Reducing Lost Votes by Mail: Evidence on Vote Curing from Pennsylvania*

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April 5, 2026

Abstract

Eligible voters sometimes return mail ballots that fail to satisfy a state's particular procedural requirements. Vote curing can reduce the number of such voters whose vote is "lost," or ultimately not counted. We characterize vote curing policies along two dimensions: notice of a deficient ballot and the opportunity to correct it. Pennsylvania's 2024 general election provides a unique setting to evaluate the effects of vote curing because it featured both within-county variation in notice and across-county variation in correction opportunities. Using individual-level data on voters who returned deficient mail ballots, we find that the likelihood such voters ultimately had their votes counted increased by about 25 percentage points (p.p.) when notice of the deficiency was provided before versus on Election Day, about 10 p.p. when voters had any opportunity to correct the deficiency before rather than only on Election Day, and about 25 p.p. when deficient ballots were automatically returned or replaced. These large effects support emerging due process challenges to the lack of notice about deficient ballots as well as *Bush v. Gore* equal protection challenges to non-uniform correction opportunities. We conclude by considering how to structure vote curing to expand voter access without harming election integrity or exacerbating concerns about uniformity.

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For their comments and engagement, we thank Ben Geffen, Jeff Greenburg, Dave Hoffman, Doug Spencer, Nicholas Stephanopoulos, Dan Tokaji, Carter Walker, and Tess Wilkinson-Ryan as well as participants in the Election Science, Reform, and Administration conference at Florida State University, the University of Pennsylvania's American Politics Working Group, the Penn Carey Law Ad Hoc Workshop, the Wharton Legal Studies Speaker Series, the Conference on Empirical Legal Studies at Georgetown University Law Center, and the research webinar series jointly hosted by the Center for Election Innovation & Research, The Elections Group, and Arizona State University's Mechanics of Democracy Laboratory. For their research assistance, we also thank Tait Helgaas, Cayla Kaplan, and Nicholas Wu, as well as Andy Lang of the Penn Carey Law Biddle Law Library. A prior version of this article was titled "Saving Lost Votes by Mail." Data necessary to replicate the results are available upon request from the corresponding author.

1 Introduction

The growing use of mail balloting has transformed the voting experience. In general, election administration has accommodated the shift in vote mode by imposing a set of procedural requirements on mail voters (see, e.g., Nyhuis et al. 2025). These additional requirements can bolster electoral integrity, but the substantial number of rejected mail ballots has also prompted concerns about voter access (see, e.g., Baringer et al. 2020; Cottrell et al. 2021; Shino et al. 2022; Hopkins et al. 2022).

Vote curing policies help balance the tension between promoting both access and integrity in mail balloting. In short, vote curing can reduce the number of eligible voters whose deficient mail ballots become "lost votes" (Stewart 2010). In this context, a lost vote refers to an eligible voter who returns a mail ballot but does not have their vote counted because it failed to conform with a state's procedural requirements. For example, an eligible voter who returns a deficient mail ballot without completing the accompanying affidavit would not have their vote counted without remedial action. Vote curing facilitates such action by providing voters with notice about the deficiency alongside an opportunity to correct it.

The partisan split in who votes by mail has made state vote curing policies a new front in what Hasen (2012) termed the "voting wars." In general, most litigation about mail balloting has challenged the validity of particular procedural requirements, such as requirements that a voter sign or date an affidavit. In contrast, emerging arguments about vote curing assume that some mail ballots will be deficient and consider the extent of notice about the deficiency or opportunities to correct it. In particular, the lack of notice may implicate voters' procedural due process rights while non-uniform correction opportunities across voters in the same state may implicate the equal protection principle in *Bush v. Gore*.

Both the due process and equal protection claims depend in part on whether vote curing policies actually reduce the number of lost votes. The canonical procedural due process framework of *Mathews v. Eldridge* takes into account "the probable value" of notice as part of a cost-benefit analysis in determining how much notice, if any, is due. Relative to the due process standard, the relevant standard for a *Bush v. Gore* equal protection claim

is an open question. However, Morley (2023) suggests that the Supreme Court's opaque opinion should be read broadly to prevent inconsistent election rules that "could lead to substantial disparities in the likelihood of voters being able to cast their ballots and have them be counted." Under this reading, the equal protection argument overlaps with the due process argument because it also depends in part on the empirical effect of vote curing policies. But no existing work has quantified the effect of providing voters with notice of a deficient mail ballot or an opportunity to correct it on the number of lost votes by mail. As a result, the strength of the emerging legal challenges to vote curing remains unclear.

Pennsylvania's 2024 general election provides a helpful setting for evaluating the effects of vote curing policies. Unlike most states, Pennsylvania devolves the relevant policy choices to counties. As a result, Pennsylvania features substantial within-state variation in both notice and opportunities to correct. Counties provide varying levels of notice before Election Day about deficient mail ballots, from notice for all types of deficiencies to notice for only some types of deficiencies to no notice for any deficiencies. Further, counties also differ in whether voters can correct mail ballot deficiencies before Election Day or if the only opportunity to do so is on Election Day. Moreover, Pennsylvania maintains an official statewide database with individual-level data on voters who initially returned deficient mail ballots and ultimately corrected the deficiency.

Our results demonstrate that vote curing policies have large effects on the likelihood that voters corrected deficient ballots. We proxy for whether a voter received notice based on when the deficiency was recorded in the statewide database. In particular, recording a mail ballot as deficient triggered an email to voters about the deficiency, if the voter had provided an email address in their mail ballot application, and also facilitated third-party outreach, particularly by political campaigns, because the near-daily snapshots of the database were publicly available. We estimate that voters were about 25 percentage points (p.p.) more likely to correct deficiencies that were recorded in the statewide database before Election Day than on Election Day and, further, that voters who provided an email were about 10 p.p. more likely to correct a deficient ballot than those who did not. Finally, we find that voters were 10 p.p. more likely to correct a deficiency when they had opportunities to do

so before Election Day, relative to voting a new ballot on Election Day, and about 25 p.p. more likely to correct when their deficient ballots were automatically returned or replaced.

To be sure, the relative strength of the emerging legal arguments about procedural due process and equal protection depends on resolving both empirical and doctrinal questions. But regardless of the ultimate judicial resolution, quantifying the value of vote curing can improve election administration. We thus conclude by considering the future of vote curing, whether by litigation or legislation. In general, only about two-thirds of states offer some form of vote curing for mail ballots, while about one-third do not (Voting Rights Lab 2025). To expand vote curing, we consider the range of potential state interests in how to structure it, including maintaining electoral integrity, reducing administrative burdens, and promoting voter uniformity. We finally outline a way forward, focusing on the timely recording of mail ballot deficiencies before Election Day, the public dissemination of such information by the state, the extension of opportunities to substitute from a deficient ballot to a provisional ballot on Election Day, and the automatic return or replacement of deficient mail ballots.

2 Vote Curing

Recent scholarship on election administration has focused on the idea of a "lost vote." The concept was first developed in the context of in-person voting (Caltech/MIT Voting Technology Project 2001; Ansolabehere and Stewart 2005; Stewart 2006, 2011), but has since migrated to voting by mail too (Stewart 2010, 2020; Meredith et al. 2024). In both scenarios, the relevant concern is that some eligible voters who receive and intend to cast ballots ultimately do not have their votes counted because of frictions in the balloting process. In the context of mail balloting specifically, a state's procedural requirements may produce a lost vote by mail either because an eligible voter returned a deficient ballot or because the voter was deterred from returning a ballot that they expect would have been deficient (Meredith et al. 2024). In this section, we introduce the term "vote curing" to describe the process by which a voter can avoid the former type of lost vote by taking remedial action. We first offer a typology of vote curing and then highlight the emerging

legal issues presented when vote curing is either not available or differentially available to voters.

2.1 Typology

Vote curing is best understood in the context of broader concerns about voter access and election integrity. In general, states impose a variety of requirements to ensure that only eligible voters cast a ballot. For example, beyond state voter registration laws, there is the now familiar debate about voter identification (ID) laws (see, e.g., Highton 2017). States have adopted a wide variety of approaches that strike different balances between access and integrity concerns, from not asking for any ID to requiring ID and from allowing any form of ID to only accepting photo IDs (National Conference of State Legislatures 2025a). The differential challenges of voting by mail have led states to rely on other methods to verify eligible voters' identities, such as voter affidavits, signature matching, or witness requirements, and to require additional steps to preserve voters' privacy (National Conference of State Legislatures 2024).

In both the in-person and mail contexts, vote curing helps address the concern that the procedural requirements imposed in the interest of electoral integrity may also invalidate ballots returned by eligible voters. More specifically, vote curing allows such voters additional opportunities to cast a counted ballot. When vote curing is successful, it thus prevents a lost vote.[1]

We characterize vote curing policies along two dimensions: the provision of notice about a deficiency and the opportunity to correct the deficiency. In general, providing notice requires that election officials both identify a deficiency and disseminate information about the deficiency. We also distinguish between two different ways to correct a deficiency. Consistent with the definition of Altamirano and Wang (2022), we use the term ballot curing to refer to the correction of the originally deficient ballot. We use the separate term ballot substitution to refer to the casting of a new ballot in place of the deficient ballot.

[1] A mail ballot may also be rejected because a voter is ineligible to vote and thus not at risk of experiencing a lost vote. However, a voter who corrects their mail ballot has affirmed their eligibility to vote.

Importantly, election officials implement notice and correction differently for mail versus in-person voters. For simplicity, we focus on Election Day voting specifically. First, there is a difference in when election officials verify that voters casting ballots have satisfied the relevant procedural requirements. Election officials generally assess whether Election Day voters have satisfied the relevant procedural requirements before giving them ballots. In fact, if an Election Day voter has not satisfied a relevant requirement, they typically would vote a provisional, rather than a regular, ballot. In contrast, election officials generally assess whether mail voters have satisfied the relevant procedural requirements after the ballots have been returned. As a result, the forms of notice to facilitate vote curing across the two vote modes are different. An Election Day voter is typically notified of any deficiency at the polling place, while additional outreach is needed to disseminate information about a deficiency to a mail voter.

Second, there are often differences in the form of correction available to Election Day and mail voters. Many mail voters return ballots before Election Day. By definition, there are more options for correcting a deficiency identified before Election Day than a deficiency identified on Election Day. More specifically, while Election Day voters are limited to the option of curing their provisional ballots, mail voters can have the option to either cure the deficiency with their initial ballot or substitute to a new ballot, either by mail or in person on Election Day. For that reason, not all rejected mail ballots should be understood as lost votes (Meredith et al. 2024).

We focus here on vote curing for voters who return deficient mail ballots. Prior research documents which types of voters are more likely to have a mail ballot rejected as deficient. In particular, several studies demonstrate how ballot rejection rates are often tied to voters' age, race, ethnicity, language access, disability, and prior experience with the voting process (see, e.g., Mann 2014; Baringer et al. 2020; Cottrell et al. 2021; Shino et al. 2022; Hopkins et al. 2022; Altamirano and Wang 2022; Allard et al. 2023). Other studies also highlight within-state heterogeneity in mail ballot rejection rates (see, e.g., Baringer et al. 2020; Smith 2021; Allard et al. 2023). However, there is no existing work on the extent to which notice or correction opportunities reduce lost votes by mail. The lack of research stands in stark

contrast to the emergence of vote curing as a new front in the partisan "voting wars" (Hasen 2012), which we take up next.

2.2 Legal Standards

While federal law makes vote curing part of the standard toolkit of election administration on Election Day, the availability of vote curing for deficient mail ballots varies dramatically both across and even within some states.

As is relevant here, there are some minimum federal statutory standards for vote curing on Election Day. In particular, the Help America Vote Act (HAVA) requires that election officials at a polling place offer provisional ballots to voters in federal elections who do not meet procedural requirements to verify their eligibility (52 U.S.C. § 21082). For example, the most common reason to vote a provisional ballot is that an election official cannot find a voter's registration in the poll book, while a less common reason is that a voter did not provide sufficient ID (U.S. Election Assistance Commission 2023). Federal law does not dictate whether provisional ballots should be counted (52 U.S.C. § 21082). Instead, it defers to state law. In the case of registration issues, a state might count a provisional ballot without any further action from the voter by confirming a voter's registration. But in the case of voter ID, a state typically requires a voter to appear in person at the county election office with proper ID.

There are no similar minimum federal statutory standards for vote curing after the return of a deficient mail ballot. As a result, states have taken starkly different approaches to both the provision of notice as well as opportunities for either ballot curing or ballot substitution (Voting Rights Lab 2025). Pennsylvania, in particular, offers a helpful window into both the divergent approaches and the emerging legal challenges. In short, Pennsylvania's county-by-county variation in vote curing policies, the details of which we review in our case study below, has prompted litigation about both procedural due process and the equal protection principle in *Bush v. Gore*.

These emerging challenges are distinct from the more typical challenges to mail ballot requirements. To use Pennsylvania as an example, litigants have brought many different

challenges to the state's procedural requirements for mail ballots, including under both federal and state statutes and under both the federal and state constitution (see, e.g., Pa. Democratic Party v. Boockvar 2020; In re Canvass of Absentee and Mail-in Ballots 2020; Ball v. Chapman 2023; Baxter v. Phila. Bd. of Elections 2024; Pa. State Conf. of NAACP v. Sec'y Commonwealth of Pa. 2024; Eakin v. Adams Cnty. Bd. of Elections 2025a). In contrast, the procedural due process and *Bush v. Gore* challenges accept that certain mail ballots will be deficient and focus instead on what should happen next. Below, we outline the relevant doctrines and highlight why both claims depend in part on empirical evidence.

