The Electoral Effects of Voting Technology: Evidence from Bulgaria *

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Abstract

Can voting technology improve the integrity of elections in developing democracies? We study this question in the context of Bulgaria's transition from paper ballots to voting via direct-recording electronic machines – a measure introduced with the goals of improving the accuracy of elections, enhancing ballot secrecy and reducing opportunities for human interference with the voting process. Our empirical strategy leverages a sharp discontinuity in the rule for the allocation of voting machines across polling stations, and variation in the implementation of machine voting over nine consecutive general elections. We document two main results. First, machine voting significantly increases the share of valid votes, effectively increasing the likelihood that votes – especially those cast by less educated, elderly or ethnic minority voters – are counted toward the electoral outcome. Second, machine voting causes a large and significant reduction in turnout, particularly in poor and rural areas. Decomposing this decline, we find that it is driven by a reduction in votes for parties that were locally dominant at baseline, while we find no change in votes for other parties. We conduct representative surveys to further investigate mechanisms related to the reduction of bought or fictitious votes, as well as alternative mechanisms related to voters' aversion to new technologies.

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1 Introduction

The legitimacy and accountability of elected governments hinge on the implementation of fair and inclusive elections (Norris 2014). Yet, many democracies grapple with concerns over the integrity of their electoral processes. Between 2020 and 2024, one in five elections worldwide faced legal challenges over voting or vote counting procedures, and one-third of voters today live in countries with deteriorating electoral integrity (International IDEA 2024). Understanding whether, and which, electoral reforms can address these problems is therefore an important policy question.

In this paper, we ask whether voting technology can be instrumental in improving the integrity of elections in developing democracies. Specifically, we study the effects of voting with direct-recording electronic (DRE) voting machines – a technology currently used in about 20 countries, including Brazil, India, and the Philippines. These machines are designed to minimize ambiguities in how voter intent is captured and interpreted, and can thereby reduce invalid votes (i.e. votes that are not counted toward the election results). They are also hypothesized to enhance ballot secrecy by eliminating opportunities for pre-filling and tracking ballots, and to limit interference by polling station officials, as the machines keep record of votes in real time.

We study the effects of this technology in the context of Bulgaria – a democracy with independent electoral institutions and strong electoral competition, where concerns over electoral integrity have nonetheless been pervasive for the past 30+ years. Specifically, numerous accounts suggest widespread vote buying and voter coercion – i.e. use of monetary rewards or threats to induce voters to turn out and vote for a given party, or to induce polling station officials to interfere with votes. According to a representative survey conducted by Gallup, over 50% of respondents know of instances of vote-buying and voter coercion in their locality. Only 10% of Bulgarians report confidence in the honesty of elections – the lowest level globally and six times below the EU median (Gallup 2024).

In an attempt to reduce the share of invalid votes and the incidence of vote-buying, Bulgaria introduced machine voting in 2021. From an empirical perspective, the setting has several useful features that allow us to credibly evaluate the causal effects of the voting technology. First, Bulgaria had 7 general elections since 2021 with different versions of machine voting – either mandating it (a regime we refer to as "machine elections"), or giving voters the choice between machine and paper ballot (a regime we refer to as "mixed elections").[1] Second, in all of these elections, machine voting was only implemented in polling stations with 300 or more ex-ante registered voters, while polling stations below this cutoff continued to vote with paper ballots throughout. Under the assumptions of no manipulation of the running variable and continuity of potential outcomes around the threshold, this discontinuous rule allows us to estimate the causal effects of machine versus paper-ballot voting on polling-station level electoral outcomes in a regression-discontinuity framework. We provide evidence in support of these assumptions – the distribution of the number of ex-ante registered voters is smooth around the threshold, and we find that both baseline electoral outcomes (prior to the introduction of machine voting), and the socio-economic characteristics of polling station localities are largely balanced around the threshold.

