

SOCIAL SCIENCES

The racial burden of voter list maintenance errors: Evidence from Wisconsin's supplemental movers poll books

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Administrative records are increasingly used to identify registered voters who may have moved, with potential movers then sent postcards asking them to confirm their address of registration. It is important to understand how often these registrants did not move, and how often such an error is not corrected by the postcard confirmation process, because uncorrected errors make it more difficult for a registrant to subsequently vote. While federal privacy protections generally prevent researchers from observing the data necessary to estimate these quantities, we are able to study this process in Wisconsin because special poll books, available via public records requests, listed those registrants who were identified as potential movers and did not respond to a subsequent postcard. At least 4% of these registrants cast a ballot at their address of registration, with minority registrants twice as likely as white registrants to do so.

INTRODUCTION

Voter registration list maintenance, or list maintenance, is a practice that is increasingly at the heart of what has been termed “the voting wars” (1). Election administrators are required to periodically engage in list maintenance to “remove the names of ineligible voters from the official lists of eligible voters” [52 U.S.C. §20507(a)(4)]. This is necessary because up to one in every eight registrations is thought to no longer be valid (2). For example, a registrant may have subsequently moved or died. However, there is often a difficult trade-off between voter access and electoral integrity in making “reasonable effort(s)” at list maintenance (3). Failing to remove the registration of a registrant who is ineligible to cast a ballot can reduce electoral integrity (e.g., if that registration is used to fraudulently cast a ballot), but inactivating or removing the registration of an eligible citizen can reduce confidence in the voting process, exclude voters from certain forms of official election communication, and result in disenfranchisement if a citizen is removed and does not reregister before their state’s registration deadline.

This paper focuses on the challenges of using administrative records to fulfill the federal mandate to identify “a change in the residence of the registrant” [52 U.S.C. §20507(a)(4)(B)]. Because of the decentralized nature of election administration in the United States and the lack of a national identity system, election administrators often resort to matching registration records to other administrative records to look for evidence that a registrant has moved. The Electronic Registration Information Center (ERIC), a nonprofit corporation governed by member states, currently assists 30 states and the District of Columbia in this list maintenance process. Member states agree to contact those registrants that ERIC suspects have moved, often using a mailed postcard, and ask them to confirm their address of registration. Registrants who fail to confirm that they reside at their address of registration can have their registra-

tion removed or, more likely, inactivated, which starts a process through which a registration is eventually removed.

This paper estimates how often registered voters are wrongly identified as suspected movers. Little is known about the extent of this type of list maintenance error, despite the widespread use of administrative records for list maintenance, because the ERIC membership agreement prohibits states from disclosing the necessary data. Our analysis instead focuses on publicly available poll books. Most of the registered voters in Wisconsin who were identified as suspected movers in 2017 were put into a “Supplemental Movers Poll List,” henceforth referred to as the movers poll books, for the April, August, and November elections in 2018.

We took advantage of this state policy by collecting the movers poll books from a representative sample of wards, extracting the voter registration numbers in the poll books, and then matching the voter registration numbers to copies of the Wisconsin statewide voter file from early 2018 and early 2019. This workaround allows us to observe who did not respond to confirm their address of registration when sent a postcard and, for a subset of these registrants who voted in 2018, whether they did in fact, move.

A registrant may be falsely flagged as a suspected mover for multiple reasons. First, a registration record may be matched, incorrectly, to the administrative record of a different individual. Second, even when a registrant is correctly matched to their own administrative record(s), it can be difficult to determine which record contains a registrant’s current address of residence.

In total, we estimate that about 4% of suspected movers cast a vote in 2018 at the address flagged as out of date. That is, they were flagged by ERIC as a suspected mover, did not respond to a postcard, and yet did not actually move and instead voted at their original address of registration. This is a lower bound on what we call the “false mover” error rate, because it is the act of voting that allows us to observe whether a suspected mover continues to reside at their address of registration. We cannot observe how many additional registrants in the movers poll books also continued to reside at their address of registration but did not vote in 2018. Limiting our analysis to the suspected movers who did vote in Wisconsin in 2018—and thus for whom we have the most recent address—we estimate

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that about 9% of those who voted in Wisconsin in 2018 cast a ballot at the address of registration flagged as out of date. Consistent with concerns about the potential disparate racial impact of voter list maintenance, we find that minority registrants in the movers poll books were more than twice as likely as white registrants in the movers poll books to vote at the address flagged by ERIC as out of date.

Background

The decentralized nature of election administration in the United States makes it hard for election administrators to conduct list maintenance. Currently, about 10% of Americans move to a new residence every year (4). Registrants are not required to, and often do not, tell local election officials when they have moved. Thus, election administrators need ways to identify and remove these registrants who are no longer eligible to vote at their address of registration.

