050)	(0.027)	(0.025)	(0.023)
Age 51-60	1.600***	1.668***	1.650***	1.310***	1.284***	1.446***	1.228***	1.160***	1.129***
	(0.055)	(0.049)	(0.058)	(0.046)	(0.065)	(0.048)	(0.035)	(0.030)	(0.020)
Age 61-70	1.809***	2.089***	1.866***	1.830***	1.602***	1.714***	1.681***	1.470***	1.368***
	(0.071)	(0.055)	(0.062)	(0.055)	(0.071)	(0.056)	(0.056)	(0.059)	(0.052)
Male	-0.120***	0.059***	-0.097***	0.061***	-0.085***	-0.146***	0.082***	-0.028	-0.087***
	(0.016)	(0.011)	(0.012)	(0.014)	(0.012)	(0.012)	(0.016)	(0.017)	(0.015)
N	2,233,454	2,052,504	1,959,022	2,649,221	2,526,291	2,271,271	3,483,612	3,247,453	2,846,915
Adj. R2									

* p < 0.05, ** p < 0.01, *** p < 0.001

Table SI8: Logistic Regressions Predicting Future Voting After Ballot Rejection for Non-Matching Signatures — New Voters

	Colorado						Washington		
	2018 to 2020	2018 to 2022	2018 to 2024	2020 to 2022	2020 to 2024	2022 to 2024	2020 to 2022	2020 to 2024	2022 to 2024
Cured Mismatch	0.064	0.120	-0.014	0.197***	0.084	0.208**	0.042	0.023	-0.057
	(0.125)	(0.068)	(0.042)	(0.045)	(0.057)	(0.068)	(0.038)	(0.041)	(0.083)
Rejected Mismatch	-0.428***	-0.480***	-0.485***	-0.577***	-0.514***	-0.732***	-0.698***	-0.581***	-0.613***
	(0.068)	(0.050)	(0.051)	(0.040)	(0.028)	(0.043)	(0.031)	(0.034)	(0.033)
Prob. Black	-1.057***	-1.043***	-1.119***	-1.088***	-1.175***	-0.851***	-1.252***	-1.103***	-0.748***
	(0.097)	(0.064)	(0.045)	(0.048)	(0.029)	(0.082)	(0.037)	(0.090)	(0.136)
Prob. Hispanic	-0.666***	-0.941***	-0.746***	-0.949***	-0.763***	-0.555***	-0.937***	-0.592***	-0.273***
	(0.076)	(0.084)	(0.075)	(0.088)	(0.077)	(0.054)	(0.049)	(0.030)	(0.039)
Prob. Asian	-0.238*	-0.603***	-0.607***	-0.788***	-0.780***	-0.338***	-0.774***	-0.496***	-0.058
	(0.099)	(0.091)	(0.063)	(0.045)	(0.036)	(0.095)	(0.031)	(0.025)	(0.041)
Prob. Other	-0.960***	-1.099***	-0.984***	-1.101***	-1.030***	-1.365***	-1.025***	-1.002***	-0.822***
	(0.227)	(0.190)	(0.200)	(0.177)	(0.185)	(0.169)	(0.088)	(0.080)	(0.167)
Age 22-30	0.090	0.355***	0.283***	0.209**	0.147*	0.315***	-0.181**	-0.098***	-0.190**
	(0.083)	(0.079)	(0.072)	(0.078)	(0.060)	(0.076)	(0.060)	(0.022)	(0.073)
Age 31-40	0.439***	0.691***	0.570***	0.438***	0.343***	0.634***	0.108***	0.112***	0.128**
	(0.071)	(0.050)	(0.061)	(0.046)	(0.043)	(0.049)	(0.025)	(0.017)	(0.047)
Age 41-50	0.642***	0.897***	0.692***	0.547***	0.360***	0.666***	0.259***	0.213***	0.238***
	(0.064)	(0.051)	(0.064)	(0.035)	(0.054)	(0.067)	(0.029)	(0.021)	(0.049)
Age 51-60	0.695***	1.084***	0.776***	0.741***	0.410***	0.710***	0.468***	0.309***	0.203***
	(0.075)	(0.056)	(0.079)	(0.039)	(0.047)	(0.074)	(0.063)	(0.044)	(0.033)
Age 61-70	0.947***	1.520***	1.041***	1.094***	0.616***	0.889***	0.821***	0.514***	0.476***
	(0.081)	(0.080)	(0.083)	(0.046)	(0.052)	(0.098)	(0.078)	(0.069)	(0.083)
Male	-0.263***	-0.074**	-0.212***	-0.003	-0.140***	-0.329***	0.049**	-0.064***	-0.191***
	(0.019)	(0.023)	(0.023)	(0.016)	(0.014)	(0.019)	(0.016)	(0.011)	(0.015)
N	176,652	148,971	141,657	298,188	282,419	123,483	445,855	399,331	123,769
Adj. R2									

