

Turnout Effects from Vote by Mail Elections

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Abstract: Research on how vote by mail election systems impact voter participation has produced a wide range of mixed findings, including many counter-intuitive null and negative results. We review this literature and describe how the research designs and settings of past studies may have biased their results. We then test whether voting by mail can increase voter turnout using a setting and research design intended to minimize these biases. Using a county-level panel dataset in the state of Colorado, we find that VBM elections are associated with significantly higher voter turnout across a variety of model specifications.

I. Introduction

Voting is no longer confined to a polling place. An increasing number of states and jurisdictions are making voting easier by mailing ballots to voters weeks before Election Day, giving them ample time to complete and return their ballots at their own leisure. Both permanent absentee mailing list (PM) and vote by mail (VBM; also referred to as all-mail) election systems send ballots to voters through the mail and also allow voters to return their ballots by mail or in-person at centrally located facilities. VBM and PM systems eliminate some of the costs of voting such as the time spent traveling to polling places, waiting in line to vote, and using unfamiliar voting equipment. All-mail VBM elections also eliminate the initial cost of signing up to receive mailed ballots by automatically mailing ballots to all registered voters. These reforms have been touted as a way to increase voter turnout, lower the cost of elections, and reduce incomplete and spoiled ballots. Since 2000 three states—Oregon, Washington, and Colorado—have adopted vote by mail for all their elections, and nineteen other states have adopted permanent absentee mail-in voting, which allows voters to register for a list once to have a ballot mailed to them for every following election (NCSL 2016). More states including California and European Union member states (White 2015) are considering legislation to adopt vote by mail elections.

Despite the growing adoption of VBM, there remains a significant disconnect between the arguments in favor of vote by mail and the scholarly research on the benefits of this mode of voting. If the act of voting is made easier and more convenient by VBM elections, it logically follows from the rational choice theory of voting that more registered voters should cast ballots under this system since it eliminates or reduces many

of the costs of voting (Leighley 1995). Despite widespread acceptance that the costs of voting affect the probability of casting a ballot (Brady and McNulty 2011; Dyck and Gimpel 2005; Rosenstone and Wolfinger 1978), scholars have been unable to find evidence for this seemingly obvious implication for VBM elections in multiple studies (Kousser and Mullin 2007; Southwell 2009, 2010; Bergman and Yates 2011; Gronke et al. 2012).

Why have so many studies of VBM systems failed to find a positive effect from balloting by mail on voter turnout? After reviewing the literature, we argue that the mixed results on VBM systems result from policy settings that forced the use of VBM on voters and data types or research designs that are susceptible to various types of omitted variable bias. Using a unique policy setting and a panel design, we overcome many of these limitations in a research design that yields robust inference of the effect of VBM systems. Using this design, we find that the adoption of vote by mail systems, including both permanent absentee lists and all-mail VBM elections, significantly increased aggregate voter turnout. This finding is robust to many alternative analyses, including using alternative specifications of the independent variable of interest and across a variety of models that are each robust to different types of assumptions about the structure of the data.

II. Previous research

The history of postal-assisted voting traces back nearly 400 years to the earliest colonial elections. Voters in the colony of Virginia were allowed to select the House of Burgesses by submitting their choices in writing if they could not be present to vote *viva voce*. The practice was abandoned in 1646, however, due to concerns about the

“subscribing of hands contrary to the warrant directed” (Hening 1823, pp. xix and 333). Absentee voting practices were also established and abandoned in the first 40 years of American elections.

Modern absentee voting replaced traveling to a polling location with receiving and returning a ballot by mail, at least for those persons eligible to choose this option. For most states until the most recent decades, this eligible group included persons over the age 65, persons traveling out of their voting jurisdiction on Election Day, and the infirmed. With the adoption of no-excuse absentee mail-in voting, the convenience of mail voting was extended in most states (N=28) to all eligible voters, enhancing the available methods for voter participation. Since it eliminated the cost of traveling to a polling location at a specific time, postal-assisted voting was hypothesized to increase voter turnout. Despite the clear ways in which they reduce the costs of voting, absentee mail-in voting and no-excuse absentee mail voting have not boosted turnout in Presidential or midterm elections (Richey 2008; Fitzgerald 2005; Patterson and Calederia 1985; however, see Karp and Banducci 2001 for a positive finding). The lack of turnout effects is likely explained by the fact that no-excuse absentee systems still require the substantial cost of requesting a ballot prior to Election Day. While no-excuse absentee systems eliminate the travel cost of voting, the only people who can take advantage of this cost reduction are those who request a ballot months or weeks prior to Election Day.

The adoption of permanent absentee mail voting (PM), practiced in 6 states (i.e., AZ, CA, HI, MT, NJ, and UT), allows voters to make a one-time request for a ballot to be mailed to them before every election. This system eliminates the cost of requesting a ballot for each subsequent election. The most expansive form of postal-assisted voting is

vote by mail (VBM) election systems (also known as all-mail elections, universal vote by mail, or universal ballot delivery by mail), in which every registered voter is automatically mailed a ballot prior to Election Day. Oregon, Washington, and Colorado have adopted this election system, with Colorado being the most recent adopter. In both PM and VBM systems, voters are notified about an upcoming election by receiving an unrequested ballot in the mail, which could have an effect akin to voter mobilization efforts through mailings because it reminds voters of an election (Kousser and Mullin 2007). In addition to the reminder effect, both PM and VBM elections can potentially increase turnout by allowing voters to fill out and return their ballots at their leisure. In addition to reducing or eliminating the cost of traveling to the polls, mailed ballots allow voters to fill out their ballots at the most convenient times for them, thereby allowing voters to minimize the cost of their time. The rational choice theory of voting clearly predicts that this reduction in costs should lead to higher levels of voter turnout (Leighley 1995; Riker and Ordeshook 1968).