Procedural Due Process A procedural due process challenge typically focuses on the deprivation of a right without either notice or an opportunity to be heard. The standard for such a claim is relatively straightforward. A procedural due process claim typically proceeds in two steps. A court first determines whether the challenged policy implicates a protected liberty interest and, if so, then considers the adequacy of current procedures. Under *Mathews v. Eldridge*, courts balance the private interest and the government's interest with both "the risk of an erroneous deprivation" of the private interest and "the probable value, if any, of additional . . . procedural safeguards."

In the context of mail balloting, the procedural due process challenge focuses on the lack of notice about a deficient mail ballot. At the first step, an eligible voter who returns a deficient mail ballot must have some interest in having their vote count. This interest could be construed as part of a broad constitutional right to vote or a narrow statutory right to cast a ballot on Election Day. Either way, the balancing framework suggests that whether a voter has a due process right to notice of a mail ballot deficiency can depend on whether such notice leads to vote curing.

There has only been sporadic litigation about the procedural due process requirements for mail balloting. However, after the 2024 election, the Pennsylvania Supreme Court held in *Center for Coalfield Justice v. Washington County Board of Elections* that a county violated voters' right to procedural due process when it did not provide notice of known

deficient mail ballots.[2] The Court first held the voters at least had a protected liberty interest in correcting their mail ballot deficiency by voting provisionally on Election Day, as permitted by state law. It then determined that balancing favored notice.

Importantly, the state supreme court's decision was narrow. In the particular circumstances of *Center for Coalfield Justice*, county election officials had identified the deficiencies before Election Day, leading the court to describe the county as "hid[ing]" the relevant information. The Court explicitly did not address the much more typical reason Pennsylvania counties might not provide notice to voters of a deficient mail ballot, which is that they wait to identify any deficiency until on or after Election Day.[3] We expect the broader procedural due process question to be presented in future litigation, which we revisit in the discussion.

Equal Protection In general, a *Bush v. Gore* equal protection claim focuses on differences in voting within a state. But relative to a procedural due process claim, both the scope of and the standards for such a claim are much less certain.

In short, the relevant equal protection question in *Bush v. Gore* was whether Florida's recount procedures caused the state to "value one person's vote over that of another." A majority of justices agreed that Florida's recount violated equal protection because "the standards for accepting or rejecting contested ballots might vary not only from county to county but ... within a single county from one recount team to another." However, the per curiam opinion included an explicit caveat that the court's "consideration is limited to the present circumstances." As a result, the bounds of *Bush v. Gore* are much debated (see, e.g., Foley 2007; Lowenstein 2007).

The legal scholar Michael Morley has argued that *Bush v. Gore* should be read broadly to extend to variation in voters' opportunities to correct deficient mail ballots across different counties in the same state. In an exhaustive survey of litigation since the 2000 decision, Morley (2020) revealed how lower federal courts had developed *Bush v. Gore* into

[2]Although the plaintiffs brought a state constitutional claim, the state supreme court had previously adopted the *Mathews* framework to assess procedural due process claims brought under Article I of the Pennsylvania Constitution (R. v. Dep't of Pub. Welfare 1994).

[3]As the court explained in a footnote, "[i]f the [county] Board [of elections] is not segregating [deficient] ballots ... it is not required under the trial court's order to notify the elector of such defect...." We address county practice in more detail in the Case Study below.

a "fully enforceable, generally applicable election-law doctrine." Morley coined the term the "[u]niformity [p]rinciple" to describe the emerging equal protection doctrine and explained it in empirical terms. In short, it applies "when inconsistent rules could lead to substantial disparities in the likelihood of voters being able to cast their ballots and have them be counted" (Morley 2023). Under this reading of *Bush v. Gore*, the effect of vote curing policies on reducing lost votes becomes the relevant doctrinal question.

Importantly, there is disagreement about the proper scope of *Bush v. Gore*. In fact, in the aftermath of the 2020 election, a federal court in Pennsylvania rejected the argument that differential vote curing across Pennsylvania counties violated *Bush v. Gore* (Donald J. Trump for President, Inc. v. Boockvar 2020). Among other things, the court pointed to the limiting language in the Supreme Court's opinion that "[t]he question . . . is not whether local entities . . . may develop different systems for implementing elections." Moreover, even if Morley's broader reading of *Bush v. Gore* is adopted, it is not clear how far it should extend, a question we revisit in the discussion.

These types of doctrinal questions were raised but not resolved in the run-up to the 2024 presidential election. Some academics speculated that the Supreme Court might revisit *Bush v. Gore* in a post-election challenge to Pennsylvania's vote curing policies (see, e.g., Hasen 2024; Muller 2024). However, the ultimate margin of victory for president in the state was greater than the number of affected mail ballots, so no lawsuit was brought. Nonetheless, as with procedural due process challenges, we expect the equal protection question is likely to recur in future elections.

3 Case Study

We use Pennsylvania's 2024 general election as a case study to estimate how much the provision of notice and the availability of opportunities to cure deficient ballots before Election Day affected the likelihood of a vote being counted. We first explain the benefits of a within-state design to study vote curing. We then detail a few features of vote curing in Pennsylvania that make it an ideal candidate for such an analysis, before acknowledging

several limitations.

3.1 Design Considerations

Our goal is to identify a set of voters who return deficient mail ballots and relate variation in their notice and correction opportunities to the likelihood of casting a counted ballot. While both components of vote curing do vary by state, it is hard to leverage national variation to learn about the effects of these policies. The issue with such a cross-state design is that many other things also differ over states that could affect the likelihood that voters correct deficient ballots. For example, the composition of people who cast deficient ballots depends on a state's rules about who can cast mail ballots and what causes those ballots to be deficient. Further, voters' motivations to correct ballots are also likely to vary over states because of differences in states' electoral environments.

Focusing on a single state can make it easier to identify a comparable set of voters, situated within the same political environment, whose mail ballots are deficient for similar reasons. The challenge is that vote curing policies are usually set at the state level. As a result, existing single-state work lacks variation in the notice or correction opportunities available to voters (see, e.g., Meredith and Kronenberg 2023). Unlike most states, though, Pennsylvania features within-state variation in both notice and correction opportunities because counties have substantial policymaking discretion.

3.2 Pennsylvania Context

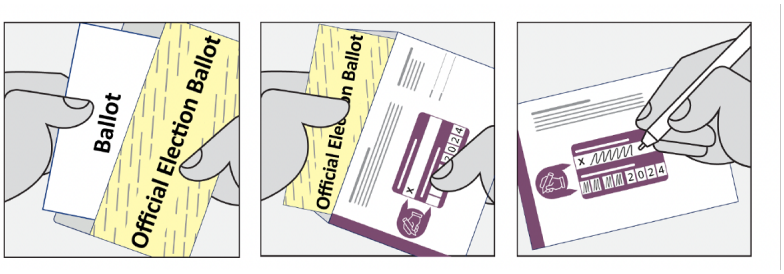
The design of Pennsylvania's election administration makes it an ideal case for learning about the effect of vote curing policies. First, Pennsylvania has objective, statewide criteria for which mail ballots must be rejected as deficient, such that we are not concerned about local election official discretion in determining which mail ballots are deficient. Second, the state offers a default level of notice for any mail ballot that has been recorded as deficient in the statewide database, as well as a baseline opportunity for any voter to substitute to a provisional ballot on Election Day. The availability of provisional ballots allows us to observe how any level of notice relates to correction across counties. Further, the fact that

counties could modify the state default for notice for each type of deficiency—by either providing no notice or more notice—and could provide additional opportunities to correct mail ballot deficiencies—by permitting curing before Election Day—allows us to leverage variation in both notice and correction policies both across and within counties.

3.2.1 Statewide Rules

Pennsylvania's mail balloting policies have garnered national attention in part because they generate a substantial number of rejected ballots in a competitive, battleground state (see, e.g., Gabriel 2020; Wang 2024; Meredith et al. 2024). As is relevant here, Pennsylvania imposes two types of procedural requirements on mail ballots using two sets of envelopes (25 Pa. Stat. and Cons. Stat. § 3146.6, 3150.6). As shown in Figure 1, a voter must place their voted ballot inside an inner envelope designed to protect voter privacy and then sign and date the voter affidavit printed on the outside of the outer envelope (Pennsylvania Department of State 2024). Under Pennsylvania law, a mail ballot returned without a so-called secrecy sleeve or with an incomplete voter affidavit is deficient and thus will be rejected. For ease, we refer to deficient mail ballots as involving either an inner- or outer-envelope deficiency.

Figure 1: Pennsylvania Mail Ballot Instructions



Pennsylvania's mail ballot rules are controversial in part because critics see them as unnecessary. For example, the lack of a proper date on the voter affidavit "does not inform whether a voter is eligible to cast a ballot" because the ballot must be received before the close of polls on Election Day to count (Eakin v. Adams Cnty. Bd. of Elections 2025a). Similarly, the lack of a secrecy envelope also does not relate to voter eligibility. In

theory, an unsigned affidavit could indicate that a mail ballot was returned by an ineligible voter, although we are not aware of such prosecutions. For each of these reasons, we think voters who return deficient mail ballots in Pennsylvania are likely eligible voters at risk of experiencing a lost vote.

For our purposes, though, the more relevant feature of Pennsylvania's mail ballot rules is that the criteria for a deficient mail ballot are generally objective rather than subjective. Whether warranted or not, there is little-to-no subjectivity involved in determining whether a mail ballot is returned outside of an inner envelope or what constitutes a complete voter affidavit on the outer envelope.[4] Pennsylvania thus looks fundamentally different than other states, particularly those with signature matching, in which the rate of rejected mail ballots may vary by county because of differences in the use of subjective discretion to identify deficiencies (see, e.g., Baringer et al. 2020; Janover and Westphal 2020; Cottrell et al. 2021; Altamirano and Wang 2022; Street 2024).

3.2.2 Statewide Database

Pennsylvania also maintains a statewide database for election administration known as the Statewide Uniform Registry of Electors (SURE). For our purposes, the SURE database allows us to identify who returns a deficient mail ballot and who corrects it.

In general, SURE provides a standardized process for counties to document the status of each mail ballot over time. When a registrant is sent a ballot, it is assigned a status of pending. Figure A1 shows how county election officials may subsequently update the status of a mail ballot to reflect that it was returned or that it was deficient because of a particular reason, such as an unsigned affidavit on the outer envelope (Pennsylvania Department of State and Secretary Al Schmidt 2024).[5]

SURE also separately allows counties to document whether any registrant ultimately cast a valid vote. After an election, county election officials update the vote history of every registrant in SURE. Helpfully, the statewide voter file differentiates between voters who cast

[4] There are only isolated instances of differences across counties in whether they accepted a mail ballot with a European-style date. (See, e.g., Brief of Appellees in Baxter v. Phila. Bd. of Elections 2025)

[5] Figure A1 also highlights that SURE only allows a county to indicate a single deficiency with a mail ballot.

a vote by mail versus on Election Day, and separates regular from provisional ballots.

3.2.3 Statewide Default and Baseline

Pennsylvania ultimately offers a useful case study in part because vote curing policies vary by county rather than being imposed by the state. However, county policies, reviewed below, are difficult to understand without the context of the statewide policies in the background.

Default Notice The SURE database could facilitate notice of deficient mail ballots in three related ways. However, as we explain below, each of these default forms of notice is dependent on each county's particular practice of recording deficient mail ballots in the database.

First, the state hosted an online website to allow individual voters to look up the current status of their mail ballot as it was recorded in SURE. Second, for any voter who provided an email on their mail ballot application, the state also sent an email informing the voter whenever the status of their mail ballot was changed in SURE. Third, on most days in the lead-up to the election, the state distributed a snapshot of a mail ballot file with the status of all mail ballots to any interested person. The various snapshots included a voter's address, party of registration, and email and phone number, if available. As a result, third-parties, particularly campaigns, could contact specific voters who had a mail ballot recorded as deficient in the statewide database.

Baseline Substitution In the run-up to the 2024 election, the Pennsylvania Supreme Court clarified that state law provides all voters with a baseline opportunity to correct their deficient mail ballot by substituting to a provisional ballot on Election Day (Genser v. Butler County Bd. of Elections 2024). A voter's provisional ballot was ultimately counted if their mail ballot was a "nullity," either because it was rejected or had not been returned.[6] For our purposes, the ruling ensured that all voters had at least one opportunity to correct deficient mail ballots, regardless of their specific county's vote curing policy.

[6] At least one county treated the voter affidavit printed on the outside of provisional ballot envelope as instead curing the originally defective mail ballot, but the distinction does not matter for our analysis (see, e.g., Brief of Appellees in Baxter v. Phila. Bd. of Elections 2025).