Our first result is that machine voting increases the share of valid votes by about four percentage points. This is driven by the (almost full) elimination of null votes – i.e. votes that cannot be unambiguously assigned to a party or are filled out improperly, and thus are not counted in the election results.[2] While this effect is ubiquitous, its magnitude varies depending on the socio-economic characteristics of polling station localities. It is significantly larger in localities with low education, high share of ethic minorities or high share of elderly population. We also document positive effects of the option of machine voting in mixed elections, with a magnitude roughly proportional to machine take-up.

Our second result is that, despite improving accuracy, machine voting caused a sizable reduction in turnout. Pooling the three machine elections, we estimate a negative effect on turnout of about five percentage points. This is a sizable magnitude given the low turnout

[1] These frequent elections are a result of ongoing political instability and a failure to form a stable coalition government.

[2] We find that machine voting also leads to a significant but quantitatively small reduction in the share of blank votes – that is, votes explicitly indicating support for no one (an option available on both the paper and machine ballots).

rate in Bulgaria in this period (about 43%). The effect is driven entirely by rural areas, by localities with low education, and ones with high unemployment. Looking at mixed elections, we find no significant impact of the machine option on turnout.

Together, these results present a puzzle from a Downsian calculus-of-voting perspective. Despite increasing the probability of being pivotal – which should, if anything, increase voters' incentives to turn out – we find that machine voting has a strong negative impact on turnout. In fact, the second effect dominates the first in terms of magnitude, which results into a 10% reduction in the number of valid votes. We investigate two possible explanations.

The first explanation is that this reflects a reduction in bought or fictitious votes – an effect that would be consistent with the motivations behind the introduction of machine voting. Specifically, by preventing practices such as the use of pre-filled ballots or ballot stuffing after the end of the election day, the machine technology may directly hinder irregularities or reduce parties' willingness to pay for votes in machine polling stations. The second explanation is that voter aversion to the technology, or mistrust in its security, depresses turnout. Such reservations could explain our results if they vary discontinuously at the machine assignment threshold – i.e., if they are triggered by one's personal assignment to machine voting, rather than by the overall technology regime in the election.

We take two approaches to distinguish between these mechanisms. First, we consider the implications of a reduction in electoral irregularities for the distribution of votes across parties. We assume, given Bulgaria's proportional representation system in which strategic incentives play a limited role, that the main determinant of the distribution of vote-buying activity is parties' ability to control brokers and polling station committees. This leads to the prediction that a reduction in these activities should disproportionately weaken parties that were dominant in a given locality under the paper ballot regime. We test this prediction by dis-aggregating total valid votes received in each polling station into votes for parties that received the most votes in that polling station at baseline, versus votes for other parties. We find that the reduction in total votes is driven entirely by votes for dominant parties (which decline at the threshold by about 20%), while we find no effect for other parties. We further show that this heterogeneity is not explained by a general reduction in turnout among supporters of established versus new parties, and that it is robust to alternative definitions of party dominance (e.g. a measure based on the party of the incumbent municipal mayor).

Second, we partner with Gallup International to conduct a nationally representative door-to-door survey that elicits: (1) attitudes towards machine voting; and (2) experiences with vote-buying in the period since the introduction of machine voting. We then link each of these measures to self-reported machine- or paper- polling station assignment. These data reveal that although 8% of respondents report that they have been discouraged from turning out in the past 3 years due to the voting technology, this rate does not differ between respondents assigned to paper-ballot polling stations and voters assigned to machine-voting stations.[3] In other words, while there is non-negligible aversion to the machine voting regime, it does not appear to vary with voters' individual polling station assignments – a necessary condition to explain our discontinuity result. On the other hand, we find that over 50% of respondents report hearing about vote-buying attempts in their locality over the past 3 years, and that this rate is lower among respondents assigned to machine stations compared to those assigned to paper stations. This difference is especially pronounced in rural areas, where respondents assigned to machine stations are 26 percentage points less likely to report vote buying compared to those assigned to paper stations.