However, scholarly analyses of the turnout effects from PM and VBM elections have produced inconsistent findings, with no clear consensus on a positive turnout effect. Table 1 shows an overview of all the major studies on vote by mail elections conducted in the United States in the last 25 years. Depending on the setting and research design used, estimates vary from a positive effect of up to 11% (Richey 2008) down to a negative effect of as much as -2.7% (Kousser and Mullin 2007). Studies of the turnout effects of permanent absentee mail voting and all-mail voting in federal elections are generally limited to two states, Oregon and Washington (Southwell and Burchett 2000;

Gronke and Miller 2012; Berinsky et al. 2001; Gerber et al. 2014)¹. A few other studies have examined whether VBM increases turnout in a variety of local, municipal, and special elections, including mandated vote-by-mail in some California precincts (Arceneaux et al. 2012; Bergman and Yates 2011; Kousser and Mullin 2007). More of these studies find a positive effect in lower-salience elections, but even here some studies like Bergman and Yates (2011) find negative effects. Clearly, there is no unequivocal link between VBM and PM reforms and voter turnout.

What is the reason for the diversity of the findings on mail-in voting's effect on voter turnout? Arceneaux et al. (2012) explain these divergent findings as a function of several mitigating factors that intervene and shape the effect of postal assisted voting on voter turnout. "Contextual factors, including campaign activity, the election's salience, and the composition of the electorate have an important role in conditioning the impact of VBM systems (2012: 891)." In many of the studies listed above and others on VBM, researchers report that the turnout effects of vote by mail vary between high and low turnout elections (Karp and Banducci 2000; Kousser and Mullin 2007; Southwell 2009; Arceneaux et al. 2012). These researchers report that postal assisted voting boosts turnout in low salience primaries, special elections, and local elections, but has a null or negative effect on turnout in higher salience general elections.

¹ Colorado adopted vote by mail in 2013 and held its first federal VBM election in 2014.

Table 1: Past Literature on Voting by Mail and Turnout

Authors, Year, and Journal	Findings (federal elections)	Findings (local, primary, and special elections)	Setting	Data Type	Research Design	Who Caused VBM Adoption?
Magleby (1987); <i>The Western Political Quarterly</i>	N/A	Positive	Various cities (local elections)	Other	Aggregate turnout data analyzed by comparing most recent comparable local elections to local elections under VBM.	County or city administrators
Hamilton (1988); <i>Public Administration Review</i>	N/A	Positive	Case studies of various local elections (1978-1988)	Other	Simple comparisons of turnout rates in pairs of elections.	County, city, and other administrators
Karp and Banducci (2000); <i>Political Behavior</i>	Positive	N/A	Oregon (all federal / statewide elections 1986-2000)	Time-Series	State-level aggregate data analyzed by comparing pairs of counties or elections.	County administrators (until 1998); state legislators (after 1998)
Southwell and Burchett (2000); <i>American Politics Research</i>	Positive	N/A	Oregon (federal elections 1960-1996)	Time-Series	State-level aggregate data analyzed using FGLS Beach-Mackinnon procedure.	County administrators
Berinsky, Burns, and Traugott (2001); <i>Political Opinion Quarterly</i>	Mixed (fewer new voters, but more old retained)	Mixed (fewer new voters, but more old retained)	Oregon ('95 and '96 Senate primary and general elections. 5 elections in total, of different types)	Other	Individual-level survey and observational voting data. Conducts duration analysis on the "state" of voting.	County administrators
Hamner and Traugott (2004); <i>American Politics Research</i>	Positive	N/A	Oregon (all federal / statewide elections 1992-2000)	Time-Series	Individual voter data analyzed with descriptive statistics.	County administrators (until 1998); state legislators (after 1998)

Table 1 (continued): Past Literature on Voting by Mail and Turnout

Authors, Year, and Journal	Findings (federal elections)	Findings (local, primary, and special elections)	Setting	Data Type	Research Design	Who Caused VBM Adoption?
Southwell (2004); <i>PS: Political Science and Politics</i>	Positive	Positive	Oregon (all elections self-recollection of voting frequency)	Other	Surveyed voters about self-reported frequency of voting prior to and after adoption of VBM.	County administrators (until 1998); state legislators (after 1998)
Kousser and Mullin (2007); <i>Political Analysis</i>	Negative	Positive	California (local and presidential elections in 18 counties-- 2000 to 2005)	Cross-Sectional	Used matching to compare voters in VBM precincts to non-VBM precincts.	County administrators
Gronke, Galanes-Rosenbaum, and Miller (2007); <i>PS: Political Science and Politics</i>	Positive (VBM); Null (PM absentee list)	N/A	All states (federal elections only 1980-2004)	Panel	Analyzed state-year aggregate data using OLS with PCSE.	State legislators
Richey (2008); <i>Social Science Quarterly</i>	Positive	N/A	All states (federal elections only 1980-2006)	Panel	Analyzed state-year aggregate data using FGLS.	State legislators
Sled (2008); University of California at Berkeley dissertation	Positive	Positive	3310 municipal, county, and statewide elections (1965-2007) in 8 states	Panel	Analyzed election-level turnout data using OLS with controls, dummy variables, and county/state fixed effects.	Mixture of county/local administrators and state legislators