Administrative records are an important source of information for identifying registrants with a new residence. Registrants who moved may generate a record of having done so with the Department of Motor Vehicles (DMV), when they change the address on their driver's license, or with the United States Postal Service (USPS), which is recorded in the National Change of Address (NCOA) System. Someone registering to vote in a new jurisdiction also generates an administrative record of where they resided on the day that they registered to vote. Thus, an election administrator can identify potential movers by linking their registration records with DMV data, the NCOA registry, or registration records from other jurisdictions.

While administrative records can be helpful for identifying potential movers, some of the registrants flagged as potential movers will actually still reside at their address of registration. One issue is that the NCOA does not contain all of the information that election officials would ideally want to implement list maintenance, because its primary purpose is to support the USPS. For example, the NCOA registry does not contain information on the date of birth of the person filing a change of address request. Another issue is that there is no unique identifier that links voter registration records across states. As a result, to identify people with multiple registrations, election administrators sometimes identify registrations with similar information in multiple states' voter registration databases using fields such as full name, date of birth, and, when available, the last four digits of a registrant's Social Security number. When all of this information is available and accurate, it is unlikely that two matched registrations belong to distinct people (5). However, this information is not always known or accurate in both states, which can lead to two registrations with similar information that nonetheless belong to two distinct people being erroneously classified as pertaining to the same person (6). When this happens, it can give the false impression that a registrant has moved.

Further, even when administrative records are correctly linked to a particular registrant, identifying the current residence of a registrant can be challenging, particularly if someone is a frequent mover (7). For example, individuals with multiple registrations sometimes do vote at the address of registration for the registration with an earlier registration date (6). This might arise when one state reports the date a registration was initiated as the registration date, while another reports the date the registration was last updated. The broader lesson is that administrative data often contain information about a voter's address on the day the administrative record was generated, but this may not be their address moving forward. A similar issue can emerge when an individual has multiple residences.

For example, DMV records may show where a registrant typically resides in the summer, while their address of registration may be where they typically reside in the fall and winter. Last, data quality issues can also make it difficult to determine whether addresses in two different administrative data sources represent two distinct addresses or the same address presented differently.

Because of the challenges of identifying registrants who moved using administrative data, election administrators increasingly are partnering with ERIC to assist in this process. ERIC is a nonprofit organization that assists states in identifying unregistered citizens and maintaining accurate voter registration lists. Member states provide ERIC with their voter registration lists and administrative data, and ERIC returns two categories of lists to each partnering state. One type includes residents who are likely eligible to vote but who are not registered. The other type includes registrations potentially in need of list maintenance because the registrant may have moved within their state, moved to another ERIC state, died, or have duplicate registrations within their state. ERIC member states agree to contact most individuals on these lists, and encourage them either to register to vote or to confirm whether their registrations are accurate.

Prior evaluations show that states increase registration by contacting individuals who are not registered but likely eligible to vote. The seven states that initially joined ERIC in 2012 increased registration by about one percentage point more between 2008 and 2012 than states that did not initially join ERIC (8). People ERIC identified as unregistered in Delaware and Oregon were two percentage points more likely to be registered when sent a postcard encouraging them to register (9). Similarly, a postcard sent by Pennsylvania increased the registration rate among people ERIC identified as unregistered by about one percentage point (10).

Much less is known about the consequences of using the lists generated by ERIC to engage in list maintenance, including how many registrants flagged by ERIC fail to confirm their eligibility despite remaining eligible to vote at their address of registration. As this section highlights, there are a number of reasons why someone may appear to move in administrative records despite continuing to reside at their address of registration. Such individuals may also fail to respond to a postcard asking them to confirm their registration. For example, media reports highlight that some postcard recipients believe that these postcards are junk mail or a scam, while others report never receiving the postcard (11, 12). Whatever the source of this error, anything that results in a valid registrant not receiving or returning their postcard risks jeopardizing their ability to vote.

An evaluation of ERIC's list maintenance practices was never publicly released despite a suggestion that such an evaluation was forthcoming (8). Moreover, independent external evaluations have not occurred because ERIC prevents member states from disclosing the data it provides to third parties. In part, this is because disclosure of information derived from DMV records could violate the federal Driver's Privacy Protection Act. As a result, ERIC maintains that any disclosure of ERIC data to researchers must be under the terms of a nondisclosure agreement negotiated with ERIC. The bylaws of ERIC state the following:

The Member shall not use or transmit any ERIC data for any purpose other than the administration of elections under state or federal law. Should a Member receive a request to disclose ERIC data and determines that it is legally obligated, in whole or in part, to comply with such request, it shall not

make the disclosure without first obtaining a court order compelling it to do so, a copy of which shall be provided to ERIC.