3.2.4 County Notice and Correction Policies

Finally, Pennsylvania counties had the ability to set their own vote curing policies.[7] In general, the state election code does not address vote curing. Before the 2020 general election, the state supreme court held that the state constitution does not require any county to develop notice and cure procedures (Pa. Democratic Party v. Boockvar 2020). However, the state court has explicitly "not spoken to whether or not the Election Code allows individual counties to utilize notice and cure procedures" (Genser v. Butler County Bd. of Elections 2024). In the absence of guidance, counties have taken two different interpretive approaches. Some take the position that vote curing is appropriate because the election code does not forbid it, while others take the opposite position that doing so is inappropriate without a state law explicitly permitting it (Walker 2025).

For our purposes, there are two relevant features of county vote curing policies during the 2024 general election. For one, counties could determine the extent of notice provided to voters based on when they chose to identify and record deficient mail ballots in the statewide database. For another, counties could also choose to offer voters an additional opportunity to cure their deficient mail ballot or substitute to a new mail ballot before Election Day. Typically, a county's policy was determined by elected county commissioners who serve on the county's election board and select the county election director (Huangpu 2024).

Notice Under Pennsylvania law, the canvassing of ballots begins on Election Day (25. Pa. Stat. and Cons. Stat. § 3146.8). As a result, election officials may not open the outer envelope of any mail ballot packet before Election Day. Despite the prohibition, though, it is possible for counties to identify and record potential deficiencies with mail ballots without physically opening the packet up, a phenomenon known in Pennsylvania as "pre-processing."

The most common form of pre-processing involved identifying outer-envelope deficiencies, because the affidavit is printed on the outside of the return envelope, and thus checking

[7] As discussed below, Pennsylvania counties also had discretion over how voters could vote by mail. For example, only some counties in Pennsylvania permitted voters to return mail ballots at drop boxes, and only some of these drop boxes were staffed by election officials. Further, some counties provided voters with more opportunities to request and return a mail ballot during the same transaction at either a county election office or a satellite office in what is known as "on-demand" voting.

whether it is complete does not require opening it up. Other counties also found creative ways to identify inner-envelope deficiencies without opening the outer return envelope. Figure A2 shows how some counties adopted mail ballot materials which made the lack of an inner secrecy sleeve visible via a pre-punched hole in the outer return envelope (Stockburger and Willson 2024). Still other counties weighed the entire mail ballot packet (Jouvenal and Itkowitz 2024) or measured the thickness of the packet (see, e.g., Brief of Appellees in Baxter v. Phila. Bd. of Elections 2025) to determine whether the inner envelope was likely missing.

These differences in pre-processing caused voters to be informed about deficient mail ballots at different points in time depending on their county and type of ballot deficiency. Some counties pre-processed both inner- and outer-envelope deficiencies before Election Day, often as the ballot was received. In these counties, voters who returned a deficient mail ballot had their ballot status in SURE updated to reflect the specific deficiency. Other counties only pre-processed outer-envelope but not inner-envelope deficiencies. In these counties, voters who returned a ballot with an inner-envelope deficiency had their ballot status initially updated to only reflect that a ballot was returned but not the deficiency. The implication is that these voters could not be notified about the deficiency until the ballot was canvassed on Election Day and the county further updated the status to reflect the deficiency. A third set of counties did not pre-process at all, meaning that all deficient ballots would initially only receive a status indicating it was returned. Thus, these voters also could not be notified about any deficiency until on or after Election Day.

Counties also had the discretion to provide additional notice to voters about mail ballot deficiencies. For example, some counties posted online lists of persons who returned deficient mail ballots, although this was redundant with the mail ballot file provided by the state (Walker 2024; ACLU of Pennsylvania 2024). A few counties also reached out to voters via phone calls in addition to the emails generated by the statewide system.

Finally, the statewide database also facilitated third-parties, particularly campaigns, to supplement notice to voters of deficient mail ballots. As we take up below, we thus expect the total amount of notice a voter received to be dependent on the activity of local and

state campaigns associated with their party of registration.

Correction before Election Day Separate from its notice policy, counties also had the responsibility to determine whether to permit voters to cure their deficient mail ballot or substitute to a new mail ballot before Election Day. Of the counties that provided additional correction opportunities, most did so by allowing voters to fix their deficient mail ballots at the county elections office or satellite locations (ACLU of Pennsylvania 2024; Walker 2024; Neil 2024). A few counties automatically mailed back either the original deficient mail ballot or a replacement mail ballot, while a few others required the voter to contact the county and request a new mail ballot (ACLU of Pennsylvania 2024; Walker 2024).

3.2.5 Limitations

Despite its many benefits, there are several limitations to using Pennsylvania's 2024 general election as a case study to evaluate vote curing.

Some limitations relate to estimating the effect of vote curing policies. First, the variation in policies across counties is not random. Instead, it reflects the politics of particular counties. In fact, as we show in the next section, Democratic counties provided more notice and more opportunities to correct deficiencies before Election Day than Republican counties. Second, the extent of notice is a function of both a county's chosen policy and the unobserved efforts of political campaigns to encourage likely supporters to correct their mail ballots. Below, we will show how our empirical approach can mitigate these related limitations by adopting a within-county design and by controlling for a voter's party of registration. In short, while we cannot observe the extent of notice received by any particular voter, our assumption is that campaigns put in similar efforts to contact all voters with the same party of registration whose deficiency is recorded in SURE around the same time.

Other limitations relate to generalizing our estimate of the effect of vote curing to contexts beyond Pennsylvania's 2024 general election. These limitations cannot be mitigated in the same way. In particular, Pennsylvania's electoral votes were thought to be central to winning the Electoral College. We thus expect that Pennsylvania voters were more cognizant

of the potential for mail ballots to be rejected, more motivated to correct any deficiencies, and more likely to be mobilized by campaigns to do so. As such, the effects we find in Pennsylvania may not necessarily apply in a context in which mail ballot deficiencies are less salient, voters care less about who wins, or campaigns are less actively supporting vote curing.

4 Measurement

We measure the effect of vote curing policies by leveraging multiple administrative datasets in Pennsylvania. In brief, we collect near-daily snapshots of the mail ballot status of all Pennsylvania registrants in SURE and pair this with a post-election voter file updated to reflect 2024 general election turnout. Together, these data allow us to identify the universe of voters who were recorded as submitting a deficient mail ballot and observe whether they corrected this mail ballot deficiency, either by ballot curing or ballot substitution. The data also allow us to validate a county's curing policy against media reports from before the election. We ultimately model the likelihood of a voter correcting their deficient mail ballot based on the county's notice and correction policies, accounting for an individual's party of registration, age, and other individual-level controls.

4.1 Baseline Sample

Our baseline sample captures the universe of approved mail ballot applicants who were ever recorded in SURE as returning a deficient mail ballot. For ease, we refer to the individuals in our sample as voters. To identify these voters, we collect all snapshots of the mail ballot file distributed by the state on most days between late September and late-November. Each snapshot of the mail ballot file reflects the status of a mail ballot in SURE at that point in time. In general, a mail ballot could be listed as not yet returned, returned, or deficient for a particular reason. Using these snapshots, we identify each voter who ever had a recorded status indicating a deficiency with either the outer or inner envelope of a returned mail ballot. Our approach thus captures both voters whose final mail ballot status is deficient,

as well as voters who initially returned a deficient mail ballot but whose ultimate status is no longer deficient. Let $Inner_i$ be 1 if voter i is ever recorded as having returned a mail ballot with an inner-envelope deficiency, and 0 otherwise.

Table 1 reports that there were more than 2.1 million approved mail ballot applicants, of which more than 90% returned a mail ballot. As is relevant here, our baseline sample consists of the 15,902 voters who were ever recorded as having an inner- or outer-envelope deficiency at some point in time, or about 0.8% of all approved applicants who returned mail ballots. Ultimately, 10,227 of these voters had their mail ballots rejected. The bottom panel of Table 1 details the final mail ballot status for this subset of voters.

Table 1: Mail Ballot Outcomes in 2024 General Election

	N	%
Approved Mail Ballot Applicants		
Sent Ballots	2,161,912	—
Returned Ballots	1,959,037	90.6%
Returned Mail Ballots with Envelope Error		
Ever Inner or Outer Envelope Error	15,902	0.81%
Ever Inner or Outer Envelope Error and Ultimately Rejected	10,227	0.52%
Ultimately Rejected Mail Ballots by Final Mail Ballot Status		
Undated Affidavit	1,758	0.09%
Misdated Affidavit	2,151	0.11%
Unsigned Affidavit	3,026	0.15%
No Secrecy Envelope	2,705	0.14%
Other	587	0.03%

Depending on our analyses, we further restrict our sample based on when a mail ballot was recorded as returned or when a mail ballot was recorded as deficient in the various snapshots of the mail ballot file. Let t_i^r be the date of the earliest mail ballot file in which voter i is recorded as returning a mail ballot. Similarly, let t_i^d be the date of the earliest mail ballot file in which voter i is recorded as returning a deficient mail ballot. For all analyses, we restrict the sample to mail ballots returned before Election Day, such that any

voter in our sample could have received contemporaneous notice of a deficiency and had an opportunity to correct it. We detail the additional sample restrictions about the date of recorded deficiency in each separate analysis.

4.2 Dependent Variable

We measure whether a voter corrected a deficient mail ballot by merging the sample of voters who ever returned deficient mail ballots to the voter file based on a registrant's unique identification number.[8] We characterize whether voters corrected deficient mail ballots based on whether their vote history in the voter file indicates that they successfully voted. We also identify how a deficient mail ballot is corrected by distinguishing between different vote methods. To continue our notation, let $Correct_i$ be an indicator for whether voter i is recorded as voting in the general election using any vote method. Further, let $Cure_i$ be an indicator for whether voter i is specifically recorded as voting by mail[9] and $Substitute_i$ be an indicator for whether voter i is specifically recorded as voting in-person on Election Day, including by provisional ballot.

4.3 Independent Variables

Our key independent variables are measures of whether a voter received notice of a mail ballot deficiency and had an opportunity to correct it.

4.3.1 Notice

We measure three types of notice of a mail ballot deficiency. The primary measure is when a mail ballot was recorded as deficient. Additional measures are whether the recording of a deficiency triggered an automatic email to the voter and whether a county had a policy of automatically returning the deficient mail ballot or sending a new mail ballot to the voter.

[8]Table A1 confirms that the voter file, collected in January 2025, has complete turnout information for nearly all registrants who voted in the November 2024 general election. Table A2 validates the merge of the mail ballot file with the voter file. Finally, Table A3 shows that the vote history in the voter file is generally consistent with the final mail ballot status in the mail ballot file.

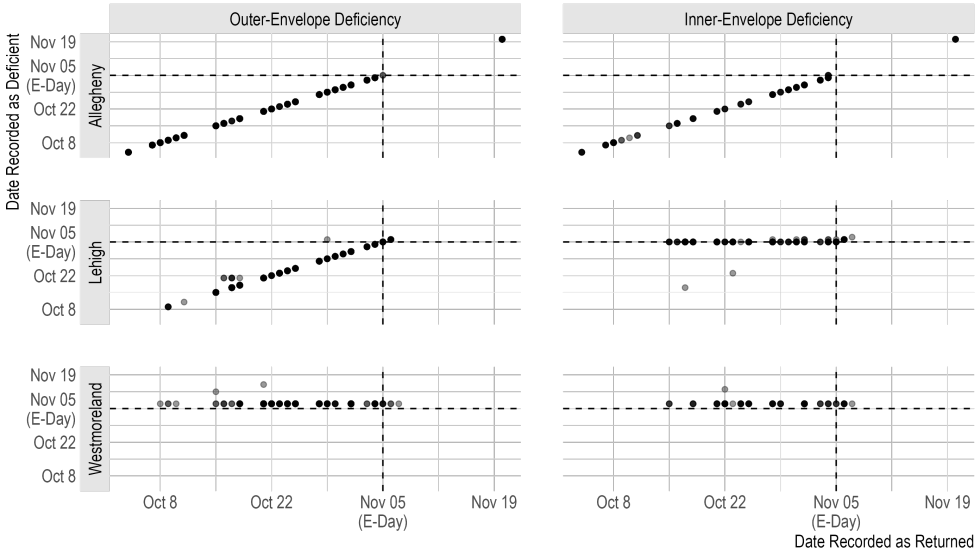
[9]The data do not allow us to differentiate between people who cured their original mail ballot and people who cast a new mail ballot because both are recorded as voting by mail. We assume that most people who returned a deficient mail ballot and ultimately voted by mail did so by curing the original mail ballot.

Recorded as Deficient We previously introduced t_i^d, which measures the first date on which a mail ballot was recorded as deficient in the statewide mail ballot file. At this point, a voter could learn their ballot was deficient by visiting the statewide ballot tracker or receiving either an official email or campaign outreach.

To illustrate the variation in pre-processing mail ballots, Figure 2 compares the first date that mail ballots were recorded as returned (t_i^r) versus recorded as deficient (t_i^d) in three illustrative counties. The figure is divided into facets, with the rows corresponding to the counties and columns corresponding to the type of deficiency. In Allegheny County, depicted in the first row, both inner- and outer-envelope deficiencies were generally recorded in the statewide database on the same day that the ballot was recorded as returned. In contrast, Lehigh County, depicted in the second row, generally recorded outer-envelope deficiencies concurrent with recording the ballot as returned, but did not record inner-envelope deficiencies until Election Day. Finally, Westmoreland County did not record any mail ballots as deficient until the day after Election Day, no matter when they were recorded as returned. Below, we address how there are also some observations that do not follow these trends. These observations appear gray because each mail ballot is plotted with transparency, such that overlapping observations are darker.