Table 1 (continued): Past Literature on Voting by Mail and Turnout

Authors, Year, and Journal	Findings (federal elections)	Findings (other elections)	Setting	Data Type	Research Design	Who Caused VBM Adoption?
Southwell (2009); <i>The Social Science Journal</i>	Null	Positive	Oregon (federal / statewide elections 1980-2007)	Time-Series	Analyzed state-level aggregate data using OLS.	County administrators (until 1998); state legislators (after 1998)
Southwell (2010); <i>The Social Science Journal</i>	Null	Positive	Denver, Colorado (presidential and local elections 2004, 2005, and 2007)	Other	Compared city-level aggregate turnout in 2004 to 2005 and 2007.	County administrators
Bergman and Yates (2011); <i>Election Law Journal</i>	N/A	Negative	California (4 local elections in 5 counties from 2006-2008)	Cross-Sectional	Compared voters in VBM precincts to non-VBM precincts with controls for demographics.	County administrators
Larocca and Klemanski (2011); <i>State Politics and Policy Quarterly</i>	Positive, bigger for PM absentee list than for VBM	N/A	All states (2000, 2004, 2008 elections)	Cross-Sectional	Analyzed individual-level data from CPS surveys.	State legislators
Gronke and Miller (2012), <i>American Politics Research</i>	Null	Positive	Oregon (all federal / statewide elections 1960-2010)	Time Series	Analyzed state-level aggregate data with OLS and AR(1) models.	County administrators (until 1998); state legislators (after 1998)
Gerber, Huber, and Hill (2013); <i>Political Science Research and Methods</i>	Positive	N/A	Washington (2006, 2008, 2010 elections)-- 39 counties in first analysis, and 5 in second	Panel & Cross-Sectional	First model: Analyzed aggregate panel data with county and year fixed effects. Second model: Used matching to compare individuals between VBM and non-VBM counties.	County administrators

While this explanation for the mixed findings on VBM could explain the differences in some of the findings, the theory behind why this effect might exist is not well-established. One explanation is given by Berinsky et al.'s (2001) study of VBM voters in Oregon, which shows that VBM retains existing voters but does not mobilize new voters; "the VBM system, therefore decreases the rate at which voters move out of the electorate (2001:190)." This suggests that perhaps VBM has a "retention" effect only on frequent voters, causing them to vote in elections they normally would have ignored. However, this finding is directly countered by Gerber et al.'s (2013) finding that infrequent voters were more likely to vote after the adoption of VBM, while frequent voters were less affected by the reform. If infrequent voters are more likely to be mobilized by VBM, then we should see a larger effect in high salience elections, which contain more infrequent voters.

Furthermore, the mediating effects of election salience and individuals' propensities to vote do not explain the contradictory findings on the turnout effect of VBM in federal, high-salience elections. The findings of Gerber et al. (2013), Gronke et al. (2007), Richey (2008), and others run directly against the studies finding mediating effects by election type (Karp and Banducci 2000; Kousser and Mullin 2007; Southwell 2009; etc.). The only clear differences between these studies are the research designs and settings in which their data are collected. We believe that the setting, type of data, and research design are the most important factors in shaping the results of studies on the relationship between voting by mail and voter turnout.

In particular, we identify two factors that have influenced the findings of past studies, the first having to do with the policy context of VBM adoption. First, the effects

of VBM have only been observed in settings in which voting by mail was the only available voting method, instead of an addition to other methods. This differs from the research on no-excuse absentee and early voting, which were both added as complements to Election Day voting methods. The second factor influencing the findings of past studies is that many of them relied on data types and research designs that are vulnerable to bias from omitted variables, which could potentially result in either positive or negative bias on the effect sizes. While the first factor can be addressed by simply looking at different policy settings, the second factor is complex and requires careful thinking about research design and statistical methods. We will explain both of these factors in more detail in the following paragraphs.

The first major factor influencing these findings in a negative direction is that voting by mail is not the preferred method of casting a ballot for some voters. Voters who distrust the mail voting system, those who prefer voting with other people, and those who lack experience with voting by mail may prefer to cast their ballots in-person at a polling place (Stewart 2011). When VBM is adopted as the only option, these types of people may become less likely to vote even if others' probability of turnout increases. This theory would predict that the aggregate effect of VBM-only election systems depends on the composition of registered voters in the electorate. If the electorate consists mostly of voters who distrust the postal system, prefer voting with other people, or have never used mail ballots, then switching to a VBM-only system may actually have a demobilizing effect when observed in the aggregate. To date, all studies of VBM have

looked at systems where in-person voting methods were not retained.² The only studies that do not contain this potential demobilizing effect are the few that look at the permanent absentee mail lists, e.g., Larocca and Klemanski (2011) and Gronke et al. (2007).