This paper contributes to several strands of literature. The study closest to ours is Fujiwara (2015), which analyzes Brazil's transition from paper ballots to machine voting, with a focus on the de-facto enfranchisement of illiterate voters. More recently, Aragón et al. (2025) analyze the introduction of machine voting in the case of Peru. In line with these studies, we find that machine voting helps lower socio-economic status voters cast valid votes, if they turn out. However, in contrast to these studies, we find a sizable negative effect on turnout, concentrated among voters of locally dominant parties – consistent with the interpretation that voting technology reduces clientelistic mobilization.[4] In a similar

[3]Furthermore, out of the respondents surveyed in the week before the June 2024 election, over 50% were not informed what voting technology will be used in their polling station.

[4]One possible reason why Fujiwara (2015) and Aragón et al. (2025) find no significant effect on turnout is that voting is compulsory in both Brazil and Peru, and participation rates are about twice as high as in

vein, Debnath et al. (2017) provide suggestive evidence of reduced fraud in Indian state assembly elections. Overall, we contribute new causal evidence to the debate about the role of technology in enhancing electoral integrity.

Our study also contributes to a theoretical and empirical literature on vote-buying and voter coercion (Stokes 2005; Nichter 2008; Larreguy et al. 2016; Finan and Schechter 2012; Duarte et al. 2023; Blattman et al. 2024; Vicente 2014, e.g.). A central question in this literature is how vote-buying is sustained under the secret ballot, with previous studies emphasizing the role of social networks and reciprocity between brokers and vote-sellers. While prior work has examined anti-vote-buying campaigns aimed at voters (Vicente 2014; Blattman et al. 2024), we study an institutional reform that alters the mechanics of how elections are conducted. We argue that voting technology can reduce bought or fictitious votes by increasing ballot secrecy and limiting opportunities for human interference. In doing so, we connect to historical work on the introduction of the secret ballot in the US and Western Europe (Heckelman 1995; Aidt and Jensen 2016), and to studies of increased monitoring during vote counting in settings with a high fraud risk (Enikolopov et al. 2013; Callen and Long 2015).

More broadly, a growing literature in development economics studies the potential for information technology to reduce corruption and improve state capacity in areas such as welfare distribution, public procurement and tax collection (Lewis-Faupel et al. 2016; Banerjee et al. 2020; Okunogbe and Pouliquen 2022, e.g.,). We contribute to this literature by studying the impact of technology in the electoral process, which is arguably foundational to the functioning of other institutions.

Finally, our paper relates to a literature on the impact of electoral rules on voter turnout in developed democracies – recently reviewed by Cantoni et al. (2024). Previous studies have examined the turnout effects of various electoral procedures, including voter registration (Braconnier et al. 2017; Nickerson 2015), early or mail-in voting (Kaplan and Yuan 2020; Thompson et al. 2020) and voter ID laws (Cantoni and Pons 2021).[5] While the focus in

Bulgaria.

[5]Other related studies consider the role of distance to the polls or voting wait times (Cantoni 2020; Chen

this literature is on how electoral rules may affect the cost side of voters' turnout decision, we investigate an additional channel that may operate in less established democracies – the effect of voting procedures (in this case – voting technology) on the mechanics of vote buying and voter coercion.

The rest of this paper is organized as follows. Section 2 introduces the setting and the outline of Bulgaria's transition to machine voting. Section 3 introduces the data used in our analysis. Section 4 presents our empirical strategy. Section 5 presents the main results. Section 6 presents evidence on the mechanism, and section 7 concludes.

2 Background

Electoral system. Bulgaria has an open-list proportional representation system with 31 multi-member constituencies. Each constituency elects multiple representatives to the National Assembly, with the number of seats allocated based on population size. The overall distribution of seats is determined by the proportion of votes each party receives at the national level, with a minimum threshold of 4% vote share. The open-list element allows voters to optionally express preferences for candidates within the party list, which can lead to a re-ranking if one or more lower-ranked candidates surpass a threshold in preference votes (typically 7% of their party's total district votes). However, in practice, such re-ranking is a rare occurrence.