Nonetheless, the general patterns in Figure 2 make clear that counties provided different levels of notice about deficiencies on ballots returned before Election Day. Figure 3 summarizes county notice policies based on the share of such ballots that counties recorded as deficient before Election Day, compared to on or after Election Day. Let $\mathbb{1}(t_0 < t < t_1)$ be a function equal to 1 if date t falls between dates t_0 and t_1. Thus, $\mathbb{1}(t_i^d < t_{\text{ED}})$ indicates whether voter i's ballot deficiency was recorded before Election Day (i.e., t_{ED}). Further, let $c(i)$ be a function which returns the county of voter i. Our measure of the share of inner-envelope errors recorded in county c before Election Day is $RecordedInner_c = \frac{\sum_{c(i)\in c} \mathbb{1}(t_i^d < t_{\text{ED}}) * \mathbb{1}(t_i^r < t_{\text{ED}}) * Inner_i}{\sum_{c(i)\in c} \mathbb{1}(t_i^r < t_{\text{ED}}) * Inner_i}$. Analogously, we measure the share of outer-envelope errors recorded in county c before Election Day using $RecordedOuter_c = \frac{\sum_{c(i)\in c} \mathbb{1}(t_i^d < t_{\text{ED}}) * \mathbb{1}(t_i^r < t_{\text{ED}}) * (1 - Inner_i)}{\sum_{c(i)\in c} \mathbb{1}(t_i^r < t_{\text{ED}}) * (1 - Inner_i)}$. Figure 3 compares $RecordedOuter_c$ on the x-axis with $RecordedInner_c$ on the y-axis, mapping the number of mail ballots to the size of the dot

Figure 2: Illustrating Variation in Pre-Processing



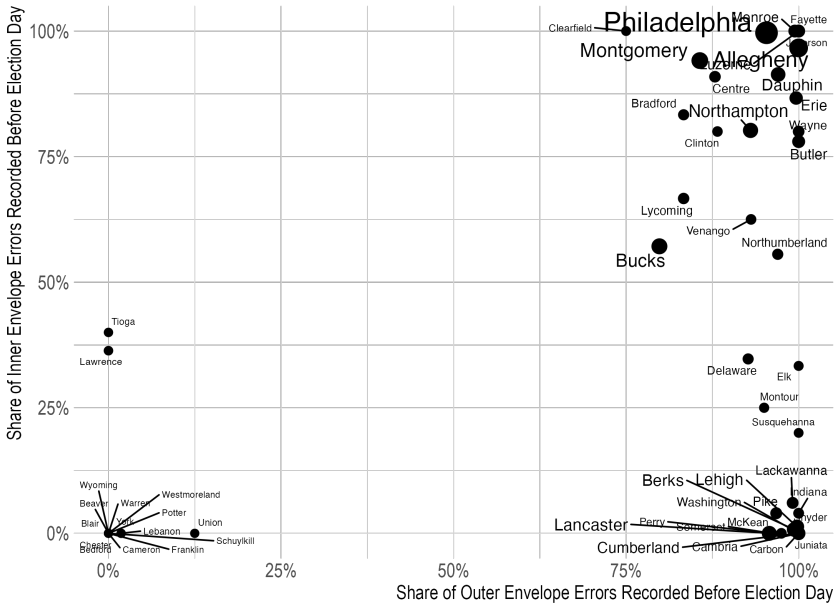
and label.[10]

Overall, there are three observed types of county notice policies in Figure 3. First, counties in the top right of the figure generally facilitated notice of both outer- and inner-envelope deficiencies before Election Day. Second, counties in the bottom left generally did not facilitate notice prior to Election Day. Finally, counties in the bottom right generally facilitated notice for outer-envelope deficiencies before Election Day, but not for inner-envelope deficiencies. We refer to these three types of counties as, respectively, all-notice, no-notice, and split-notice counties.

Together, Figures 2 and 3 also suggest that there is some amount of idiosyncratic variation in the recording of mail ballots as deficient. For example, Figure 2 shows that a few ballots in Lehigh were recorded as deficient before Election Day but after they were recorded as returned. Table A4 shows that this ratio of generally contemporaneous, but sometimes delayed, notice matches the general pattern in other counties statewide. Figure 2 also shows that Lehigh recorded a small number of inner-envelope deficiencies before

[10]Figure 3 is limited to counties that recorded at least one inner- and one outer-envelope deficiency.

Figure 3: Observed Notice Policies by County



Election Day and that both Allegheny and Lehigh recorded some deficiencies after Election Day. The fact that Figure 3 has few county shares at either 0% or 100% shows that similar deviations occurred in many other counties too. There are several potential explanations for these deviations, including variation in election administration compliance and measurement error in SURE. These different explanations motivate our sample restrictions and use of instrumental variables, which we discuss more below.

Email We separately measure whether the recording of a deficiency triggered an automatic email to the voter from the SURE system. Let $Email_i$ be an indicator for whether voter i provided an email address with their mail ballot application. Only voters who provided an email address received an automatic notification when their mail ballot was recorded as deficient, with instructions on correction opportunities as shown in Figure A3 (Pennsylvania Department of State and Secretary Al Schmidt 2024). However, voters who did not provide an email could still learn about their mail ballot's deficiency if they visited the statewide

ballot tracker or were contacted by campaigns, or if the county undertook additional notice measures, such as calling voters.

Returned Mail Ballot We finally measure whether a county returned a deficient mail ballot or sent a new mail ballot to a voter. Let $MailBack_{c(i),t_i^d}$ be an indicator for whether county $c(i)$ automatically returned or replaced mail ballots recorded as deficient by t_i^d. The statewide mail ballot file does not contain information on which counties mail back ballots. Instead, we rely on media reporting in the run-up to the election to learn which counties adopted this practice (ACLU of Pennsylvania 2024; Walker 2024). The information is particularly relevant because we expect that a returned mail ballot functioned as a particularly salient type of notice, especially for voters who did not receive an automatic email notification.

4.3.2 Ballot Curing

We construct a combined measure of whether a county permitted voters to cure their mail ballot deficiencies before Election Day, based on both observed and reported outcomes.

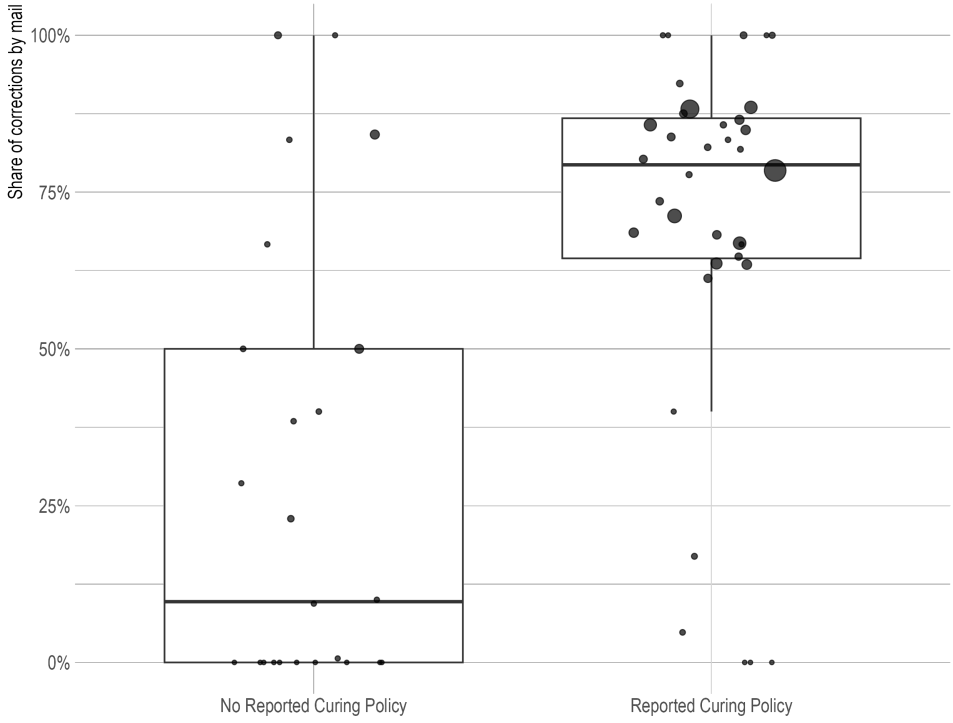
We first create an outcome-based measure of county practices using the merged mail ballot and voter file. We start with voters who correct a mail ballot deficiency—that is, they submitted a deficient mail ballot at some point in time and have a recorded vote in the voter file. Let $ObservedCure_{c(i)}$ be the share of voters correcting a mail ballot deficiency in county $c(i)$ who have a mail vote method in the voter file. In counties which permitted ballot curing before Election Day, we expect a substantial share of corrections to come from mail voting, although some people will instead substitute to in-person voting.

To supplement our outcome-based measure, we also look to media reporting. Prior to the election, both the ACLU of Pennsylvania and the media organization Votebeat published summary descriptions of whether each county planned to permit curing based on public records requests, litigation, meeting minutes, other media reports, and state data (ACLU of Pennsylvania 2024; Walker 2024). Let $ReportedCure_{c(i)}$ be an indicator of whether either the ACLU or Votebeat reported that county $c(i)$ planned to allow voters to cure mail ballot

deficiencies.

Figure 4 compares the two measures of county cure policy. The x-axis depicts $ReportedCure_{c(i)}$, while the y-axis shows $ObservedCure_{c(i)}$. The size of each dot is proportional to the number of mail ballots in the sample. Overall, we observe more corrections by mail ballot in counties which were reported to permit curing than to forbid it. Importantly, we also observe non-trivial amounts of correction by mail ballot in many counties which reported that they would not permit curing.

Figure 4: Measurement of County Cure Policy



We ultimately prefer a combined approach to address concerns about each separate measure. First, our outcome-based measure relies on counties correctly recording vote method in the voter file. For example, media reports indicated that Chester County permitted ballot curing before Election Day even though our outcome-based measure would suggest they did not (Table A7). Second, media reporting may not accurately capture a county's practice.

For one, the concept of curing may be subject to different interpretations. For another, a county may have updated their policy between the media reports and the election.

Let $CombinedCure_{c(i)}$ be an indicator for whether either $ReportedCure_{c(i)}$ is 1 or $ObservedCure_{c(i)}$ is greater than a 60% threshold. We use 60% because Figure 4 shows that the vast majority of counties reported to permit curing had an $ObservedCure_{c(i)}$ of at least 60%. We thus suspect that all counties which reached this threshold did permit curing, whether the media reported it or not.

4.4 Controls

We finally construct a series of controls using information contained in both the mail ballot file and the voter file. We first address the complex role of partisanship, which influences the adoption of vote curing policies across counties, the likelihood that a voter actually learns that their mail ballot is deficient, and even the interest of a voter in taking advantage of any opportunity to correct a deficiency. We then address other individual-level characteristics which we expect also relate to voters' likelihood of correction.

4.4.1 Partisanship

Table 2 makes clear that partisanship was an important determinant of a county's vote curing policy. The first row provides baseline statistics for all voters in Pennsylvania, while the remaining rows break out voters by the types of observed notice and correction policies shown in Figures 3 and 4.[11] For example, Trump won 50.4% of the vote statewide. Relative to this statewide baseline, Trump won about 8 p.p. less of the vote in counties that generally provided notice of all mail ballot deficiencies and about 4 p.p. less of the vote in counties that generally permitted ballot curing. The party of registration of voters with deficient mail ballots follows a similar trend. Overall, 56.1% of voters who ever returned a deficient mail ballot statewide were registered Democrats. However, voters who returned deficient mail ballots were about 7 p.p. more likely to be Democrats in counties that provided notice

[11] Table 2 summarizes a county's notice policy based on whether $RecordedInner_c > 0.5$ and $RecordedOuter_c > 0.5$.

about all errors and about 4 p.p. more likely to be Democrats in counties that permitted curing.

Table 2: Partisan Demographics by Observed Vote Curing Policies

	All Voters		Voters with Deficient Mail Ballots		
	Total Votes	Trump Share	Party Share		
			Rep.	*Dem.*	*Other*
Statewide	7,034,206	50.4%	31.9%	56.1%	12.0%
By Observed Notice Policy					
All Notice	3,609,250	42.8%	25.5%	62.9%	11.6%
Split Notice	1,794,592	55.0%	39.3%	47.4%	13.3%
No Notice	1,630,364	61.9%	47.0%	41.4%	11.6%
By Cure Policy					
Allowed	5,411,108	46.3%	28.3%	59.7%	12.1%
Did Not Allow	1,623,098	64.1%	47.3%	41.1%	11.5%

Together, the implication of Table 2 is that voters in more Democratic counties had more opportunity to correct a deficient ballot than voters in more Republican counties. To account for this, our evaluation of the effect of notice on correction will control for the county of each voter using a county fixed-effect. As explained in detail below, our model of notice will ultimately be identified by the variation in notice within split-notice counties, such as Lehigh in Figure 2, rather than across all counties. The primary benefit of a within-county design is that all voters in a county are subject to the same notice and correction policy once a ballot is recorded as deficient. In contrast, voters across counties may have been provided differential opportunities to cure ballots before Election Day or received additional notice provided by particular county election officials or county chapters of political parties. The within-county design also accounts for the fact that vote curing policy was endogenous to a county's politics by comparing voters situated in the same political environment. However, as discussed below, our model for curing cannot include a county fixed-effect because that policy does not vary within a county.