When rejecting our public records request for all of the registrations flagged by ERIC, the Wisconsin Election Commission (WEC) noted that “while the WEC possesses this data, due to the restrictions in the ERIC Membership Agreement and the statutory directive to comply with the Agreement as outlined above, this request is denied as it would require the transmission of ERIC Data for purposes other than the administration of elections.” Thus, it remains unknown what share of suspected movers remain eligible to vote at their address of registration, as well as how the false mover error rate is distributed across important groups in the population. As with any algorithmic process, we need to understand its overall accuracy and assess the mechanism for mitigating any potential discriminatory impact (13). The goal of this paper is to provide credible evidence about these important public policy questions.

Evaluating vote list maintenance using Wisconsin data

In October 2017, ERIC provided data to the WEC indicating that 341,855 registered voters had potentially moved. These registrants were separated into three groups: (i) registrants identified as in-state movers, based on matching Wisconsin registration and Wisconsin motor vehicle data; (ii) registrants identified as cross-state movers, based on matching Wisconsin registration data to other participating states’ registration or motor vehicle data; and (iii) registrants identified as general movers, based on NCOA data.

In addition to the general challenges associated with identifying movers in administrative data, there were specific challenges with Wisconsin data that caused some of these registrants to be identified as potential movers despite continuing to reside at their address of registration. Wisconsin is not subject to the National Voter Registration Act (NVRA) because of their historical use of Election Day registration. An implication is that motor vehicle data and voter registrations are not integrated in Wisconsin in the same way that they would be in a state subject to the NVRA. According to a 2019 memorandum produced by the WEC, “[s]taff identified several data discrepancies that caused voters to appear on the Movers list who may have not moved, such as differences in spelling between the street name on their voter registration record versus their DMV record, or cases where the new address was a PO Box” (14). Registrants in Wisconsin also may be less likely than registrants in other states to understand how a DMV transaction can affect their voter registration because, unlike in states subject to the NVRA, the Wisconsin DMV does not attempt to register individuals to vote. The WEC concluded that “while available data from the DMV implied many had moved, some of the voters, in fact, had not moved. Some reasons for this include voters who registered a vehicle or obtained a driver’s license at an address other than the address they considered to be their voting residence. This included persons who registered a vehicle at a business address, vacation home, or their child’s college address, and college students who obtained a driver’s license when they are temporarily living away from home” (14).

The WEC sent postcards to the 341,855 potential movers identified by ERIC at their address of registration. Of these 341,855 registrants, 6153 responded to the postcard confirming that they continued to be eligible to vote at their address of registration. The remaining 335,702 registrants were initially removed from the voter rolls. We note that a state subject to the NVRA would not have been able to immediately remove these registrations and likely would have instead made them inactive. Indiana, although not a member of ERIC,

recently was blocked from instituting a policy in which data provided by Crosscheck, a now defunct alternative to ERIC, were used to immediately remove registrants who did not confirm their eligibility [see *Common Cause Indiana v. Lawson*, 937 F.3d 944 (7th Cir. 2019)].

A unique policy intervention gives us an unusual opportunity to observe registrants who continued to reside at their address of registration despite not responding to the WEC’s postcard. After a number of people whose registrations were removed showed up to vote in Wisconsin’s statewide primary election in February 2018, the WEC took two actions that inform our understanding of the “false mover” error rate, which we define as individuals removed for having apparently moved despite actually residing at their address of registration. First, Wisconsin proactively reactivated 12,133 of these removed registrations between January and March 2018 because of some questions about data quality. This means that among those registrants who failed to return a postcard, at least 3.6% of registrants were likely incorrectly flagged as having moved.

Second, Wisconsin created separate movers poll books, containing the registrations of the suspected movers for the April, August, and November 2018 statewide elections. These poll books excluded registrations that had already been reactivated by the time these elections were held (e.g., did not include the 12,133 registrants automatically restored by the WEC or registrants whose current address of registration was confirmed in some other way before the election). Registrants listed in the movers poll books who showed up in person to vote at their address of registration would sign their name in these poll books, which certified that they still resided at their registration address and wanted to remain registered at it. Wisconsin law says that the state cannot restrict the public from observing a poll book, despite the ERIC policy agreement described above. A registrant would not sign the mover book if they voted via absentee ballot, although a voter would need to specify their registration address when requesting an absentee ballot. The default is that an absentee ballot is sent to a voter’s address of registration, although a voter could request that it be sent to another address. Absentee ballots may not be forwarded.

We collect copies of these movers poll books for a random sample of precincts, extract the voter registration number of all of the listed registrants, and identify these registrants’ records in the Wisconsin statewide voter file from both before and after the 2018 elections of interest.