The second factor influencing the findings of past studies is the potential for omitted variable bias from factors like mobilization, demographics, or political culture that were not adequately controlled for. Researchers' choices of data structure and research design determine which variables may present "backdoor pathways" (Pearl 2009) by which they influence both turnout and the adoption of mail-assisted voting systems. These choices are often constrained by the availability of data and when and how election reforms are implemented. We have identified three types of datasets used by researchers studying the turnout effects VBM elections: cross sectional, time-series, and panel (time-series cross-sectional). Each type of data presents particular challenges for identifying, measuring, and controlling for omitted variables that influence the correlation between voter turnout and VBM systems.

Cross-sectional datasets, used in four studies listed in table 1, face the issue of geographic units that vary on many factors in addition to voting systems. These factors include social and demographic traits (Leighley 2008), political culture (Verba, Nie, and

² While most, if not all, vote by mail systems allow for voters to return their mailed ballots in-person to polling locations or drop-off locations, we believe this is substantively different from voting in-person. Waiting in line and casting a ballot on a machine or paper ballot at a polling location provides a different voting experience from simply dropping an already completed ballot in a box. This method does not provide an equal substitute for people who distrust voting by mail or like the social benefits of voting in-person.

Kim 1978), differences in election competitiveness and campaign mobilization (Kahn and Kenney 1999; Hill and Leighley 1993), different voting laws like early voting (Burden et al. 2014), and geographic differences that shape the costs of voting, such as distance and impedance to the polls (Dyck and Gimbel 2005; Haspel and Knotts 2005). Another concern is that past turnout levels or election costs might have led election administrators to adopt VBM elections (Stein and Vonnahme 2008). Two of the studies that used a cross-sectional research design found that the adoption of VBM elections had a significant and positive effect on voter turnout. Kousser and Mullin (2007) confirm this finding, but only for non-federal elections; they found that VBM elections have a significant and negative effect on turnout in federal elections. In contradiction to Kousser and Mullin's (2007) finding on other types of elections, Bergman and Yates (2011) found that VBM has a negative effect on turnout for local elections. Clearly, the findings of the cross-sectional analyses on the turnout effects of VBM are a mixed bag of contradictory results.

Controlling for omitted variables in a cross-sectional dataset is constrained by the number of observations and the availability of data on these variables. Since many of these variables like political culture and mobilization are difficult to measure, these designs are the most vulnerable to omitted variable bias arising from differences between geographic units. As we discuss below, studying the same observations over multiple time periods increases the number of observations and allows for statistical methods that reduce the risk of omitted variable bias.

Time-series studies of VBM elections, used in five studies reported in table 1, study the same geographic unit (usually a state) over time. While by design these studies

are robust to bias from factors that vary by geography, they are most vulnerable to omitted variable bias from unmeasured factors that vary over time, such as the types of races on the ballot in each year and election-specific differences in mobilization. Using a longer set of observations and including the proper control variables allow researchers to reduce this bias, but the use of proper statistical methods can also minimize some types of bias. Unlike cross-sectional studies, long time-series studies of voter turnout can readily include a lagged value for the dependent turnout measure, providing a means of controlling for conditions that vary over time and may be consequential to turnout. However, only one of five time series studies in Table 1, Karp and Banducci (2000), reported using a lagged dependent measure in their model of voter turnout. Like the cross-sectional studies, the findings for time-series studies are rather mixed. Three studies report a significant and unqualified positive effect for VBM elections on voter turnout, and two studies (Gronke et al. 2012; Southwell 2009) report a null effect for VBM in federal elections, but positive in other types of elections.

If it is possible to obtain data on different geographic units over multiple time periods, researchers can use a panel (or time-series cross-sectional) design, which allows for several approaches that are each robust to different types of omitted variables (Wilson and Butler 2007). Combining both cross-sectional and time-series data allows researchers to include control variables that vary both between units and over time. Even when information across observations and time is limited, researchers can employ statistical methods like fixed and random effects to run statistical analyses that are robust to any unmeasured factors affecting turnout that are constant over time inside of geographic units (or uniform across units over time). All four studies that used panel data

found that VBM elections were associated with significant and positive effects on voter turnout, although Gronke et al. (2007) found no turnout effect from the adoption of permanent absentee lists.

In the next section, we describe how our setting of the state of Colorado and panel design with 6 elections in 64 counties avoids these criticisms of many past studies. In addition to the setting and data type, we further ensure the robustness of our findings by employing multiple statistical models, where each model relies on different assumptions about the potential unmeasured variables affecting the data. In doing so, we take to heart Wilson and Butler's (2007) advice that using multiple models, each minimizing certain types of omitted variable biases but potentially prone to others, gives researchers more certainty that their findings are not an artifact of their model choice.

III. Setting, Dataset, and Research Design

We use our concerns about the data and research designs used in many past studies to construct a new observational dataset and several research designs that minimize or avoid many of the problems listed above. The first benefit of our dataset is the setting from which we draw our data. First, the state of Colorado adopted voting reforms that made voting by mail progressively more available and easier to use. Beginning in 1992, voters do not have to provide an excuse to request an absentee ballot. In 2008, the state adopted permanent absentee mail lists (which we refer to by the initials PM), in which each registered voter had the option to sign up one time to receive a mail ballot in every future election. In 2012, Colorado further adopted an all-mail VBM election system in which every active registered voter is automatically mailed a ballot for every election. The progressive liberalization of mail-assisted voting in Colorado should

reduce concerns about any novelty effect (Gronke and Miller 2012) from the adoption of VBM, since many voters have used mail balloting before the adoption of reforms in 2008 and in 2013. Furthermore, the reforms were adopted statewide in a politicized process, which should reduce concerns regarding the endogeneity of election administrators self-selecting VBM as an election system.