The relationship between county partisanship and policy likely reflects the fact that

Republicans in Pennsylvania currently stand to gain fewer votes from vote curing than Democrats. The pattern of litigation about Pennsylvania's mail ballot rules likely reflects the same phenomenon. Table 2, above, suggests that voters who return deficient mail ballots are disproportionately Democratic. Table A5 clarifies that Democrats and Republicans are about equally likely to return a deficient mail ballot, but Democrats in Pennsylvania are substantially more likely than Republicans to vote by mail. As a result, Figure A4 suggests that vote curing today would only net Republican votes in counties in which Republicans have about a 20 p.p. registration advantage over Democrats.

A further implication, then, is that we expect Democratic voters were more likely to be contacted by a campaign about their mail ballot deficiency than Republican voters. In general, we expect that political campaigns played a prominent role informing people of their deficient mail ballots using the information on mail ballot statuses provided by the state. Importantly, because of the differential partisan benefits available by vote curing, we expect the Democratic Party was more likely to invest resources in contacting people with deficient mail ballots than the Republican Party. However, as explained above, we cannot observe the extent of notice received by any particular voter. Instead, we control for a voter's party of registration. We assume that political campaigns put in similar efforts to contact all voters with the same party of registration whose deficiency is recorded around the same time. Further, the county fixed-effect accounts for any differences in the level of outreach to all voters in more Democratic compared to more Republican counties.

Accounting for party of registration is also helpful for a more general reason. In short, we also expect that people registered with either major political party were more likely to receive outreach than people registered with no party, for the simple reason that political campaigns are likely to devote limited resources to those persons most likely to be supporters.

4.4.2 Likelihood of Correction

We control for several other variables which we expect also relate to a voter's likelihood of correcting a mail ballot deficiency.

Previous work makes clear that age is positively related to the likelihood of correction

(Meredith and Kronenberg 2023). Further, as Table A6 shows, age is also negatively associated with whether a voter provided an email address when applying for a mail ballot. We thus control for a voter's age.

We also expect voters' likelihood to act upon notice will be related to both their political engagement as well as their practical ability to correct the deficiency. We proxy for political engagement in several ways. One measure of political engagement is how often someone previously voted. We expect that people who voted more often in the six general elections between 2018 and 2023 will be more likely to correct any deficient mail ballots. Another measure of political engagement is the number of weeks prior to Election Day that someone returned their mail ballot. Here, we expect that voters who return their mail ballots earlier will be more interested in taking advantage of notice than voters who return their mail ballots later.

We also expect voters' likelihood of correction will be related to both their access to in-person voting on Election Day as well as the amount of time they have to take action. We construct several proxies. First, we measure the prior number of mail votes cast in general elections between 2018 and 2023. We expect that voters who routinely vote by mail generally have less access to in-person voting on Election Day than other voters. Second, we also identify voters who had their mail ballot sent to a zip code other than their zip code of registration. Following Meredith et al. (2024), we expect that these voters had less access to Election Day voting in the 2024 general election than other voters. Finally, in our correction analysis, we measure the amount of time to take action based on the week in which a mail ballot was recorded as deficient, because voters with an earlier recorded deficiency have more opportunity to act upon notice than voters with later recorded deficiencies.

5 Results

Using our data, we investigate the effect of vote curing policies in Pennsylvania's 2024 general election. We start with notice and then turn to opportunities for ballot curing.

5.1 Notice

We first motivate our sample restriction with statewide statistics, then introduce our design, and finally present our estimates of the effect of notice on mail ballot correction.

Table 3 breaks out the voters whose mail ballots were ever recorded as deficient based on the time of deficiency (t_i^d) and the vote method recorded in the voter file. Overall, we observe a correction rate of about 53%, most of which comes from voting by mail rather than voting on Election Day. We also observe much higher rates of correction among voters whose mail ballot is recorded as deficient before versus on Election Day, although a non-trivial number of voters whose mail ballot was only recorded as deficient on Election Day still managed to correct the deficiency. More specifically, voters corrected about two-thirds of mail ballots recorded as deficient before Election Day and about a quarter of mail ballots recorded as deficient on Election Day. Consistent with our expectations, voters who had advance notice primarily corrected their vote by mail, while voters who only had notice on Election Day instead substituted to cast an in-person ballot.

Table 3: Mail Ballot Correction by Time of Recorded Deficiency

			By Vote Method	
	Ever Deficient	% Corrected	% Mail	% Election Day
Overall	15,902	53.1%	37.5%	15.6%
By Time Recorded as Deficient				
Before Election Day	10,917	68.9%	51.7%	17.2%
On Election Day	1,914	27.8%	2.3%	25.5%
After Election Day	3,071	12.5%	8.6%	3.9%

The final row of Table 3 shows that some persons whose mail ballots were not recorded as deficient until after Election Day nonetheless are recorded as having voted. A voter may have voted provisionally on Election Day before their mail ballot was recorded as deficient because they anticipated their mail ballot would be rejected. However, we suspect that many of these cases represent measurement error in either the mail ballot file or the voter file.[12] Such measurement error would make the 15 p.p. difference in correction rates between

[12] In these cases, the mail ballot file could have an error in either the date of deficiency or the status,

deficiencies recorded on versus after Election Day understate the effect of providing the bare minimum of notice relative to no notice at all.

To be cautious, we ultimately restrict our sample in this sub-section to voters whose mail ballots were returned before Election Day and recorded as deficient by Election Day.[13] The former restriction ensures that all of the mail ballots in this analysis could have been recorded as deficient before Election Day, while the latter restriction responds to concerns that measurement error would lead us to underestimate the effect of notice. As a result, our empirical approach cannot inform us about the effect of all possible notice policies. In particular, we estimate the effect of providing more versus less notice, rather than providing the minimum notice versus no notice at all.

Equation (1) shows how we estimate the effect of notice. In addition to a county fixed effect ($\gamma_{c(i)}$) and an indicator for the type of deficiency ($Inner_i$), Equation (1) models correction as a function of an indicator for whether the deficiency was recorded before Election Day ($\mathbb{1}(t_i^d < t_{\text{ED}})$), an indicator for whether voter i included an email address on their mail ballot application ($Email_i$), indicators for the week that a mail ballot was recorded as returned in the statewide database ($\mathbb{1}(t_{ED} - 1 - 7j \leq t_i^r < t_{ED} - 1 - 7(j-1))$ for $j \in 1, 2, 3, 4$),[14] and other voter-level characteristics (X_i). As detailed above, these characteristics include not only party of registration but also voter age, prior vote history, prior mail ballot usage, and whether the mail ballot was sent beyond their zip code of registration.

while the voter file could have an error in its vote history. For one, some people likely voted provisionally on Election Day before their mail ballot was recorded as deficient because an election official informed them about the deficiency by Election Day without going through the statewide database. For another, the mail ballot file could have incorrectly described a returned mail ballot as being deficient. Finally, the voter file could have incorrectly recorded a person as voting by mail. This could occur either because an election official generally marked people as voting when they returned any mail ballot or specifically because they treated a provisional ballot as curing the mail ballot deficiency.

[13] This excludes 669 mail ballots included in Table 3 that were recorded as deficient on Election Day because they were also returned on Election Day.

[14] The indicator is top-coded at four weeks before Election Day, while the excluded category is the day before Election Day.

$$Corrected_i = \gamma_{c(i)} + \delta Inner_i + \beta \mathbb{1}(t_i^d < t_{ED}) + \theta Email_i + \sum_{j=1}^{4} \lambda_j \mathbb{1}\big(t_{ED} - 1 - 7j \leq t_i^r < t_{ED} - 1 - 7(j-1)\big) + \kappa X_i + \epsilon_i \quad (1)$$

Equation (1) is identified by within-county variation in whether ballots were recorded as deficient before versus on Election Day in the same county. The benefit of such a design is that it allows us to account for differences over counties, including in correction opportunities, that lead voters to correct ballots at different rates. However, our within-county design could leverage two different types of variation in notice. First, there is the policy-induced variation in the notice applied to mail ballots with outer- versus inner-envelope errors in split-notice counties. Second, there may also be idiosyncratic variation in how mail ballots with the same type of deficiency are treated within the same county. In general, we prefer a design that leverages the policy variation because it is clear what causes the differential notice. Such a design relies on some counties generally providing notice prior to Election Day about both inner- and outer-envelope deficiencies to identify any baseline difference in the rates of correction among voters who return ballots with the two different types of deficiencies.

Table 4 presents estimates of Equation (1) using both OLS and an instrumental variables approach.[15] The OLS regression leverages both the policy-induced and idiosyncratic variation in the notice given to deficient ballots in the same county. In contrast, the instrumental variable regression isolates the within-county variation in notice that is driven by policy as opposed to idiosyncrasy. Specifically, we instrument for whether a specific deficient ballot received notice before Election Day based on whether a majority of deficiencies of the same type in the same county were recorded before Election Day ($\mathbb{1}(RecordedInner_c > 0.5)$ or $\mathbb{1}(RecordedOuter_c > 0.5)$). Finally, given the autocorrelation of some of our independent variables among voters who reside in the same county, we cluster standard errors by county when estimating Equation (1).

[15] See Table A8 for the full regression table.

Table 4: Effect of Notice on Correction

	OLS			IV		
	(1)	(2)	(3)	(4)	(5)	(6)
Notice						
Recorded before E-Day	0.307	0.317	0.320	0.241	0.261	0.248
	(0.049)	(0.048)	(0.050)	(0.048)	(0.049)	(0.053)
Provided Email	0.100	0.091	0.100	0.100	0.091	0.100
	(0.011)	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)
Mail Ballot Return						
1 Week Before E-Day	0.160	0.154	0.144	0.161	0.155	0.143
	(0.039)	(0.035)	(0.040)	(0.039)	(0.035)	(0.041)
2 Weeks Before E-Day	0.318	0.298	0.280	0.319	0.298	0.280
	(0.038)	(0.035)	(0.039)	(0.039)	(0.035)	(0.039)
3 Weeks Before E-Day	0.383	0.347	0.331	0.385	0.348	0.332
	(0.041)	(0.037)	(0.042)	(0.041)	(0.037)	(0.043)
4+ Weeks Before E-Day	0.394	0.345	0.328	0.395	0.346	0.328
	(0.041)	(0.036)	(0.043)	(0.041)	(0.037)	(0.043)
Error Type						
Inner Envelope Error	-0.070	-0.056	-0.060	-0.085	-0.069	-0.078
	(0.024)	(0.024)	(0.028)	(0.028)	(0.028)	(0.034)
County Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Voter Demographics	No	Yes	Yes	No	Yes	Yes
Drop Mail Back Counties	No	No	Yes	No	No	Yes
First-Stage F-Statistic	--	--	--	473.43	473.6	308.59
Observations	12,162	12,162	10,238	12,162	12,162	10,238

Table 4 shows that voters who were provided earlier notice of their deficient mail ballots were substantially more likely to correct them. The first three columns report estimates of Equation (1) using OLS, while the latter three columns report estimates using instrumental variables. The first column shows results without voter-level characteristics, the second includes them, and the third drops voters in counties which automatically mailed back deficient ballots. Based on column 1, having a mail ballot recorded as deficient before

Election Day is associated with about a 30 p.p. increase in correction relative to a ballot recorded as deficient on Election Day. Consistent with our theory, voters who returned their mail ballots earlier (and thus had more time to correct a deficiency) were more likely to correct. Additionally, being sent an email about the deficiency increased correction by about 10 p.p. Adding controls for voter-level characteristics in column 2 and dropping counties which mailed back deficient ballots in column 3 does little to change these estimates. The instrumental variable approach reported in the final set of columns produces similar results, albeit with an estimated effect of about 25 p.p. rather than 30 p.p. for recording a mail ballot as deficient before versus on Election Day.

Based on the available evidence, we think the estimates in Table 4 are likely to generalize from split-notice counties to the counties that did not generally provide notice. As explained above, we expect that the effect of notice across counties will be driven in large part by the extent of campaign outreach to voters who return deficient mail ballots. Consistent with the differential partisan incentives of campaigns, Table A8 reports that, relative to people registered with no party, Republicans were nearly 17 p.p. less likely to correct deficient ballots while Democrats were about 4 p.p. more likely to do so. At least on this front, split-notice counties have a more similar partisanship to no-notice than all-notice counties (Table 2). Moreover, Figure A5 shows that the differences in correction rates between Democrats and Republicans in split-notice counties were similar to the differences statewide.

5.2 Curing

We next focus on estimating the effect of opportunities to cure mail ballots before Election Day on the rates of both curing specifically and correction generally. We restrict our sample in this sub-section to mail ballots recorded as deficient before Election Day because the ability to cure mail ballots is not helpful for voters who could not learn about the deficiency in time to take advantage of the opportunity.