Because we use the term “suspected mover” or “mover” to refer to someone in the movers poll books, we define a “mover voter” as someone who used a registration contained in a movers poll book to vote in at least one of the April 2018, August 2018, or November 2018 elections. Because the act of voting causes a registrant’s address of registration to update if it has changed, we can be sure that a voter continues to reside at their listed address of registration in a way that we cannot for a nonvoter. Thus, we first estimate the share of registrants in the movers poll books who voted at the address contained in the poll book. This estimate provides a lower bound on the false mover error rate because a nonvoter who continues to reside at the address in the movers book will not be accounted for in this estimate.

Because our design relies on voting to estimate the false mover error rate, we also examine the relative error rate among suspected movers who voted in Wisconsin in 2018, whether at their original registration address or a new address. This allows us to measure, conditional on voting, the relative frequency of having been incorrectly flagged as having moved. The limitation of this analysis is that

we are better able to track when someone votes at the same address than when someone votes at a new address. Thus, this estimate likely provides an upper bound on the false mover error rate.

In addition to characterizing the overall false mover error rate, we also investigate how the error rate varies as a function of various characteristics of the registration. Specifically, we examine whether minority suspected movers are more likely than white suspected movers to continue to reside at their registration address. Understanding whether list maintenance policies burden racial and ethnic minorities more than whites is one of the most important academic, legal, and policymaking questions about list maintenance and algorithmic fairness more generally. Some recent research suggests that minorities may be more burdened by registration removal than whites. For example, the share of registrations that were removed increased in counties that were previously subject to Section 5 of the Voting Rights Act before *Shelby County v. Holder* [570 U.S. 529 (2013)] (15). However, it is unclear whether this reflects increased incorrect removals or, instead, an ability to more easily remove ineligible registrants once these counties were free of federal oversight. Similarly, minorities were more likely than whites to have their registrations removed in 90 of 100 North Carolina counties between September 2016 and May 2018 (16), but again, it is not clear how many of these removals were incorrect removals, as some differences in the removal rates of minorities and whites are to be expected given that minorities are more likely than whites to move in a given year (17). Examining whether minority removed voters are more likely than white removed voters to continue to reside at the registration address flagged by ERIC is a more direct test of differential burden.

To be clear, we are not suggesting that minorities are intentionally targeted for removal. Instead, there are at least two reasons why minorities may be more likely than whites to be falsely flagged as suspected movers, even absent any intentional discrimination. First, minorities are more likely to reside in multi-unit buildings and more likely to reside in larger households (18, 19), both of which, we hypothesize, increase the risk that someone who did not move will nevertheless be falsely flagged as moving. We expect registrants in multi-unit buildings to be disproportionately falsely flagged as moving because the additional complexity of addresses in multi-unit buildings increases the chance that two administrative records will represent the same address differently and thus wrongly suggest that a registrant has moved. We also expect registrants in larger households to be disproportionately falsely flagged as moving when other members of a household move, particularly when the movers and nonmovers share a similar name. Of course, registrants in multi-unit buildings and larger households might also be more likely to move in general. If living in a multi-unit building or living in a large household is too predictive of moving, then registrants in multi-unit buildings and larger households may not ultimately be more likely to be falsely flagged as moving.

Another reason why minorities may be more likely than whites to be falsely flagged as suspected movers is that they are more likely to be correctly flagged as having moved, but their registration address is incorrectly flagged as being out of date. One common scenario that we expect generates problems is when someone initially registers to vote at their address, moves to a new address, and then moves back to the address that they are registered to vote at. More generally, we expect that election administrators will be better able to correctly identify the address that someone is moving from and

the address that someone is moving to the longer that someone lives at an address. Election administrators report that they find it challenging, for example, to identify the most recent address of frequent movers using ERIC data (7). Thus, we hypothesize that election administrators will be disproportionately likely to falsely flag a minority's registration address as out of date because minorities are more likely to frequently move (20).

Last, many of the same factors that increase the likelihood of being falsely flagged as a mover or being falsely flagged as having an out-of-date registration address could also make someone less likely to confirm their address of registration using a postcard. For example, mail may be less likely to reach a person living in a multi-unit building or a large household. Minorities may also be less likely to return the postcard than whites, for example, if they are more likely to perceive that the postcard is junk mail or a scam.

RESULTS

Main results

We would ideally estimate $p(\text{same}_i == 1 \mid \text{mover})$, the conditional probability that registrants in the sampled movers poll books continued to reside at the same address contained in the movers poll book (i.e., the false mover error rate). We define same_i as equal to 1 if registrant i has the same registration address in the 2018 and 2019 voter files, and 0 otherwise. This means that we only reliably measure same_i for people who voted, because it is the act of voting that allows us to observe a registrant's most recent address. Thus, we define voted_i as equal to 1 if registrant i voted in Wisconsin in either the April, August, or November 2018 elections, and 0 otherwise. While our baseline analysis only considers registrants who vote using the same registration number listed in the movers poll books, we consider the possibility that people might vote using a different registration number in our robustness analysis.