The election system in Colorado also has a unique quality that makes it an ideal research setting to study the effects of VBM elections. While other states and counties that adopted VBM removed all in-person voting options (other than dropping off the mailed ballot in-person), Colorado retained all previously available voting options. The only voting method that was eliminated was Election Day neighborhood precinct voting, which was replaced with the option of voting on Election Day at Voter Service and Processing Centers (VSPCs). VSPCs are essentially equivalent to Election Day Vote Centers (EDVCs) in that they are large, centrally located polling places. In other states, the adoption of VBM removed voters' ability to ballot in-person inside of a traditional voting booth. If some voters prefer to cast their ballots in-person and are denied this method, they may become less likely to vote. Preliminary survey evidence (Stein et al. 2015) and other studies (Stewart 2011; Monroe and Sylvester 2011) suggest that these voters may make up a substantial portion of the electorate. Since in-person methods were retained in Colorado, this potentially demobilizing effect on some voters should not affect our data to the same extent as in other states. We can consider any turnout effect in Colorado as the effect of *adding* VBM as an option, rather than *switching* to VBM as the only option.

We address the problem of omitted variable bias from factors that vary mostly at the state level, like demographics, state political culture, and mobilization, by using a panel research design of county-year observations in the state of Colorado. We obtained data from the Election Assistance Commission (EAC) for election performance measures including voter turnout from 2004 until 2014³. These data provide the number of registered voters and the number of voters who cast ballots at the county level for six federal elections in Colorado. The data also give us the number of voters who registered using same day or Election Day registration, allowing us to control for the potential turnout effect from same day registration (SDR) as emphasized by Burden et al. (2014).

Since the data contains a panel of observations from 64 counties in 6 years, we use different models including clustered standard errors, fixed effects, random effects, and a first differences analysis to ensure that any observed turnout effect is present both over time and cross-sectionally within each election. This reduces the possibility that our findings are a spurious relationship caused by omitted variables. To ensure that our results are robust to different types of assumptions about the structure of the data, we run multiple types of models separately. In addition to employing different statistical methods, we also use the percent of voters who used mailed ballots as an alternative measure of our independent variable.

³ The quality of the data was verified by the current Secretary of State's Office, as well as by several county clerks.

IV. Models and Findings

a. Dummy variable analysis

To assess the effect of PM and VBM voting systems on voter turnout we use county level data on voting methods and turnout in Colorado for all federal elections from 2004 until 2014. In the first analysis, our variables of interest are dummy variables indicating the availability of different methods of voting for each election by county. We include control variables from the 2010 U.S. Census for the county population, mean income, median age, percent with bachelor's or higher degree, percent white, percent black, and percent Hispanic for each county. We estimate linear regressions of voter turnout as a percentage of all registered voters for each county-year observation⁴. To account for the interdependence of observations at the county level, we employ random intercepts for counties.

Table 2 (below) shows the results of the county-level model of voter turnout. We find that both the adoption of permanent absentee lists and vote by mail are associated with positive and highly significant effects on voter turnout. Since the models are linear regressions of the turnout rate, the coefficients are directly interpretable as the substantive effects of the dummy variables representing the different voting regimes. The impact of having the option to sign up for a permanent absentee mailing list is an increase in aggregate voter turnout of 2.03%, with a 95% confidence interval from 1.16% to 2.90%.

The adoption of all-mail VBM elections is further associated with an increase in turnout

⁴ While many studies examine voter turnout as a percentage of voting age or voting eligible population, we believe that when looking at reforms affecting the act of voting but not registration, turnout as a percentage of registered voters is a better measure. VBM does not affect registration, and there is no reason to expect more or less new registrants as a result of VBM. The effect we are interested in is: Once a citizen has registered, are they more or less likely to cast a ballot? Although registration pools are potentially subject to "noise" from list purging, Colorado has established procedures by which voters' status is checked before each election. We think this trade-off is worthwhile to measure the concept we are most interested in rather than using a proxy.

of 3.28%, with a 95% CI from 1.47% to 5.10%. These results are robust to alternative specifications including cluster robust standard errors, fixed effects for counties, and random effects without control variables. See Appendix II for the results of these models, which all show that both PM and VBM have statistically significant effects at the $p < 0.01$ level. As shown in Appendix V, this model is also robust to including a lagged dependent variable.

Table 2
Regression coefficients for voter turnout in Colorado Counties: 2004-2014

VARIABLES	Coefficients
Election Day	-0.283
Vote Centers	(0.764)
Permanent Vote	2.027***
By Mail	(0.443)
Vote by Mail	3.282***
Election	(0.926)
Presidential	12.96***
Election	(0.414)
County Population	0.057
	(0.043)
Mean Income	-0.013
	(0.051)
Median Age	0.366***
	(0.093)
Percent With	-0.129*
B.A. or Higher	(0.068)
Percent White	0.352
	(0.259)
Percent Black	0.059
	(0.364)
Percent Hispanic	0.232
	(0.261)
Constant	16.19
	(25.49)
County Variance	3.572
Residual Variance	3.575
Observations	384

Standard errors in parentheses. Model includes random intercepts for counties.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

One caveat to these findings is that since same day registration (SDR) was adopted at the same time as the vote by mail election system, we cannot distinguish if the effect shown by the VBM coefficient is due to the change in registration system or the voting system. However, since the dependent variable is turnout as a percentage of registered voters, any voter who used same day registration would increase both the numerator and denominator of the dependent variable. Therefore, it seems reasonable that the increase in turnout observed from the vote-by-mail variable is mostly attributable to the voting system rather than the registration reform.⁵ We confirm this conclusion in an additional analysis, shown in Appendix III, in which we removed voters who used SDR from the measurement of the dependent variable. Using this alternative dependent variable (which conservatively assumes that every SDR voter would not have turned out without the availability of SDR), the coefficients for the variables and significance levels are very similar.