In contrast to our within-county analysis of notice, we largely leverage variation across counties to estimate the effect of cure opportunities. In general, all voters in the same county had the same cure opportunities. However, within a particular county, we can take

advantage of variation in a voter's ability to cure. We focus on two sets of variables in particular. The first are indicators constructed based on the value of t_i^d, which denotes when a returned mail ballot was first recorded as deficient. Our expectation is that the benefits of cure opportunities will decrease the later the ballot is recorded as deficient, as this will leave voters with less time to cure by the Election Day receipt deadline. The second is an indicator denoting whether voter i had their mail ballot sent to a different zip code than their zip code of registration ($DifferentZip_i$).[16] Our expectation is that voters who send their mail ballots to a different zip code than their zip code of registration will have less ability to take advantage of cure opportunities that require them to be in person at specific locations in their county of registration.

Equation (2) shows how we estimate the relationship between cure opportunities and the rates that mail ballots were cured and corrected. Let Y_i represent the outcome of interest for voter i, which can either be $Cure_i$ (voted by mail) or $Corrected_i$ (voted by any method). Y_i is modeled as a function of an indicator for the presence of curing opportunities in voter i's county ($CombinedCure_{c(i)}$), an indicator for whether voter i had their deficient ballot automatically returned or replaced ($MailBack_{c(i),t_i^d}$), an indicator for whether voter i had their mail ballot sent to a different zip code than their zip code of registration ($DifferentZip_i$), and indicators for the week that a mail ballot was recorded as deficient in the statewide database ($\mathbb{1}(t_{ED} - 1 - 7j \leq t_i^d < t_{ED} - 1 - 7(j-1))$ for $j \in 1, 2, 3, 4$).[17] While our baseline specification examines each of these variables separately, we also estimate specifications that include interactions between these measures. We finally account for voter-level characteristics (X_i) in various specifications, as detailed above.[18]

[16] We drop 144 observations for which the mail ballot file does not record where the mail ballot was sent, perhaps because the mail ballot was requested and returned at a county election office.

[17] The indicator is top-coded at four weeks before Election Day, while the excluded category is the day before Election Day.

[18] As noted above, some counties in Pennsylvania allowed voters to return mail ballots at a drop box staffed by election officials, and some counties allowed voters to receive and immediately return mail ballots at election offices prior to the mail ballot application deadline. While neither of these policies should directly affect the rates at which deficient ballots are corrected, they may prevent some deficient ballots from being returned in the first place. For example, an election official could alert a voter that the affidavit on the outer envelope of a mail ballot was left unsigned or undated. In theory, a selection model could be used to account for any compositional differences in voters who return deficient mail ballots in different counties that are not accounted for by our control variables (for example, see Baringer et al. 2020, for a similar application of a selection model). However, we have not yet identified a variable that should affect the likelihood of returning a deficient ballot but not a voter's ability to correct that ballot. We believe this would be a productive

$$Y_i = \gamma CombinedCure_{c(i)} + \delta MailBack_{c(i),t_i^d} + \beta DifferentZip_i + \sum_{j=1}^{4} \lambda_j \mathbb{1}(t_{ED} - 1 - 7j \leq t_i^d < t_{ED} - 1 - 7(j-1)) + \kappa X_i + \epsilon_i \quad (2)$$

Table 5 presents our results.[19] The first three columns report estimates of Equation (2) when the dependent variable is whether the voter successfully cast a mail ballot, while the latter three columns report estimates when the dependent variable is whether the voter successfully cast any type of ballot, including in person on Election Day. In all specifications we estimate Equation (2) using OLS and cluster standard errors by county because all voters in the same county share the same value of $CombinedCure_{c(i)}$.

The first three columns of Table 5 confirm that a significant number of voters took advantage of cure opportunities.[20] The first column highlights that voters who initially returned a deficient mail ballot were about 44 p.p. more likely to cast a counted mail ballot in counties that had cure opportunities compared to those counties that did not. This increased to about 62 p.p. in counties that also automatically returned or replaced mail ballots, given that all of these counties are also coded as providing cure opportunities. Further, we observe the expected pattern that voters were more likely to cure ballots the earlier their ballot was recorded as deficient. Also as expected, voters were less likely to cure when they initially sent their mail ballot to a different zip code than their zip code of registration. The second column reveals very similar relationships between these variables and cure rates when controlling for several individual-level characteristics of voters. Finally, column three shows that certain types of voters were more likely to take advantage of access to cure opportunities. Specifically, there were larger differences in cure rates between counties with and without cure opportunities among voters whose deficiencies were recorded long before Election Day than among voters whose deficiencies were recorded just before

direction for future research.

[19] Table A9 shows the results are robust to different measurements of $CombinedCure_{c(i)}$ using a 25% rather than 60% threshold.

[20] See Table A10 for the full regression table.

Election Day. In contrast, being in a county with cure opportunities was less consequential for voters who sent their mail ballots outside of their zip code of registration than voters who sent their mail ballots to their registration zip code.

The remaining columns of Table 5 show that having cure opportunities not only associates with more ballot curing before Election Day, but also more overall correction, including on Election Day. In most cases the coefficients are in the same direction but with a smaller absolute magnitude. This is consistent with some, but not all, voters in counties which lacked cure opportunities instead substituting to a new ballot on Election Day. In particular, the likelihood voters ultimately had their votes counted by any method increased by about 10 p.p. when voters had any opportunity to correct the deficiency before versus on Election Day and further increased to about 25 p.p. in counties that also automatically returned or replaced deficient ballots. The one notable exception is that there is a larger difference in correction rates than cure rates for voters who sent their mail ballots beyond their zip code of registration versus to their zip code of registration. The exception is consistent with our expectation that voters who sent their mail ballots beyond their zip code of registration had relatively less access to their polling place than voters who sent their mail ballots to their zip code of registration.

Table 5: Effect of Cure Opportunity on Correction

	Outcome: Mail			Outcome: Voted		
	(1)	(2)	(3)	(4)	(5)	(6)
Cure Opportunity						
Permitted Curing	0.436	0.404	0.036	0.165	0.117	0.101
	(0.092)	(0.093)	(0.023)	(0.026)	(0.025)	(0.090)
Returned Deficient Mail Ballots	0.192	0.190	0.198	0.141	0.141	0.147
	(0.015)	(0.018)	(0.017)	(0.014)	(0.014)	(0.013)
Mail Ballot Sent to Different Zip	-0.137	-0.106	0.022	-0.233	-0.208	-0.105
	(0.029)	(0.034)	(0.024)	(0.025)	(0.028)	(0.082)
Provided Email	0.084	0.080	0.081	0.115	0.104	0.104
	(0.014)	(0.014)	(0.013)	(0.011)	(0.011)	(0.011)
Mail Ballot Deficiency Recorded						
4+ Weeks before E-Day	0.581	0.517	0.034	0.455	0.407	0.365
	(0.032)	(0.037)	(0.102)	(0.022)	(0.023)	(0.101)
3 Weeks before E-Day	0.572	0.533	0.097	0.444	0.424	0.378
	(0.033)	(0.036)	(0.115)	(0.024)	(0.026)	(0.106)
2 Weeks before E-Day	0.477	0.456	0.103	0.382	0.374	0.366
	(0.036)	(0.038)	(0.108)	(0.024)	(0.025)	(0.092)
1 Week before E-Day	0.253	0.253	0.050	0.199	0.205	0.206
	(0.025)	(0.026)	(0.026)	(0.022)	(0.019)	(0.078)
Interactions						
Cure Opportunity x 4+ Weeks before E-Day			0.513			0.043
			(0.104)			(0.102)
Cure Opportunity x 3 Weeks before E-Day			0.467			0.048
			(0.118)			(0.108)
Cure Opportunity x 2 Weeks before E-Day			0.369			0.005
			(0.112)			(0.095)
Cure Opportunity x 1 Week before E-Day			0.201			-0.005
			(0.034)			(0.080)
Cure Opportunity x Sent to Different Zip			-0.113			-0.096
			(0.030)			(0.085)
Returned Deficient Mail Ballot x Sent to Different Zip			-0.156			-0.101
			(0.024)			(0.023)
Voter Demographics	No	Yes	Yes	No	Yes	Yes
Observations	10,773	10,773	10,773	10,773	10,773	10,773

6 Discussion

We evaluate the effectiveness of vote curing policies in an era of increased attention on voting by mail. We first offer a typology of vote curing and then consider its effects in Pennsylvania, where each county has discretion about when to record deficient mail ballots and whether voters could cure deficiencies before Election Day.

Our results show that vote curing substantially reduces lost votes by mail. We find substantively meaningful differences in whether voters corrected mail ballot deficiencies based on whether the deficiency was recorded before versus on Election Day (25 p.p.), the recording triggered an email about the deficiency (10 p.p.), and there was an option to cure the deficiency before Election Day (10 p.p.).

Our evidence is thus relevant to emerging legal arguments about vote curing, particularly in Pennsylvania. To be sure, the nascent litigation about both procedural due process and the equal protection principle in *Bush v. Gore* has so far proceeded without much empirical evidence. For one, in its assessment of procedural due process, the Pennsylvania Supreme Court simply assumed that the effect of notice would be meaningful (Ctr. for Coalfield Just. v. Washington Cnty. Bd. of Elections 2025). For another, there was no need to consider empirics after a Pennsylvania federal court declined to extend *Bush v. Gore* to the correction of mail ballots in the aftermath of the 2020 election (Donald J. Trump for President, Inc. v. Boockvar 2020). Nonetheless, we expect empirical evidence to be relevant to future litigation efforts on both doctrinal fronts.

The Pennsylvania Supreme Court is likely to face more litigation about the extent of notice required for deficient mail ballots. Despite some suggestions to the contrary (see, e.g., Eakin v. Adams Cnty. Bd. of Elections 2025b), the Court's 2025 procedural due process decision did not require counties to pre-process mail ballots in order to timely identify deficiencies (Ctr. for Coalfield Just. v. Washington Cnty. Bd. of Elections 2025). Instead, it simply required that if a county were to pre-process mail ballots, it must disseminate information about them. In the future, we expect the Court to eventually consider whether to require counties to pre-process mail ballots in order to facilitate notice. At that point, the

"probable value" of notice (Mathews v. Eldridge 1976) will become particularly relevant, because the Court will need to balance the benefit of requiring notice with the relevant state interests. Among those interests might be preserving electoral integrity and managing administrative burden, including the cost of reworking county election administration.

We ultimately see little state interest in delaying the processing of mail ballots until Election Day. The prompt recording of which mail ballots will be rejected poses no threat to electoral integrity. Further, local election officials are already responsible for identifying deficient mail ballots as part of the canvassing process. At least in Pennsylvania, which canvasses mail ballots in a central county location rather than by local precincts, the additional burden would seem modest at most, particularly relative to the expected benefits for voters.[21] In general, requiring mail ballots to be processed before Election Day would shift the task from a more to a less busy time for election officials (Manson and Gronke 2025). The dissemination of information about deficiencies is not particularly burdensome either. In particular, local election officials in Pennsylvania do not need to manually contact each individual voter to inform them of a deficiency. Instead, they can rely on an automated email notification rather than election official labor and can publicly post the information to facilitate other outreach too. If anything, such transparency supports, rather than diminishes, electoral integrity.

Relative to the procedural due process litigation, it is less clear whether a court will embrace any effort to extend the equal protection principle in *Bush v. Gore*. Some courts have suggested that policies which increase voter access are subject to less scrutiny, although the carve-out fits awkwardly with *Bush v. Gore* (Morley 2017). For his part, Morley has argued that differences in the opportunity to correct a mail ballot should be judged against the uniformity principle found in *Bush v. Gore*. Under this interpretation, our results support Morley (2023)'s argument that "because voters in certain counties are given a second bite at the apple if their [mail] ballot is ... deficient, the likelihood that their vote will ultimately be counted is greater."

[21] Beyond Pennsylvania, local election officials in many states are already required to record deficient mail ballots before Election Day (National Conference of State Legislatures 2025b). In general, the different vote counting processes across states may affect the degree to which moving up the task in the election calendar would affect the administrative burden.

To the extent *Bush v. Gore* is relevant to vote curing, the debate has generally focused only on the correction of mail ballots. However, our theoretical approach to vote curing presents both notice and correction as necessary, interdependent components of a single policy. The Pennsylvania Supreme Court embraced this relationship: the state court's decision extending notice for known mail ballot deficiencies depended in part on the availability of a correction opportunity on Election Day (Ctr. for Coalfield Just. v. Washington Cnty. Bd. of Elections 2025). Further, our results also underline how unlikely it is for a voter to correct a mail ballot absent notice.[22] Importantly, however, our study focuses on the general value of recording mail ballots as deficient before Election Day rather than the specific value of recording them within a particular time after receipt. Further, while pre-processing in some form is necessary for notice before Election Day, the specific timeline for pre-processing is fundamentally unlike the recount standards at issue in *Bush v. Gore* or even correction opportunities. In short, recount standards determine whether a particular ballot is valid, and correction opportunities determine whether a particular person may correct an otherwise invalid ballot. In contrast, pre-processing timelines reflect internal, administrative decisions that have implications for election administration beyond just vote curing. Further, differential implementation of pre-processing because of differences in county size or budget may not be the same type of "arbitrary and disparate treatment" at issue in *Bush v. Gore*. Finally, even Morley's broad reading of *Bush v. Gore* does not suggest it would extend to such granular details (Morley 2020, 2023). Perhaps that is because embracing the minutiae of pre-processing as coming within the ambit of *Bush v. Gore* threatens to sweep much of local election administration in with it.