We then estimate two related conditional probabilities, each of which is informative of the false mover error rate. First, we estimate how frequently a suspected mover voted at their address of registration. That is, we estimate $p(\text{same}_i == 1, \text{voted}_i == 1 \mid \text{mover})$. This will be a lower bound on the false mover error rate, because there are registrants whose listed address of registration did not change ($\text{same}_i == 1$) but who did not vote ($\text{voted}_i == 0$) and thus did not confirm that their address is up to date. Second, we limit our analysis to only those suspected movers who voted and examine how frequently they did so at their address of registration. Here, we estimate $p(\text{same}_i == 1 \mid \text{voted}_i == 1, \text{mover})$. However, extrapolating from the subset of voters to the population of suspected movers requires an additional assumption that voters and nonvoters are equally likely to be falsely flagged as a mover and that the act of being flagged as a mover did not affect the turnout of those who had not moved. In addition, we suspect even then that this will be an upper bound because we believe it will be easier to observe that someone voted when they continue to reside at the same address than when they moved to a new address.

The first row of Table 1 shows that there were 60,145 registrants in the movers poll books that we sampled. Of these 60,145 registrants, 17,035 voted in at least one of the 2018 elections using their original registration number. Of these registrants, 1695 (about 2.8%) cast their ballots at the address flagged by ERIC, while 15,340 of these registrants (about 25%) cast a ballot at a new address of registration.

Table 1. 2018 turnout among registrants in movers poll books. Note: Standard errors in parentheses.

	<i>N</i>	Voted	Voted and same address	Voted and different address
Sampled movers poll books registrants	60,145	17,035 28.3%	1695 2.8%	15,340 25.5%
Population estimate of movers poll books registrants	259,650 (47,020)	77,450 (16,015) 29.8% (1.3%)	9015 (2655) 3.5% (0.5%)	68,435 (13,505) 26.4% (0.9%)
Total registrants	5,927,690	2,443,715 41.2%	2,159,265 36.4%	284,450 4.8%

In the second row of Table 1, we use the data from our sample to extrapolate to the population of registrants in all movers poll books statewide. This estimate therefore applies the weights described in Materials and Methods to extrapolate from our sample to the entire state population. We estimate that 9015 (about 3.5%) of the 259,650 registrants in the movers poll books cast a ballot at the address flagged by ERIC. This 3.5% figure is substantial, implying that for about every 29 registrations in the movers poll book, one registrant continued to reside at their address of registration and used that registration to cast a ballot. We also find that more than 90% of these voters cast at least one in-person ballot.

However, 3.5% only represents a lower bound on the false mover error rate. First, the number does not include any voters who had their registration reactivated by the WEC before the movers poll books were created, including at least 12,133 removed registrations that the WEC proactively reactivated between January and March. Second, we show in the Robustness section that some registrants flagged as movers by ERIC subsequently cast ballots using a new registration number but at the same address. Last, some registrants in the movers poll book who did not vote may also not have moved, but we cannot observe this because we rely on the act of voting to learn a registrant's most recent address. The third row of Table 1 shows that only about 41% of all registrants in the February 2018 voter file cast a ballot in either the April, August, or November 2018 elections using the registration number contained in the February 2018 voter file. While this understates overall turnout because some of these registrants cast a ballot using a new voter registration number, it makes it clear that a nontrivial number of registrants who did not vote in these elections also did not move.

Table 2 shows that minorities in the movers poll books were more likely to vote at the address of registration flagged by ERIC than whites in the movers poll books. The dependent variable in regressions reported in columns 1 through 4 is equal to 1 if a suspected mover voted and did so at the address flagged by ERIC, and 0 if a suspected mover either voted but did so at a new address or did not vote. Column 1 presents the results of a regression in which this dependent variable is regressed on the predicted probability that the registrant is nonwhite. The interpretation of the constant is that our best estimate is that 2.7% of whites in the movers poll books cast a ballot at the address of registration flagged by ERIC. The interpre-

tation of the coefficient on the probability that the registrant is minority is that our best estimate is that minorities in the movers poll books were 3.8 percentage points more likely to vote at the address of registration flagged by ERIC than whites in the movers poll books, meaning that about 6.5% of minorities in the movers poll books cast a ballot at the address of registration flagged by ERIC. Notably, this means that the lower bound on the false mover error rate is more than 100% larger for minorities than for whites.