Timeline of the introduction of machine voting. During the period of our study, the Bulgarian political landscape is highly fragmented. Between 2021 and 2025, a stable coalition government failed to emerge due to disagreements between parties on major issues such as judicial reforms and Bulgaria's involvement in the war in Ukraine. This led to a period of political deadlock and a series of snap elections.[6]

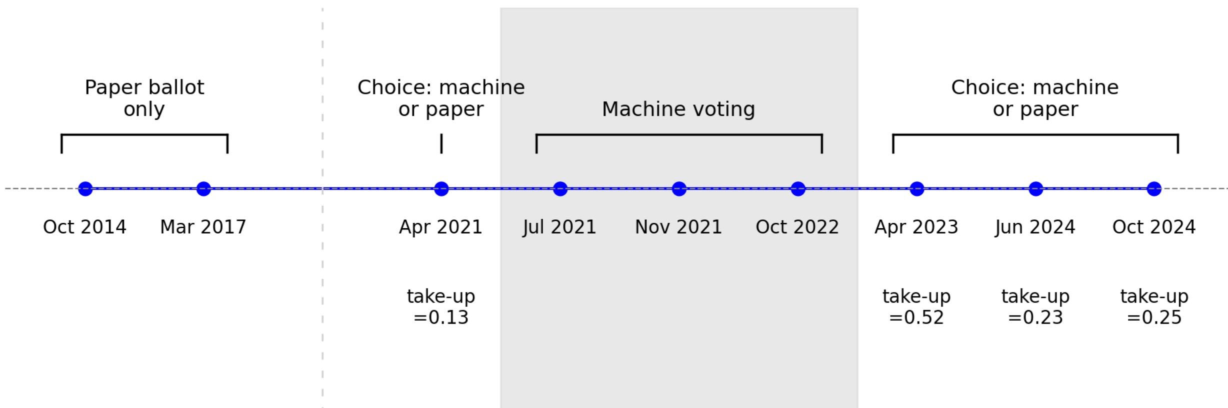
The focus of this study are the nine parliamentary elections that took place during the

et al. 2022).

[6]The general election of October 2024 included 19 parties and 9 coalitions, with 8 making it to the National Assembly.

period 2014-2024. Machine voting was first introduced in April 2021 on a voluntary basis – voters in polling stations with a machine had the choice between paper ballot and machine voting. After an amendment in the electoral law, machine voting became mandatory in polling stations with a machine. This was the case in the following three elections – July 2021, November 2021, and October 2022. Since April 2023, elections have reverted back to the earlier rules offering a choice to voters. Figure 1 illustrates this timeline.

Figure 1: Elections timeline



Notes: This figure reports the timeline of the nine general elections in our sample. These elections fall into three voting technology regimes: (1) Voting with paper ballot only; (2) Machine voting (in polling stations with ≥ 300 registered voters); (3) Choice machine or paper (in polling stations with ≥ 300 registered voters). Polling stations below the 300 threshold continued to vote with paper ballot in all elections. For mixed elections, we report machine take-up in polling stations close to the threshold, i.e., in the range of 300 to 400 registered voters.

Voting process. Figure A1 illustrates the voting process, comparing machine voting to voting with a paper ballot. All eligible voters in Bulgaria are automatically registered to vote and assigned to a unique polling station based on their address. In the polling station, the voter first presents their ID to an election official who verifies whether that voter is in the list of registered voters. In the case of paper-ballot voting, the voter receives the ballot and marks their choice in a designated private area – typically behind a curtain or a paravan. In the machine voting case, the voter receives an electronic card that activates the machine, which is positioned such that the screen is not visible to others, but the voter is visible to the election officials. Bulgaria uses Direct Recording Electronic (DRE) machines with a Voter-Verified Paper Audit Trail (VVPAT). This means that machine votes are recorded both electronically and physically: when a vote is successfully cast, the machine produces a printout that the voter casts into a ballot box. Since 2023, official machine vote results are based on a manual tallying of these printouts.

The machine interface has an identical format to the paper ballot, with parties in parliamentary elections listed on the left-hand side and candidates from the party lists listed on the right-hand side. For the vote to be valid, it must include a party choice, while choosing a candidate is optional.