One concern that should be raised with the models described above is that they use dummy variables for the availability of voting methods that only vary by year. All Colorado counties adopted permanent absentee mail voting lists for federal elections from 2008 onward, and the current VBM election system is only present in our data for the 2014 midterm election. Therefore, it is possible that the results we observe are either due to idiosyncratic factors in each election (i.e. higher mobilization of voters or election salience) or are driven by an independent time trend in voter turnout in Colorado. If voter turnout is increasing over time due to an external factor such as campaign mobilization, then we could be mistakenly attributing this change to the voting method.

⁵ Colorado also allowed statewide registration portability prior to adopting Election Day and Same Day registration (McDonald 2008).

b. Percentage vote cast by mail analysis

To ensure that our models of voter turnout are robust to time trends and election effects, we estimate another set of models using an alternative specification for the independent variable of interest: the percentage of the total vote cast using mailed ballots. Because this variable is indifferent to the particular postal-assisted voting regime (no-excuse absentee, PM, or VBM), the measure varies by both county and year. This variation allows us to confirm that the effects observed with the dummy variables are not solely due to a time trend of increasing voter turnout in more recent years or due to idiosyncratic factors in each election, such as increased voter mobilization by campaigns. The percentage vote by mail also allows us to exploit county-level variation in mail voting rates to see how mail voting is associated with turnout in cross-sectional variation as well as over time.

Table 3 shows the results of the model using this new specification of the independent variable as the percentage of the vote cast on mailed ballots. This model uses the same dependent variable (turnout as a percentage of registered voters), and the same control variables as the dummy variable model in Table 2. Additionally, we include two control variables that could not be placed in the previous model in Table 2 due to collinearity with the variables of interest. The first new control variable is the percentage of newly registered voters who registered via Election Day or same day registration (SDR). The other new control variable is a competitiveness measure for the “top of the ticket” races in each county. We calculate the competitiveness score as the absolute value of the difference between the percentage of the vote that went to the top two parties in the races for president (or governor in the midterm elections). Note that we

lose all the 2004 observations due to a lack of available data for these control variables, so this model only uses the 320 observations from 2006-2014.

Since we are using panel data and the new independent variable of interest varies both over time and cross-sectionally, we are faced with a variety of methods to account for the potential dependence between observations. We report a model that allows the intercept to vary both by year and by county, and these random effects are drawn from a shared distribution for each dimension. This model was chosen because it provides robust inference on the variables of interest even if there are omitted variables at the county or year level that are correlated with both vote by mail and voter turnout. As long as the omitted variables are constant across one dimension (over years or across counties), then this model is robust to their exclusion.

The results of Table 3 (below) largely confirm the turnout effect we observed with the dummy variables in Table 2, although the independent variable of interest is estimated with less statistical significance. The percentage of the vote cast by mailed ballots is positively associated with voter turnout, although it falls just below conventional levels of statistical significance at $p = 0.052$. The percentage of the vote cast by mail is associated with an increase in voter turnout of 0.045%, with a 95% CI from 0.0005 to 0.0908. When Colorado adopted the permanent absentee list system, the percentage of the vote cast by mailed ballots in each county increased by about 20% on average. Substantively, this means that the adoption of the permanent absentee list system is associated with a 0.9% increase in turnout. When Colorado adopted all-mail VBM elections in 2013, the percentage of the vote cast by mail further increased by approximately 35%. This increase in the percentage mail vote from the adoption of the

VBM election system is estimated to yield a 1.58% further increase in voter turnout on top of the increase that occurred with the adoption of the permanent absentee list system, for a total increase of 2.48% from all-mail VBM elections.

Table 3
Regression coefficients for voter turnout in Colorado Counties: 2006-2014

VARIABLES	Coefficients	Prob. > z
Percent Mail	0.0452* (0.0233)	0.052
Presidential Election	13.82*** (1.377)	0.000
Percent SDR	18.35* (10.17)	0.071
Competitiveness	-2.357** (1.125)	0.036
County Population	0.051 (0.044)	0.247
Mean Income	-0.023 (0.053)	0.656
Median Age	0.371*** (0.096)	0.000
Percent With B.A. or Higher	-0.114 (.070)	0.105
Percent White	0.401 (0.268)	0.135
Percent Black	0.126 (0.376)	0.737
Percent Hispanic	0.277 (0.270)	0.305
Constant	12.25 (26.39)	0.679
County Variance	3.665	
Year Variance	0.000	
Residual Variance	3.528	
Observations	320	

Standard errors in parentheses. Model includes random intercepts for counties and years (crossed).