Column 2 of Table 2 shows the results of a regression that disaggregates suspected minority movers by their probability of being different races and ethnicities. The results suggest that suspected movers who are black and, to a lesser extent, Hispanic, are significantly more likely to have voted at the address flagged by ERIC than suspected movers who are white. Suspected movers who are Asian or another race did not appear to vote at their listed addresses at rates significantly different from suspected movers who are white.

Columns 3 and 4 of Table 2 repeats the analysis from columns 1 and 2 while including some measures that we expect to account for some of the racial differences in the likelihood of being incorrectly identified as a mover. Specifically, we control for whether a registrant lives at a residence with multiple units, in a household with at least one other registered voter, and in a household with at least one other registered voter who has the same last name, each of which we expect to complicate the process of correctly matching administrative records. In the Supplementary Materials, we document how we construct these control variables. Because we cannot observe a registrant's prior movement history, we cannot control for the frequency of prior moves, which is another reason that we hypothesized we may observe differences across racial groups.

While we expected that registrants who lived in multi-unit residences would be more likely to be wrongly identified as a mover than registrants who lived in single-unit residences, they actually appear slightly less likely to be wrongly identified. One reason might be that the WEC proactively "identified several...situations where voters appeared to have moved but did not," including "cases where the voter registration address...contained a unit number but their DMV record did not, or vice versa" (14). Further, also contrary to our expectations, suspected voters who lived in a household with another registrant are less likely to vote at the address flagged by ERIC than removed voters who lived in a household with no other registrant, particularly when that registrant has the same last name as them. The fact that including these controls does not attenuate the coefficient on probability minority suggests that address complexity is not the reason for the disparate racial impact. Instead, the fact that minorities are more likely to move, making it more difficult to identify which address is the most recent, may be the culprit.

Groups of registrants who turn out at higher rates are likely to be overrepresented among registrants who vote and continue to reside at their address of registration. To ensure that this is not driving the results in columns 1 through 4, the analysis reported in columns 5 through 8 restricts our sample only to suspected movers who turned out to vote in at least one of the 2018 elections using their original registration number. This changes the interpretation of the coefficient to represent the probability that a mover voter cast their ballot at the address flagged by ERIC. This analysis shows that more than 21 and 17% of black and Hispanic mover registrants, respectively, who voted using their original registration number did so at the address flagged by ERIC, as opposed to about 10% of white mover registrants. Thus, differential turnout does not explain why black

Table 2. Racial and ethnic minorities in movers poll books are disproportionately likely to vote at the address flagged by ERIC.

	Dependent variable							
	Voted at address flagged by ERIC							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
pr(Minority)	0.038*** (0.002)		0.037*** (0.002)		0.096*** (0.008)		0.087*** (0.008)	
pr(Black)		0.053*** (0.003)		0.051*** (0.003)		0.117*** (0.009)		0.105*** (0.009)
pr(Hispanic)		0.027*** (0.005)		0.025*** (0.005)		0.085*** (0.015)		0.073*** (0.015)
pr(Asian)		-0.002 (0.006)		-0.001 (0.006)		0.014 (0.022)		0.018 (0.021)
pr(Other)		0.018 (0.015)		0.023 (0.015)		-0.004 (0.042)		0.009 (0.042)
Multi-unit			-0.005*** (0.002)	-0.004** (0.002)			-0.019*** (0.006)	-0.017*** (0.006)
Multi-ppl			-0.019*** (0.002)	-0.018*** (0.002)			-0.067*** (0.007)	-0.066*** (0.007)
Multi-family			-0.006** (0.002)	-0.006** (0.002)			-0.032*** (0.008)	-0.032*** (0.008)
Constant	0.027*** (0.001)	0.028*** (0.001)	0.038*** (0.001)	0.038*** (0.001)	0.095*** (0.003)	0.098*** (0.003)	0.142*** (0.004)	0.143*** (0.004)
Observations	58,492	58,492	58,492	58,492	16,524	16,524	16,524	16,524

* $P < 0.1$. ** $P < 0.05$. *** $P < 0.01$.

and Hispanic mover registrants were more likely to vote and reside at the address flagged by ERIC.

Robustness

In this section, we describe the robustness of our findings when we account for possible reasons why voters suspected of having moved would be missing from the regressions presented in the previous section. First, some municipalities did not provide us with poll books or only provided us copies of movers poll books for one or two of the three elections that we requested. This may cause us to miss some movers poll book voters, particularly when we are missing the April movers poll book. Second, some of the registrations flagged by ERIC may have been assigned a new voter registration number between the February 2018 and January 2019 statewide voter files,

causing us to miss their vote record in at least one of the April, August, and November elections.