* p < 0.05, ** p < 0.01, *** p < 0.001

Table SI9: Average marginal effects for voting in 2022 among voters with ballots rejected for non-matching signatures in 2020. County fixed effects omitted. Standard errors clustered by county.

	All Voters		New Voters		Prev. Voters	
Term	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Colorado 2018 to 2020						
Cured Mismatch	-0.0092	(-0.012, -0.007)	0.00506	(-0.014, 0.024)	-0.0182	(-0.022, -0.014)
Rejected Mismatch	-0.02156	(-0.029, -0.015)	-0.04115	(-0.056, -0.026)	-0.0242	(-0.031, -0.018)
Colorado 2018 to 2022						
Cured Mismatch	-0.03086	(-0.045, -0.017)	0.02437	(-0.002, 0.051)	-0.057	(-0.070, -0.044)
Rejected Mismatch	-0.07642	(-0.093, -0.060)	-0.10531	(-0.127, -0.084)	-0.0744	(-0.088, -0.061)
Colorado 2018 to 2024						
Cured Mismatch	-0.01459	(-0.019, -0.011)	-0.0019	(-0.013, 0.009)	-0.024	(-0.030, -0.018)
Rejected Mismatch	-0.03434	(-0.042, -0.026)	-0.07512	(-0.091, -0.059)	-0.0321	(-0.039, -0.025)
Colorado 2020 to 2022						
Cured Mismatch	-0.02174	(-0.035, -0.008)	0.04633	(0.026, 0.067)	-0.0638	(-0.084, -0.044)
Rejected Mismatch	-0.18251	(-0.200, -0.165)	-0.12909	(-0.146, -0.112)	-0.2643	(-0.289, -0.239)
Colorado 2020 to 2024						
Cured Mismatch	-0.01291	(-0.022, -0.004)	0.0149	(-0.004, 0.034)	-0.0334	(-0.045, -0.022)
Rejected Mismatch	-0.07997	(-0.089, -0.071)	-0.10382	(-0.115, -0.093)	-0.1277	(-0.143, -0.112)
Colorado 2022 to 2024						
Cured Mismatch	-0.00852	(-0.012, -0.005)	0.0174	(0.007, 0.028)	-0.0196	(-0.024, -0.016)
Rejected Mismatch	-0.05516	(-0.061, -0.049)	-0.08685	(-0.098, -0.076)	-0.0706	(-0.077, -0.064)
Washington 2020 to 2022						
Cured Mismatch	-0.0472	(-0.065, -0.030)	0.0091	(-0.007, 0.025)	-0.0638	(-0.086, -0.042)
Rejected Mismatch	-0.22627	(-0.249, -0.204)	-0.13107	(-0.141, -0.121)	-0.2705	(-0.298, -0.243)
Washington 2020 to 2024						
Cured Mismatch	-0.02271	(-0.035, -0.011)	0.00507	(-0.013, 0.023)	-0.0331	(-0.049, -0.018)
Rejected Mismatch	-0.12389	(-0.142, -0.106)	-0.13785	(-0.155, -0.121)	-0.1553	(-0.179, -0.132)
Washington 2022 to 2024						
Cured Mismatch	-0.01178	(-0.020, -0.004)	-0.00871	(-0.034, 0.017)	-0.0128	(-0.020, -0.005)
Rejected Mismatch	-0.06877	(-0.073, -0.065)	-0.10914	(-0.122, -0.096)	-0.0731	(-0.077, -0.069)