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The lesser statistical significance of the percent mail variable in Table 3 is not surprising, since this model is a very conservative test. Although the crossed random

effects control for omitted variables in both the county and year dimensions, they require the model to estimate a large number of parameters on only 320 observations. Tables 10 and 11 in Appendix III show the results of alternative specifications for this model. With the exception of the models using fixed effects for counties (which require calculating an additional 63 parameters), the models confirm the results of Table 3 but show a more statistically significant relationship between vote by mail and voter turnout. This model is also robust to including a lagged dependent variable as shown in Appendix V.

The model presented in Table 3 estimated the effect of the percentage of the vote cast by mail on voter turnout as a mixture of the “between-county” effect and the “within-county” effect. Table 4 (below) shows two models, each of which uses fixed effects on one dimension to estimate these effects separately. Model 1, which uses fixed effects for counties, estimates the within-county effect of VBM on voter turnout. Model 2, which uses fixed effects for years, estimates the between-county effect of VBM on voter turnout.

Examining whether the effect of VBM on turnout occurs between or within counties can reveal substantively important information on what is driving this relationship. Since voting by mail was made more accessible by the adoption of PM and VBM over time, the within-county effect is directly attributable to the increase in votes cast by mail due to the adoption of these laws. Model 1 in Table 4 shows that the percentage of the vote cast by mail is associated with a 0.042% increase in voter turnout. Substantively, this means that the adoption of PM is associated with a 0.84% increase in turnout and the adoption of all-mail VBM is associated with a further increase of 1.47%.

Table 4

Regression coefficients for voter turnout in Colorado Counties: 2006-2014

VARIABLES	(1)	(2)
Percent Mail	0.0417*** (0.0107)	0.1283*** (0.0299)
Presidential Election	13.47*** (0.521)	
Percent SDR		30.22** (14.61)
Competitiveness	-1.725** (0.995)	-1.001 (1.493)
County Population		0.000 (0.000)
Mean Income		-0.000 (0.000)
Median Age		0.362*** (0.054)
Percent With B.A. or Higher		-0.100** (.039)
Percent White		0.363** (0.149)
Percent Black		0.120 (0.210)
Percent Hispanic		0.246 (0.150)
Constant	57.96 (0.696)	14.68 (14.65)
County Variance	5.419	-
Year Variance	-	8.537
Residual Variance	3.562	4.926
Observations	320	320

Standard errors in parentheses. Model 1 includes fixed effects for counties and clusters standard errors at the county level. Model 2 includes fixed effects for years, but does not cluster standard errors due to the small number of years.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

However, the between-county effect requires a different interpretation. Because these models control for the over-time variation that is shared by the counties, the interpretation of the percent of vote cast by mail variable in these models is a little different from the previous analyses. If the adoption of voting reforms like VBM has consistent effects across the counties, then this effect would be absorbed by the fixed

effect dummy variables for years, since they were adopted statewide at the same time. Therefore, we must interpret the change in turnout associated with percent mail balloting as a relationship between the number of voters who choose to use mail balloting and turnout, rather than directly as the effect of a policy change.

The cross-sectional variation in the number of voters who choose VBM is more attributable to characteristics of the counties and the way that the county clerks' offices implemented the voting system than the VBM regime itself. We attempt to control for the demographic characteristics differentiating counties by using the census control variables. If these controls actually account for most of this variation, then the coefficient on the percent of vote cast by mail can be interpreted as the effect of county-level variation in election administration on voter turnout. Counties vary in the instructions they provide to voters, informational campaigns, and the availability of drop-off locations for ballots. All of these characteristics influence how convenient the VBM system is, and thus how many voters choose to use mail balloting.

Model 2 in Table 4 shows the results of the model using only the between-county variation. When fixed effects for years are included, each percentage point increase in the vote cast by mail is estimated to have a large and significant effect (0.128%) on voter turnout. For an example of a substantive effect, this coefficient means that a county with a mail balloting rate that is one standard deviation above the average in 2010 (71.61%, or 12.32% above the average) has a 1.58% higher expected voter turnout rate. We interpret this finding to mean that making voting by mail more convenient through voter information and drop-off locations can increase voter turnout even when laws on voting by mail do not change. Of course, an alternative explanation is that counties which have

higher vote by mail rates also have higher voter turnout due to omitted variables that are not in our model. Looking at differences in county-level election administration and whether they are associated with different levels of turnout is an area that deserves more attention in future studies.

c. First differences analysis

Finally, we conduct an analysis on the relationship between vote by mail election systems and county-level aggregate voter turnout in Colorado using a first differences estimator. The dependent variable in these models is the change in aggregate voter turnout as a percentage of registered voters in each county between comparable pairs of elections. We consider comparable pairs to be elections with similar races on the ballot, so the 2014 midterm election is compared to the 2010 midterm, the 2012 presidential election is compared to the 2008 presidential, etc. Similarly, the independent variables are either the change in vote by mail systems (Model 1) or the change in the percentage of vote cast on mailed ballots (Model 2) for the same pairs of elections. We also include the change in the percentage of registrants who used same day or Election Day registration and the change in the competitiveness score in the pair of elections as control variables. We do not include the demographic control variables used in previous models because in our data they do not vary over time.