There are two types of missing data in our sample. First, table S1 highlights that a few of the sampled municipalities were unable to provide copies of poll books or failed to respond to our request. Given that these municipalities only contain 4.6% of the weighted registered voters within our sampling frame, their omission from our analysis is unlikely to substantially affect our results. Second, table S1 also shows that a number of municipalities only provided copies of the movers poll books for one or two of the three requested elections. Lacking the April movers poll book is particularly problematic because the act of voting in the April election is one reason why a registration flagged by ERIC would not appear in the August or November movers poll books.

Table S2 shows why we conclude that our results would not change much if we had access to all three movers poll books in the 47 municipalities that sent us one or two movers poll books. We reach this conclusion by looking at how our results would change if we only observed a subset of the movers poll books in the 75 municipalities that sent us all three movers poll books.

Table S3 shows why we conclude that a significant number of movers poll book registrants voted using a new voter registration number. Some of these registrants may have reregistered on Election Day because Wisconsin permits same-day registration. Using data from the subset of mover registrants with rare names, we estimate that about 730 and 29,200 movers voted using a new voter registration number at the address flagged by ERIC and a new address, respectively. This implies that the lower bound on the false mover error rate is about 4%, while the share of mover voters who cast a ballot at the address flagged by ERIC is about 9%. However, this analysis presents no evidence that the racial differences we observe in Table 2 are an artifact of minority ERIC registrants being more likely to vote using a new voter registration number than white ERIC registrants.

Last, table S4 shows how our results in Table 2 change when we also include municipality fixed effects. We continue to find statistically significant differences in the rate at which minorities and whites in movers polls book vote at the address flagged by ERIC, although the magnitude of the difference is reduced by about one-third.

DISCUSSION

Our analysis of the list maintenance procedure used by Wisconsin reveals that it initially removed a substantial number of registrants who resided at their address of registration. These registrants were identified by ERIC as movers by matching administrative records. All registrants flagged as movers were then sent postcards in the mail that, in theory, gave those registrants who had not moved the opportunity to confirm their address of registration. Yet, we find at least 9000 registrants, or about 4% of all flagged registrants who did not respond to this postcard, went out to vote in 2018 at the address of registration flagged by ERIC as out of date. This represents a lower bound on the false mover error rate because there were additional registrants who continued to reside at their address of registration whom we could not observe, either because their registration was proactively reactivated before the creation of movers poll books or because they did not vote in 2018 and thus did not make use of the movers poll books.

In addition, we find that the burden of incorrect removal falls more heavily on minority registrants. Our analysis shows that the lower bound on the false mover error rate is more than twice as large for black registrants as it is for white registrants. This finding is consistent with claims that the more frequent movements of registrants of color may make it harder to determine their current residence and, hence, put registrants of color at a heightened risk of having their valid registrations removed (21).

Had Wisconsin not taken the unusual step of using movers poll books, the list maintenance process used by the state would have otherwise been obscured because of the state's participation in the ERIC consortium. ERIC prohibits states from disclosing to third parties the list of voters flagged as movers, which has heretofore made it impossible for independent researchers to assess its error rate. As we show, this lack of transparency may be consequential; incorrect removals are both large in number and display a disturb-

ing differential racial burden. More creativity is needed to find ways to allow evaluation that are consistent with the Driver's Privacy Protection Act. More generally, both the public and policymakers need to be able to observe enough details about how algorithms work in practice to evaluate their fairness.

Beyond these broader issues, we also believe that our findings point to policy changes that can mitigate the potential disenfranchising effects of errors in voter list maintenance procedures. First, given that a substantial number of registrants fail to respond to a postcard seeking to validate their address, states should consider revising the process of address verification. Of the more than 300,000 people sent address-confirmation postcards by the WEC, only about 6000 people responded. Subsequently, the WEC proactively reactivated about 12,000 of the flagged registrations because it appeared that the registrant had not moved, even though the registrant did not respond to the postcard, and we identified at least an additional 9000 registrations in which the registrant did not respond to the postcard despite remaining eligible to vote at their address of registration. Given that most of the registrants who remain eligible to vote at their address of registration are not responding to a postcard, it may be that state communication should include multiple efforts at contact, clearer communication, or contact through means other than the USPS. Further, election administrators should consider whether, given the generally abysmal response rate to postcards, they should treat registrants whose postcard was returned as undeliverable (83,743 registrants in this case) differently than registrants who did not respond to a postcard (251,959 registrants in this case), as the former at least provides more evidence about moving than the latter.