Information on voting technology available to voters. The Central Election Commission implemented an information campaign on machine voting prior to its full-scale introduction, which included ads on national TV and an online machine voting simulator. However, the campaign did not highlight the fact that small polling stations would continue to vote with paper – likely because this was not deemed necessary given the small share of voters assigned to such stations. A spreadsheet with the polling stations with a machine is posted on the website of the election commission a few weeks before each election, along with other documents related to the election logistics. Yet, because this information is not advertised, it is unlikely that voters in the initial machine elections (especially those with low digital literacy) were informed about the technology in their assigned polling station. Indeed, in our June 2024 survey — conducted after five consecutive elections using voting machines and just a week before the upcoming election — over 50% of respondents did not know what voting technology would be used in their polling station.

The arguments for machine voting. The motivation for the introduction of machine voting in Bulgaria was two-fold. The first explicit goal was to reduce the consistently high number of invalid votes (i.e. blank or null votes). In the 2017 parliamentary election, invalid ballots accounted for about 7% of all votes cast. Machine voting alleviates this issue as the machine interface makes it impossible to cast an ambiguous choice (though one can still cast a blank ballot by choosing the explicit ”support no one” option).

The second explicit goal was to combat Bulgaria’s persistent problem with vote-buying and voter coercion. The magnitude of this problem is difficult to quantify, but one method – based on detecting statistical anomalies in electoral returns – suggests that between 2013 and 2017, 5 to 18% of all votes were cast in polling stations suspected of widespread manipulation (Kraynova and Rusinov 2021). In a representative survey conducted by Gallup, 11% of respondents report that they would be willing to sell their vote or would give in to coercion and another 8% state that they are unsure. These rates are higher among the poor, the less educated and among ethnic minorities – consistent with evidence that the susceptibility to clientelistic practices is linked to economic vulnerability (Bobonis et al. 2022; Fajury 2023).[7]

A well-known vote-buying scheme that machine voting was expected to impede is the so-called 'Indian string' scheme – an iterative process involving pre-filled ballots. It begins with a broker handing a pre-filled ballot to a voter willing to sell their vote. The voter casts this ballot at the polling station and returns with a blank ballot as proof, allowing the cycle to continue. Machine voting disrupts this process, as the only 'ballot' cast is the real-time printout generated by the machine, eliminating the opportunity to exchange or verify paper ballots.

Additionally, machine voting likely makes ballot-stuffing more difficult. Unlike paper ballots, which can potentially be added or altered during the counting process, these printouts are generated in real-time and recorded both in the printout and electronically.[8]

Indeed, anecdotal evidence from locations particularly prone to electoral manipulations supports these predictions. One such case study is the village of Bukovlak in northern Bulgaria, where investigative reports have uncovered widespread vote-buying activities several times over the years. The village has three polling stations, all over the 300 threshold, and thus all allocated at least one voting machine. Turnout in this village collapsed from about 80% prior to the introduction of machine voting to about 20% after, with reports from the ground attributing this effect to reduced mobilization activities of vote brokers.

[7] https://www.gallup-international.bg/42259/corrupted-vote-in-bulgaria/

[8] Several cases of polling station workers filling out empty paper ballots or over-writing filled ballots during the counting process have been documented via video-monitoring.

The arguments against machine voting. A number of concerns have been raised by opponents of machine voting, ultimately leading to the reintroduction of the mixed system in April 2023. The first concern was that the new technology may present an obstacle or inconvenience for some voters (e.g., the elderly). In practice, the voting machine has an interface identical to the paper ballot and is no more difficult to operate than an ATM.

The second concern is about possible technical issues with the machines on election day. As insurance against such events, printed ballots are always supplied to all polling stations, to be used in case of a machine malfunction. Additionally, voters are allowed to annul their machine vote if it is unsuccessful and can cast a paper ballot instead.