Ultimately, resolving the various open doctrinal questions about *Bush v. Gore* is beyond the scope of our current effort. Nonetheless, statewide uniformity across local election administration remains an important consideration. In fact, there is some concern among the dissenting justices on the Pennsylvania Supreme Court that judicial efforts to require

[22]For example, consider the differences between Allegheny County, home to Pittsburgh, and neighboring Westmoreland County, reported in Table A7. Allegheny pre-processed mail ballots and also returned them to voters to correct, resulting in a correction rate of about 80%. In contrast, Westmoreland explicitly adopted a policy to not pre-process mail ballots and recorded deficiencies after Election Day, resulting in a correction rate of just 0.2%.

notice on procedural due process grounds will run afoul of the state constitutional language that all voters shall be "equal" (Ctr. for Coalfield Just. v. Washington Cnty. Bd. of Elections 2025). More generally, Pildes (2021) argues that election administration should embrace consistent statewide policies to promote trust in election administration, even when county-based discretion can expand voter access. He specifically points to cross-county variation in ballot curing as an example of a local policy that should be jettisoned in favor of statewide uniformity.

Consistent with Pildes (2021), we think there is a ripe opportunity to build sufficient statewide electoral infrastructure so that all voters are able to benefit from a robust vote curing policy. While Pennsylvania's patchwork policies provided our study analytical leverage, the state also offers a path towards more uniformity. For one, Pennsylvania provides a model for how election officials can centralize the dissemination of information about deficient ballots at the state level through the operation of its statewide voter database. For another, Pennsylvania also shows that it is straightforward for election officials to allow voters to correct deficient mail ballots on Election Day. Federal law already requires election officials to offer some voters a provisional ballot on Election Day, at least in federal elections. As a result, all jurisdictions already have the relevant processes in place to ensure that only valid provisional ballots are counted.

Finally, but more cautiously, expanding the practice of some Pennsylvania counties to automatically return or replace deficient mail ballots could also reduce lost votes. As with provisional ballots, local election officials already spoil mail ballots and issue replacements. Further, we find that mail-back has a particularly strong effect on the likelihood of a voter casting a counted vote. The mechanisms are compelling. Sending voters a new (or their prior) ballot serves as a salient form of notice, especially for voters who cannot be contacted by email. It also decreases the cost of correction, particularly for voters who vote by mail precisely because they prefer that vote method, and reduces the number of provisional ballots to be adjudicated post-election. Mail-back is also worth considering if the implementation costs scale more evenly across differently-resourced counties than offering in-person cure opportunities at county offices. Ultimately, future research on vote curing should focus on

how to work within existing election administration infrastructure to best promote voter access without exacerbating differential burdens on local election officials.

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Online Appendix for:

Reducing Lost Votes by Mail:

Evidence on Vote Curing from Pennsylvania

Marc Meredith, Michael Morse, and Liz Stark

April 5, 2026

Case Study

Figure A1: How Election Officials Record Mail Ballot Statuses

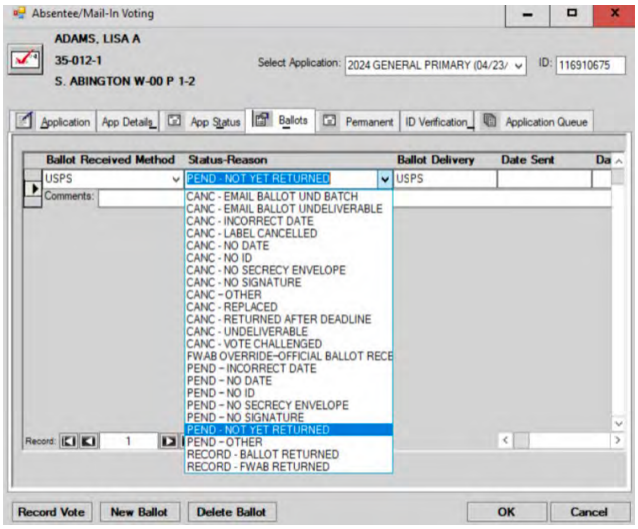
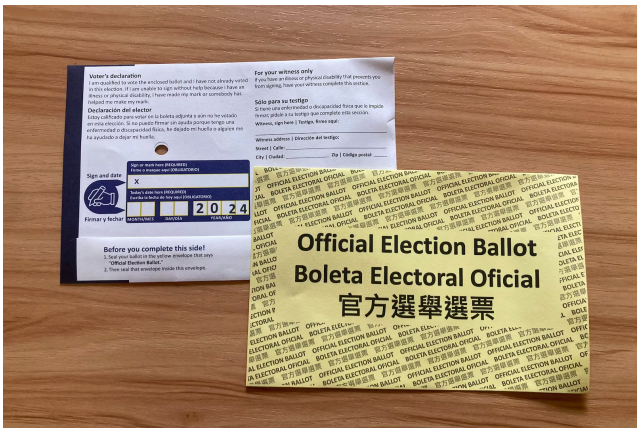


Figure A2: Mail Ballot with Pre-Punched Outer Envelope



Measurement

Dependent Variable

Table A1: Validating Voter File Vote History with Certified Election Results

	Total Votes by Source		Difference	
	Jan. 2025 Voter File	Certified Votes for President	N	%
Overall	7,042,972	7,034,206	8,766	0.1%
By vote method				
Election Day	5,032,603	5,019,136	13,467	0.3%
Mail	1,941,114	1,946,206	−5,092	−0.3%
Provisional	69,255	68,864	391	0.6%

Table A2: Validating Merge of Mail Ballot and Voter Files

	Sample		Difference	
	All Applications	Limited to Voter File Match	N	%
Approved	2,202,157	2,161,912	40,245	1.8%
Returned	1,980,740	1,959,037	21,703	1.1%
Ever Deficient	16,134	15,902	232	1.4%

Table A3: Comparing Vote History with Final Mail Ballot Status

Jan. 2025 Voter File	N	Final Mail Ballot Snapshot	
		% Returned	% Rejected
Election Day	2,483	0.1%	99.8%
Mail	5,956	95.2%	4.8%
No vote	7,463	0.0%	100.0%

Independent Variables

Table A4: Pre-Processing by Deficiency Type and County Policy

		When was Deficiency Recorded in SURE?			
		Before Election Day			
	N	Contemporeanous	Delayed	E-Day	Post E-Day
All Counties					
Outer Error	11,234	78%	6%	5%	11%
Inner Error	2,843	50%	1%	26%	23%
Split-Notice Counties Only					
Outer Error	2,486	78%	21%	1%	1%
Inner Error	817	4%	1%	58%	37%

Figure A3: Illustration of SURE Email for Misdated Ballot

Subject Line: Your Ballot Status Has Changed – Check for Updates
Email Body:
Dear [ApplicantName],

After your ballot was received by [CountyName] County, it received a new status.

Your ballot may not be counted because you did not correctly date your ballot return envelope. If you receive this email on or before election day, you can go to your polling place on election day before 8 p.m. and request a provisional ballot.

You can get more information on your ballot's new status by going to https://www.pavoterservices.pa.gov/Pages/BallotTracking.aspx.

If you have questions or need more information after checking your ballot's status, please contact [CountyName] County at [CountyContact].

To read this information in Spanish, go to [ballot tracker URL] – In Spanish
To read this information in Chinese, go to [ballot tracker URL] – In traditional Chinese

Thank you.
****Please do not reply to this email.****

Controls

Table A5: Partisan Differences in Mail Balloting

	N			Percent		
	Registrants	Approved Mail Applicants	Ever Deficient	Approved given Registered	Deficient given Approved	Deficient given Registered
Overall	8,873,044	2,161,912	15,902	24.36%	0.74%	0.18%
By Registered Party						
Democratic	3,837,878	1,176,045	8,927	30.64%	0.76%	0.23%
Republican	3,629,216	708,099	5,068	19.51%	0.72%	0.14%
Other	1,405,950	277,768	1,907	19.76%	0.69%	0.14%

Figure A4: Partisan Incentives in Vote Curing

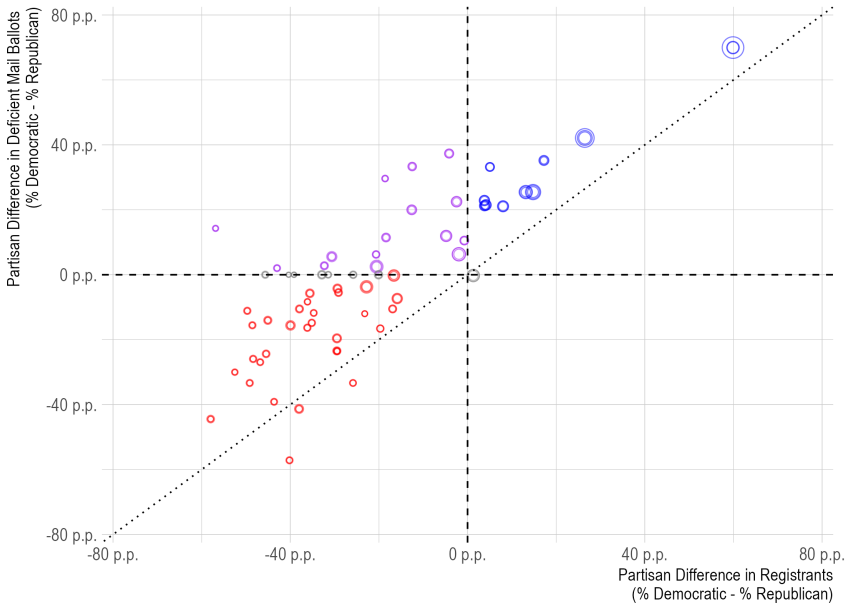


Table A6: Demographics by Email Availability

	Email	No Email
Summary		
Ever-Deficient Ballots	10,083	5,819
Share Corrected	55.9%	48.2%
Party Share		
Democratic	54.3%	59.3%
Republican	32.4%	30.9%
Other	13.3%	9.8%
Age Group		
18-29	14.6%	6.0%
30-44	14.1%	6.9%
45-64	29.5%	20.0%
65+	41.9%	67.1%