Second, in states where failure to respond to a validation postcard leads to either removal or placing a voter on an inactive list, more effort should be made to correct errors. While the protections of the NVRA and Election Day registration reduce the costs of falsely flagging movers, they do not eliminate them. Inactive registrants are always eligible to vote, but they may not be sent official mailings from election administrators and face a more burdensome process to verify their identity before they can cast a ballot. Likewise, forcing someone to reregister to vote on Election Day is likely to increase the time it takes to vote. Wisconsin's movers poll books are an example of a clear intervention that avoided the disenfranchising effects of their list maintenance procedure, as is Election Day registration, although both processes will be more efficacious when those who are removed continue to receive notices about upcoming elections. Our results show why it is essential to make registrants aware if their registration is being moved to inactive status and to continue to alert these registrants to upcoming elections so that they know when and where to vote if they still reside at their address of registration.

Last, we do not think our results should be used to claim that states should not use ERIC to help with list maintenance. List maintenance is essential, and our data show that a large majority of the registrations ERIC flags as potential movers are for registrants who no longer reside at their address of registration. There is unlikely to be a method of conducting list maintenance that avoids incorrect removals without leaving a large number of ineligible registrations on the rolls. That said, we hope that this evaluation causes ERIC and its member states to further assess its practices and work toward reducing differences in the frequency of the incorrect flagging of white registrants and registrants of color. We also hope that it highlights to policymakers and the public the importance of treating the information from ERIC as evidence that

registrants might have moved, rather than evidence that they did move, and to use it accordingly.

MATERIALS AND METHODS

Sampling movers poll books

We sent public records requests to a subset of Wisconsin municipalities that were selected on the basis of a stratified random sampling strategy designed to minimize both the cost to conduct this research and the burden placed on local election officials. Because of our sampling strategy, our analysis weights observations from sampled municipality m according to the inverse of their probability of being selected into our sample, π_m . π_m is calculated by multiplying $\gamma_{s(m)}$, the probability of sampling a municipality in strata $s(m)$, by λ_m , the probability of a ward being sampled in municipality m . We explain how weights were calculated in the following paragraphs, and note that our weighting allows us to make population-level inferences despite selective sampling.

We put each of the 1857 municipalities in Wisconsin that administer elections into one of three strata. The first strata contained the 20 biggest municipalities. We sampled municipalities in the first strata with probability 1. The second strata contained the next 124 largest municipalities. We sampled 31, or 25%, of the municipalities in the second strata. The third strata contained the 1713 smallest municipalities. We sampled 86, or 5%, of the municipalities in the third strata. Hence, $\gamma_1 = 1$, $\gamma_2 = 0.25$, and $\gamma_3 = 0.05$. This sampling strategy focused attention on large urban areas with both large numbers of voters and large numbers of minorities while also allowing us to make inferences about the state as a whole, including the many jurisdictions with small numbers of voters.

The public records request we sent to sampled municipalities initially asked for copies of the movers poll books used in the April, August, and November 2018 elections for all wards. Some municipalities, particularly those in the first and second strata, responded that they did not have the resources to copy movers poll books for every ward in their municipality. In such cases, we used a systematic sampling strategy to collect poll books from a subset of wards in the municipality. In each sampled municipality, we drew a random integer X between 1 and 10. We then asked them to provide copies of poll books for wards X , $X + 10$, $X + 20$, ... until the resulting number was higher than the largest ward number in the municipality. Hence, $\lambda_m = 1$ if we collect the universe of poll books in municipality m and $\lambda_m = 0.1$ if we collected a systematic sample of wards from municipality m .

Processing movers poll books

Once we collected and scanned the poll book records, we wrote a computer program to perform optical character recognition and identify the voter registration numbers contained on each page of the files provided to us. We merged all of the voter registration numbers found in the movers poll books to the February 2018 voter file. This provides us with each registrant's address before any 2018 election. We then searched for a record in the January 2019 voter file (the voter file that contains information about voting in 2018 and includes updated address information for anyone whose registration details changed in 2018) with the same voter registration number and last name anywhere in the state. We include last name because voter registration numbers are generally unique within municipalities but not necessarily across them.

In the Supplementary Materials, we present the results of an audit that evaluated how well this process performed at accurately capturing

the voter registration records of the registrants contained in copies of the movers poll books that we collected. This audit reveals that our process generated a dataset that accurately represents the data contained in the copies of the movers poll books that we collected.

Inferring a registrant's race and ethnicity

Because the Wisconsin voter file does not include information on a registrant's race or ethnicity, we imputed this information using a method that combines information on a registrant's surname and the racial composition of a registrant's census block group (22). We describe in the Supplementary Materials how we used this method to calculate predicted race and ethnicity scores for each registrant in the movers poll book and a random sample of the Wisconsin voter file.

SUPPLEMENTARY MATERIALS

Supplementary material for this article is available at <http://advances.sciencemag.org/cgi/content/full/7/8/eabe4498/DC1>

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