The third concern revolves around the security of the electronic system. While this concern is often raised as an argument against machine voting, in practice machine votes in Bulgaria have been counted based on physical printouts since 2023 (electronically recorded votes are only used to verify this manual count). The security argument has nonetheless gained traction. This culminated in the lead-up of the local elections of October 2023, when machine voting was banned 36 hours before election day because of a complaint about the documentation of the machines' certification. The Supreme Court later declared this ban unlawful.

Parties' stances on machine voting. Parties' positions on machine voting changed over time, but can be broadly categorized as follows. All three established parties — the center-right Citizens for European Development of Bulgaria (GERB, the main incumbent party until 2021), the ethnic-based Movement for Rights and Freedoms (DPS), and the Bulgarian Socialist Party (BSP) — expressed reservations about machine voting and voted in favor of reintroducing a mixed voting system in 2022. Indeed, critics dubbed these parties "the paper coalition". The main proponents of full-scale machine voting were new parties established or gaining influence after 2017 – the reformist We Continue the Change (PP) and Democratic Bulgaria (DB), as well as the far-right Revival – which all voted against reinstating a mixed voting system.[9]

Voter preferences appear to align with these patterns, as reflected in machine take-up during mixed elections (Appendix Figure A2): supporters of established parties more often cast paper ballots, whereas supporters of new parties more often opt for machine voting.

3 Data

Electoral returns. We collect electoral returns by polling station for all general elections taking place from 2014 to 2024 from the Central Electoral Commission of Bulgaria. For each of about 12,000 polling stations in the country, these data report whether the station had a voting machine or not, the number of registered voters (as of election day), the number of total votes cast, the number of valid votes cast, as well as their breakdown by party. Following Fujiwara (2015), we define a vote as valid if it counts towards the vote share of a party or a candidate. This definition excludes blank votes (which indicate support for "No one"), as well as null votes (which do not comply with the rules of the electoral commission or cannot be uniquely assigned to a party/candidate). Turnout is defined as the total votes cast in a polling station (including blank and null votes) divided by the respective number of registered voters as of election day.

For our running variable, we use information on the number of *ex-ante* registered voters (recorded several months before each election), which determines the allocation of machines to polling stations. Voting registration is automatic in Bulgaria and the assignment to polling stations is based on the address register, with each polling station having a geographically defined catchment area. This variable, and consequently the allocation of voting machines, varies over time as address registrations change between elections. However, because the elections in our sample are quite frequent, we find that these changes tend to be small, with only 2.2% of polling stations switching sides of the threshold between 2021 and 2024.

Table 1 reports summary statistics for the main outcomes of interest separately for paper,

[9] The party There is Such a People (ITN), established in 2020, initially supported machine voting but raised concerns ahead of the 2023 local election. The party was not represented in the National Assembly at the time of the vote on reinstating the mixed system.

machine, and mixed elections. In paper elections the average turnout is 50% and the average share of valid votes is 93%. Comparing this baseline to the period after the introduction of machine voting, it is evident that the share of valid votes increases by around 2 percentage points in mixed elections and 5 percentage points in machine elections (driven by a decline in null votes). At the same time, turnout declined substantially after the machines were introduced by 12 to 13 percentage points. Yet, some of these over-time changes may be attributable to reasons other than the voting technology – e.g., the very frequently held elections starting in 2021 likely led to significant voter fatigue. Thus, our empirical strategy will need to account for such time effects.

Table 1: Summary statistics

	N	Mean	Sd
Paper elections			
Turnout / num. reg. voters	23819	0.502	0.108
Valid votes / turnout	23818	0.932	0.044
Blank votes / turnout	23818	0.012	0.016
Null votes / turnout	23818	0.057	0.045
Machine elections			
Turnout / num. reg. voters	36887	0.373	0.129
Valid votes / turnout	36882	0.978	0.020
Blank votes / turnout	36887	0.020	0.017
Null votes / turnout	36887	0.002	0.011
Mixed elections			
Turnout / num. reg. voters	49054	0.384	0.134
Valid votes / turnout	49053	0.947	0.030
Blank votes / turnout	49057	0.029	0.020
Null votes / turnout	49057	0.024	0.028
Share machine votes	49057	0.396	0.245

Notes: Polling station-level summary statistics, weighted by number of registered voters, for the main outcomes of interest. *Paper elections* include elections in October 2014 and March 2017, *Machine elections* include elections in July 2021, November 2021 and October 2022, and *Mixed elections* include elections in April 2021, April 2023, June 2024 and October 2024.