Results

Figure A5: Correction by Party of Registration and County Notice Policy

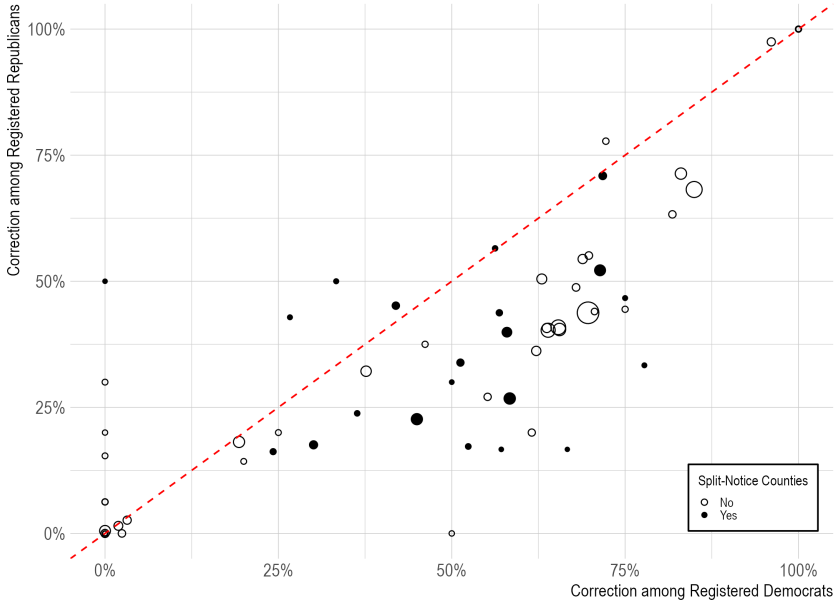


Table A7: Mail Ballot Correction by County

	Number Ever Deficient	% Corrected	By Vote Method	
			% Mail	% E-Day
Overall	15,902	53.1%	37.5%	15.6%
By County				
Adams	4	0.0%	0.0%	0.0%
Allegheny	1,460	80.4%	71.0%	9.5%
Armstrong	3	66.7%	66.7%	0.0%
Beaver	150	2.7%	0.0%	2.7%
Bedford	18	11.1%	0.0%	11.1%
Berks	686	34.7%	22.0%	12.7%
Blair	196	1.5%	0.0%	1.5%
Bradford	78	38.5%	3.8%	34.6%
Bucks	1,030	52.4%	35.0%	17.4%
Butler	251	51.4%	31.5%	19.9%
Cambria	157	43.3%	31.8%	11.5%
Cameron	6	100.0%	83.3%	16.7%
Carbon	16	43.8%	12.5%	31.2%
Centre	114	59.6%	38.6%	21.1%
Chester	409	35.7%	1.7%	34.0%
Clarion	23	4.3%	0.0%	4.3%
Clearfield	19	26.3%	10.5%	15.8%
Clinton	41	75.6%	75.6%	0.0%
Crawford	36	2.8%	2.8%	0.0%
Cumberland	437	49.0%	24.5%	24.5%
Dauphin	516	77.5%	68.6%	8.9%
Delaware	271	24.0%	4.1%	19.9%
Elk	17	35.3%	29.4%	5.9%
Erie	339	58.1%	39.8%	18.3%
Fayette	33	63.6%	54.5%	9.1%
Forest	1	100.0%	0.0%	100.0%
Franklin	141	0.0%	0.0%	0.0%
Fulton	2	50.0%	0.0%	50.0%
Greene	27	40.7%	33.3%	7.4%
Indiana	73	19.2%	19.2%	0.0%
Jefferson	9	0.0%	0.0%	0.0%
Juniata	10	30.0%	20.0%	10.0%
Lackawanna	196	71.9%	62.2%	9.7%
Lancaster	720	43.2%	0.3%	42.9%
Lawrence	19	15.8%	0.0%	15.8%
Lebanon	143	97.2%	81.8%	15.4%
Lehigh	626	62.8%	39.9%	22.8%
Luzerne	240	55.0%	37.5%	17.5%
Lycoming	105	61.0%	53.3%	7.6%
McKean	49	30.6%	12.2%	18.4%
Mifflin	45	57.8%	53.3%	4.4%
Monroe	250	63.6%	54.0%	9.6%
Montgomery	1,186	56.5%	40.2%	16.3%
Montour	25	52.0%	20.0%	32.0%
Northampton	712	55.1%	47.2%	7.9%
Northumberland	81	39.5%	3.7%	35.8%
Perry	27	40.7%	0.0%	40.7%
Philadelphia	3,226	66.0%	51.8%	14.2%
Pike	187	43.3%	34.8%	8.6%
Potter	21	14.3%	0.0%	14.3%
Schuylkill	94	1.1%	0.0%	1.1%
Snyder	26	53.8%	26.9%	26.9%
Somerset	57	31.6%	24.6%	7.0%
Sullivan	2	0.0%	0.0%	0.0%
Susquehanna	14	42.9%	28.6%	14.3%
Tioga	9	11.1%	11.1%	0.0%
Union	12	16.7%	16.7%	0.0%
Venango	49	57.1%	46.9%	10.2%
Warren	34	100.0%	100.0%	0.0%
Washington	95	52.6%	0.0%	52.6%
Wayne	108	68.5%	57.4%	11.1%
Westmoreland	425	0.2%	0.0%	0.2%
Wyoming	36	33.3%	0.0%	33.3%
York	510	18.8%	4.3%	14.5%

Table A8: Effect of Notice on Correction (All Variables Presented)

	OLS			IV		
	(1)	(2)	(3)	(4)	(5)	(6)
Notice						
Recorded before E-Day	0.307	0.317	0.320	0.241	0.261	0.248
	(0.049)	(0.048)	(0.050)	(0.048)	(0.049)	(0.053)
Provided Email	0.100	0.091	0.100	0.100	0.091	0.100
	(0.011)	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)
Mail Ballot Return						
1 Week Before E-Day	0.160	0.154	0.144	0.161	0.155	0.143
	(0.039)	(0.035)	(0.040)	(0.039)	(0.035)	(0.041)
2 Weeks Before E-Day	0.318	0.298	0.280	0.319	0.298	0.280
	(0.038)	(0.035)	(0.039)	(0.039)	(0.035)	(0.039)
3 Weeks Before E-Day	0.383	0.347	0.331	0.385	0.348	0.332
	(0.041)	(0.037)	(0.042)	(0.041)	(0.037)	(0.043)
4+ Weeks Before E-Day	0.394	0.345	0.328	0.395	0.346	0.328
	(0.041)	(0.036)	(0.043)	(0.041)	(0.037)	(0.043)
Error Type						
Inner Envelope Error	-0.070	-0.056	-0.060	-0.085	-0.069	-0.078
	(0.024)	(0.024)	(0.028)	(0.028)	(0.028)	(0.034)
Age Range						
30-44		0.079	0.088		0.079	0.088
		(0.033)	(0.040)		(0.033)	(0.039)
45-64		0.081	0.094		0.082	0.094
		(0.035)	(0.041)		(0.035)	(0.041)
65+		0.017	0.026		0.017	0.027
		(0.024)	(0.028)		(0.024)	(0.029)
Party Affiliation						
Republican		-0.169	-0.180		-0.169	-0.179
		(0.019)	(0.020)		(0.019)	(0.020)
Democratic		0.038	0.047		0.038	0.047
		(0.011)	(0.010)		(0.011)	(0.010)
Prior Vote in General Elections 2018-2023						
1 Prior Vote		0.022	0.025		0.022	0.024
		(0.014)	(0.017)		(0.014)	(0.016)
2 Prior Votes		0.072	0.087		0.072	0.087
		(0.018)	(0.017)		(0.018)	(0.017)
3 Prior Votes		0.125	0.139		0.125	0.138
		(0.019)	(0.022)		(0.019)	(0.021)
4 Prior Votes		0.138	0.144		0.138	0.144
		(0.021)	(0.022)		(0.021)	(0.022)
5 Prior Votes		0.201	0.220		0.200	0.218
		(0.020)	(0.016)		(0.019)	(0.016)
6 Prior Votes		0.253	0.279		0.251	0.276
		(0.028)	(0.022)		(0.027)	(0.022)
Prior Vote by Mail in General Elections 2018-2023						
1 Prior Vote by Mail		-0.029	-0.027		-0.028	-0.026
		(0.015)	(0.017)		(0.015)	(0.017)
2 Prior Votes by Mail		-0.058	-0.065		-0.058	-0.064
		(0.018)	(0.020)		(0.017)	(0.020)
3 Prior Votes by Mail		-0.060	-0.071		-0.060	-0.070
		(0.019)	(0.020)		(0.018)	(0.020)
4 Prior Votes by Mail		-0.076	-0.085		-0.075	-0.082
		(0.019)	(0.022)		(0.019)	(0.022)
5 Prior Votes by Mail		-0.113	-0.150		-0.112	-0.148
		(0.066)	(0.082)		(0.067)	(0.083)
6 Prior Votes by Mail		-0.159	-0.206		-0.158	-0.204
		(0.073)	(0.078)		(0.073)	(0.079)
County Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Include Mail Back Counties	Yes	Yes	No	Yes	Yes	No
First-Stage F-Statistic	--	--	--	473.43	473.6	308.59
Observations	12,162	12,162	10,238	12,162	12,162	10,238

Table A9: Effect of Cure Opportunity on Correction (Robustness Check)

	Outcome: Mail			Outcome: Voted		
	(1)	(2)	(3)	(4)	(5)	(6)
Cure Opportunity						
Permitted Curing (Robust)	0.545	0.512	0.034	0.190	0.147	0.039
	(0.026)	(0.027)	(0.027)	(0.024)	(0.018)	(0.134)
Returned Deficient Mail Ballots	0.202	0.198	0.208	0.146	0.143	0.150
	(0.017)	(0.018)	(0.018)	(0.015)	(0.014)	(0.013)
Mail Ballot Sent to Different Zip	-0.137	-0.103	0.029	-0.233	-0.208	-0.178
	(0.029)	(0.034)	(0.017)	(0.025)	(0.028)	(0.083)
Provided Email	0.083	0.079	0.080	0.115	0.104	0.104
	(0.013)	(0.013)	(0.013)	(0.011)	(0.010)	(0.010)
Mail Ballot Deficiency Recorded						
4+ Weeks before E-Day	0.591	0.528	-0.046	0.458	0.410	0.270
	(0.030)	(0.036)	(0.027)	(0.022)	(0.023)	(0.129)
3 Weeks before E-Day	0.567	0.531	-0.044	0.441	0.423	0.272
	(0.036)	(0.038)	(0.021)	(0.025)	(0.026)	(0.128)
2 Weeks before E-Day	0.480	0.460	-0.014	0.382	0.375	0.304
	(0.036)	(0.038)	(0.018)	(0.024)	(0.025)	(0.135)
1 Week before E-Day	0.241	0.243	0.017	0.194	0.202	0.154
	(0.026)	(0.026)	(0.023)	(0.023)	(0.020)	(0.110)
Interactions						
Cure Opportunity x 4+ Weeks before E-Day			0.592			0.144
			(0.036)			(0.131)
Cure Opportunity x 3 Weeks before E-Day			0.595			0.157
			(0.034)			(0.130)
Cure Opportunity x 2 Weeks before E-Day			0.485			0.070
			(0.038)			(0.138)
Cure Opportunity x 1 Week before E-Day			0.223			0.047
			(0.033)			(0.112)
Cure Opportunity x Sent to Different Zip			-0.110			-0.010
			(0.025)			(0.086)
Returned Deficient Mail Ballot x Sent to Different Zip			-0.163			-0.112
			(0.023)			(0.024)
Voter Demographics	No	Yes	Yes	No	Yes	Yes
Observations	10,773	10,773	10,773	10,773	10,773	10,773

Table A10: Effect of Curing on Correction (All Variables Presented)

	Outcome: Mail			Outcome: Voted		
	(1)	(2)	(3)	(4)	(5)	(6)
Cure Opportunity						
Permitted Curing	0.436	0.404	0.036	0.165	0.117	0.101
	(0.092)	(0.093)	(0.023)	(0.026)	(0.025)	(0.090)
Returned Deficient Mail Ballots	0.192	0.190	0.198	0.141	0.141	0.147
	(0.015)	(0.018)	(0.017)	(0.014)	(0.014)	(0.013)
Mail Ballot Sent to Different Zip	-0.137	-0.106	0.022	-0.233	-0.208	-0.105
	(0.029)	(0.034)	(0.024)	(0.025)	(0.028)	(0.082)
Provided Email	0.084	0.080	0.081	0.115	0.104	0.104
	(0.014)	(0.014)	(0.013)	(0.011)	(0.011)	(0.011)
Mail Ballot Deficiency Recorded						
4+ Weeks before E-Day	0.581	0.517	0.034	0.455	0.407	0.365
	(0.032)	(0.037)	(0.102)	(0.022)	(0.023)	(0.101)
3 Weeks before E-Day	0.572	0.533	0.097	0.444	0.424	0.378
	(0.033)	(0.036)	(0.115)	(0.024)	(0.026)	(0.106)
2 Weeks before E-Day	0.477	0.456	0.103	0.382	0.374	0.366
	(0.036)	(0.038)	(0.108)	(0.024)	(0.025)	(0.092)
1 Week before E-Day	0.253	0.253	0.050	0.199	0.205	0.206
	(0.025)	(0.026)	(0.026)	(0.022)	(0.019)	(0.078)
Interactions						
Cure Opportunity x 4+ Weeks before E-Day			0.513			0.043
			(0.104)			(0.102)
Cure Opportunity x 3 Weeks before E-Day			0.467			0.048
			(0.118)			(0.108)
Cure Opportunity x 2 Weeks before E-Day			0.369			0.005
			(0.112)			(0.095)
Cure Opportunity x 1 Week before E-Day			0.201			-0.005
			(0.034)			(0.080)
Cure Opportunity x Sent to Different Zip			-0.113			-0.096
			(0.030)			(0.085)
Returned Deficient Mail Ballot x Sent to Different Zip			-0.156			-0.101
			(0.024)			(0.023)
Age Range						
30-44		-0.007	-0.007		0.028	0.028
		(0.021)	(0.022)		(0.029)	(0.030)
45-64		0.020	0.020		0.027	0.027
		(0.031)	(0.032)		(0.035)	(0.036)
65+		-0.005	-0.003		-0.023	-0.023
		(0.029)	(0.030)		(0.028)	(0.029)
Party Affiliation						
Republican		-0.135	-0.133		-0.193	-0.193
		(0.022)	(0.022)		(0.019)	(0.019)
Democratic		0.019	0.021		0.032	0.032
		(0.015)	(0.015)		(0.010)	(0.010)
Prior Vote in General Elections 2018-2023						
1 Prior Vote		0.002	0.004		0.023	0.022
		(0.014)	(0.014)		(0.013)	(0.013)
2 Prior Votes		0.024	0.026		0.073	0.073
		(0.021)	(0.021)		(0.014)	(0.014)
3 Prior Votes		0.070	0.072		0.129	0.128
		(0.022)	(0.022)		(0.021)	(0.021)
4 Prior Votes		0.080	0.082		0.150	0.150
		(0.019)	(0.018)		(0.017)	(0.017)
5 Prior Votes		0.136	0.138		0.209	0.209
		(0.023)	(0.022)		(0.019)	(0.019)
6 Prior Votes		0.187	0.190		0.267	0.267
		(0.033)	(0.032)		(0.027)	(0.026)
Prior Vote by Mail in General Elections 2018-2023						
1 Prior Vote by Mail		-0.011	-0.012		-0.031	-0.032
		(0.013)	(0.013)		(0.017)	(0.017)
2 Prior Votes by Mail		0.013	0.008		-0.060	-0.061
		(0.013)	(0.013)		(0.016)	(0.017)
3 Prior Votes by Mail		0.013	0.009		-0.071	-0.071
		(0.017)	(0.017)		(0.018)	(0.018)
4 Prior Votes by Mail		0.033	0.028		-0.084	-0.085
		(0.022)	(0.023)		(0.019)	(0.019)
5 Prior Votes by Mail		0.017	0.005		-0.125	-0.130
		(0.063)	(0.063)		(0.059)	(0.059)
6 Prior Votes by Mail		0.002	-0.001		-0.119	-0.121
		(0.060)	(0.059)		(0.068)	(0.067)
Observations	10,773	10,773	10,773	10,773	10,773	10,773