Since they estimate the effect of a change in voting method on a change in voter turnout, these first difference models account for different baseline turnout levels in each county and are therefore robust to any omitted variables that are do not vary between the pairs of elections. We think it is safe to assume that most omitted factors that can influence county-level voter turnout are relatively time-invariant. While some omitted

variables like campaign mobilization may vary between pairs of elections even after controlling for competitiveness of the top ballot races, these should not be a concern as long as they are not correlated with the independent variable. If there is a correlation between the percent of vote cast by mail and mobilization or other factors, this presents a possible source of bias for the estimated coefficients. At least for the dummy variable models using the statewide adoption of VBM and PM as independent variables, this could only occur if there was a dramatic increase in mobilization after the adoption of these policies across all counties. Therefore, while they are not completely robust to all unmeasured factors, these models provide another method of obtaining an inference on the impact of voting systems on voter turnout that is robust under slightly different assumptions than the previous models.

Table 5
Regression Coefficients for First Differences Analysis of Voter Turnout in Colorado Counties

VARIABLES	(1)	(2)
Permanent Vote	5.681***	
By Mail	(0.599)	
Vote by Mail	11.36***	
Election	(1.433)	
Election Day Vote	-0.934	
Centers	(0.932)	
Percent Mail		0.1114***
		(0.0248)
Same Day Reg.	1.746	-1.135
	(16.16)	(13.43)
Competitiveness	0.632	1.342
	(0.988)	(0.999)
Constant	-3.868***	-2.840***
	(0.333)	(0.487)
Observations	192	192
R^2	0.3413	0.1651

Cluster robust standard errors in parentheses. Standard errors are clustered by county.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 5 shows the results of these models. Model 1 uses dummy variables for the presence of the various voting methods, including EDVCs, permanent absentee lists, and all-mail VBM elections. The coefficients for permanent absentee mail lists and for all-mail VBM elections are highly significant and positive. Substantively, the adoption of PM is associated with a 5.68% higher change in voter turnout than the baseline decrease in turnout between pairs of elections. The adoption of VBM elections is associated with an increase in turnout of 11.36% as compared to the same baseline of pairs of elections in which reforms were not adopted.

Model 2, which uses the percent of vote cast on mailed ballots in place of the dummy variables, show positive and significant results, although with lesser magnitude of the effect. Substantively, the average increase in the percent mail balloting from the adoption of PM (20%) is associated with an increase in turnout of 2.23% as opposed to the baseline change between elections. The average increase in the percent mail balloting from the subsequent adoption of VBM (35% above the average rate of mail voting under the PM list system) is associated with an additional increase in turnout of 3.90% as compared to the baseline change between the pairs of elections. This means that the magnitude of the effect estimated in this models is about half of the substantive effect in model 1, but the effect is still strong and positive.

Since including the competitiveness variable resulted in dropping 64 observations, Appendix VI shows the results of alternative specifications without the control variables. The results of these models are very similar to the results in Table 5 and are statistically significant at the same levels. Clearly, the adoption of both permanent absentee lists and

all-mail VBM elections are both positively and significantly associated with increases in voter turnout between pairs of comparable elections.

In summary, we find that the presence of vote by mail options is significantly and positively associated with voter turnout. This finding is robust to a variety of model specifications, including those using only the between-county variation, ones using only the within-county variation, and first difference estimators using the variation between pairs of elections. It also holds for two specifications of the independent variable, namely dummy variables for the presence of different options and the percentage of votes actually cast using mailed ballots. Across all models with the exception of some conservative tests using fixed effects for counties or crossed random effects, we find a positive, significant, and substantively meaningful increase in turnout from the adoption of more permissive vote by mail systems.

V. Discussion

The findings in the scholarly literature on the impact of vote by mail elections and permanent absentee mail lists on voter turnout have been mixed. We believe this is largely due to the research designs and settings that these studies have employed. The first difference between our study and others is that we examine the effect of adding VBM as a voting option, rather than looking at a mandated switch to voting only by mail. Because being forced to use a mailed ballot may demobilize some voters, our study yields a better estimate of the turnout effect from both the added convenience of VBM and the possible mobilizing effect of receiving an unexpected ballot. On the other hand, studies of mandated switches to VBM yield estimates of an effect that combines convenience and mobilization for some voters with possible demobilization for others.

Which estimated effect is more generalizable to states considering adopting a vote by mail system depends on if policymakers plan to retain in-person voting methods or not. In any case, the effect of adding VBM as an option rather than forcing voters to use a mailed ballot should be of substantive interest to researchers of election administration.

Another difference is that our study focuses on a single state and uses a panel dataset of county-years. This type of data allows for statistical techniques like fixed and random effects and first differences estimators to account for the omitted variables that vary by jurisdiction and affect baseline turnout rates. By controlling for much of this cross-sectional variation due to unmeasured characteristics of geographic units, we can be more confident that our result is due to permanent absentee list and all-mail VBM elections rather than demographic factors or campaign mobilization that vary by county and state. We also look at models that control for variation over time that is consistent across the counties by using fixed or random effects for years, and alternatively by first differencing the data. Across all of our models, we see positive and significant increases in voter turnout following the adoption of both all-mail VBM elections and PM lists, on the order of around 0.9% to 2.2% following the adoption of PM and 2.4% to 5% following the adoption of universal VBM.

As more states and localities adopt vote by mail systems, replication of this type of data and research designs in other settings should further bolster the evidence for this finding. Our hope is that when data and research designs are carefully considered, over time the literature will support a basic implication of the rational choice theory of turnout; that is, that lowering the costs of voting can increase aggregate voter turnout.

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