Local socioeconomic characteristics. We add to the above polling-station dataset locality-level characteristics from the 2011 Census (there are about 5,600 localities in Bulgaria). This includes the share of the population that is 65 years of age or older, the share without secondary education, the share of ethnic minorities (Turkish or Roma), the unemployment rate, and the type of locality (village versus town/city).

Survey data. In order to understand better the mechanisms behind our observational results, we partnered with Gallup International to embed questions on attitudes toward machine voting and experiences with vote-buying in electoral surveys taking place before and after the election of June 2024. The survey was constructed by Gallup to be nationally representative and was administered to approximately 1,800 respondents.

Our block of questions asked respondents to recall the general elections of the past 3 years (2021-2024), i.e. in the period since the introduction of machine voting. Respondents were asked whether they voted in this period, and conditional on having voted at least once, whether their polling station had a voting machine or not. We further asked the following "Yes" or "No" questions: *"In this period (2021-2024), were you ever discouraged from voting due to the voting technology used?"* and *"In this period (2021-2024), have you ever heard about vote-buying attempts in your locality?"* The survey also included additional questions on any technical issues with the machines (reports of which were negligible), and, for the survey wave taking place before the June 2024 election, a question on knowledge about the voting technology in the respondent's polling station in the upcoming election.

4 Empirical Strategy

4.1 Polling station-level RDD

The discontinuity in the allocation of voting machines. Our preferred empirical strategy exploits the rule set by the electoral commission for the allocation of machines across polling stations. In all elections since 2021, voting machines were distributed only to polling stations with 300 or more ex-ante registered voters, while smaller polling stations continued to vote with paper ballots throughout.[10] The motivation for this allocation rule was the limited number of machines available and economies of scale in their distribution to larger polling stations. About 22% of polling stations fall below the threshold of 300 ex-ante registered voters. To the best of our knowledge, no other electoral procedure varies at this threshold.

Figure B1 shows that compliance with the machine allocation rule is virtually perfect – the share of stations with a voting machine in any machine election is exactly zero for polling stations with less than 300 ex-ante registered voters, and exactly one for polling stations with 300 or more ex-ante registered voters (with only one deviation in April 2021).[11]

Estimation. To estimate the causal effects of machine voting, we use the polling-station-level cutoff and employ a sharp regression discontinuity design. We estimate specifications of the following form:

$$y_p = \alpha + \beta_1 1\{v_p \geq 300\} + \beta_2 v_p + \beta_3 v_p 1\{v_p \geq 300\} + \epsilon_p, \qquad (1)$$

The dependent variable y_p indicates an electoral outcome in polling station p. The running variable v_p is defined as the number of ex-ante registered voters in polling station p. The treatment variable is $1\{v_p \geq 300\}$, i.e. a function that takes the value 1 if this number exceeds 300, with β_1 denoting the respective treatment effect. Our preferred specification pools all three machine and all four mixed elections together, controlling for province $\times$ election fixed effects to account for secular province-level trends. We cluster standard errors by polling station.

The estimation samples are restricted to polling stations close to the cutoff, i.e. to stations

[10] As ex-ante registration is not required abroad, rules regarding machine allocation differ. Specifically, stations with either 300 or more ex-ante registered voters or actual voters in the previous election are allocated a machine. Hence, our sample excludes stations abroad, which account for less than 5% of all polling stations.

[11] Mobile polling stations, stations based in medical facilities, homes for the elderly and other specialized institutions for the provision of social services do not receive a machine regardless of their number of registered voters. In practice, stations that fall under these exceptions have few registered voters and therefore almost always fall below the threshold.

with $v_p \in (300-h;300+h)$. We consider two approaches when choosing the bandwidth h – using either the data-driven optimal bandwidth determined by the procedure of Calonico et al. (2015) or setting $h = 100$ (which happens to be close to the average optimal bandwidth). We present robust estimates following Calonico et al. (2014a) throughout, applying local linear estimation with a triangular kernel.[12]

Identifying assumption. This empirical strategy identifies the causal effects of voting technology under the assumption that the running variable (i.e., the number of ex-ante registered voters) is not manipulated. We believe that this assumption is plausible in our setting because this number is based on individual address registrations several months prior to the respective election.

To further assess the validity of the assumption, we examine the smoothness of the number of ex-ante registered voters around the threshold, implementing a formal sorting test for manipulation of the running variable following McCrary (2008). Figure B2 presents this test, pooling the three machine elections in panel (a), and the four mixed elections in panel (b). In both cases we fail to reject the null hypothesis that the density of the number of ex-ante registered voters is continuous at the threshold of 300 (with a McCrary test p-val = 0.553 in panel (a), and 0.114 in panel (b)).

Additionally, we implement a placebo test for any baseline differences between polling stations below and above the threshold of 300 ex-ante registered voters. For this test we consider the 2014 and 2017 elections which took place *before* the introduction of machine voting. Table B1 shows that our main outcomes of interest – valid votes and turnout – are smooth around the threshold in this baseline period. In a similar vein, in Table B2 we test whether polling stations on either side of the threshold differ with respect to the socio-economic characteristics of the towns or villages they are located in, as measured by the 2011 census. With the exception of a negative and marginally significant coefficient for log population, we fail to detect any discontinuity in socio-economic characteristics at the

[12] Our main results are very similar if we apply the conventional or the bias-corrected estimator instead. They are also robust to different functional forms for the running variation, such as a quadratic instead of linear polynomial.

threshold.

4.2 Municipality-level difference-in-differences

The regression discontinuity strategy in Equation 1 allows us to estimate a local average treatment effect for polling stations close to the cutoff. One may wonder whether the average effect differs. Furthermore, a limitation of the RDD analysis is that it does not allow us to distinguish between absolute changes in electoral outcomes and a reallocation of electoral activity from machine to paper-ballot polling stations (or vice versa). This question is particularly relevant for the turnout analysis, as vote-buying activity may shift from machine polling stations to paper polling stations. To understand whether such spillovers are at play and to test the robustness of the RD results, we leverage the panel dimension of our data and adopt a difference-in-differences strategy at the municipality × election level.[13]

Specifically, we estimate event study regressions of the following form:

$$y_{me} = \sum_{e \neq Mar2017} [\theta_e ShareVoters^{\geq 300}_{mMar2017} \times 1\{Election = e\}] + \delta_m + \delta_{pe} + \epsilon_{me}, \tag{2}$$

where y_{me} denotes an electoral outcome in municipality m and election e, $ShareVoters^{\geq 300}_{mMar2017}$ is the share of ex-ante registered voters in municipality m assigned to stations with 300 or more registered voters in the March 2017 election, $1\{Election = e\}$ are a set of election indicators (with March 2017 as the omitted category), and δ_m and δ_{pe} are municipality and province × election fixed effects, respectively.[14]

The coefficients of interest θ_e estimate the election-specific effects of the voting technology, under the assumption that, in its absence, municipalities with different levels of exposure would have followed similar outcome trends. Alternatively, we report difference-in-differences results pooling elections with the same technology regime. In our preferred specification, we

[13]Bulgaria consists of 265 municipalities where a municipality has on average around 25,000 registered voters. The median number of polling stations per municipality is twenty-three.

[14]We obtain similar results if, instead of using 2017 share of ex-ante registered voters assigned to stations with 300 or more voters, we use the contemporaneous election-specific share.

further control for the second-order polynomial of the number of ex-ante registered voters at baseline interacted with election dummies, in order to account for the fact that larger and more urban municipalities tend to have larger polling stations. Standard errors are clustered at the municipality level.

5 Results

5.1 Share of valid votes.

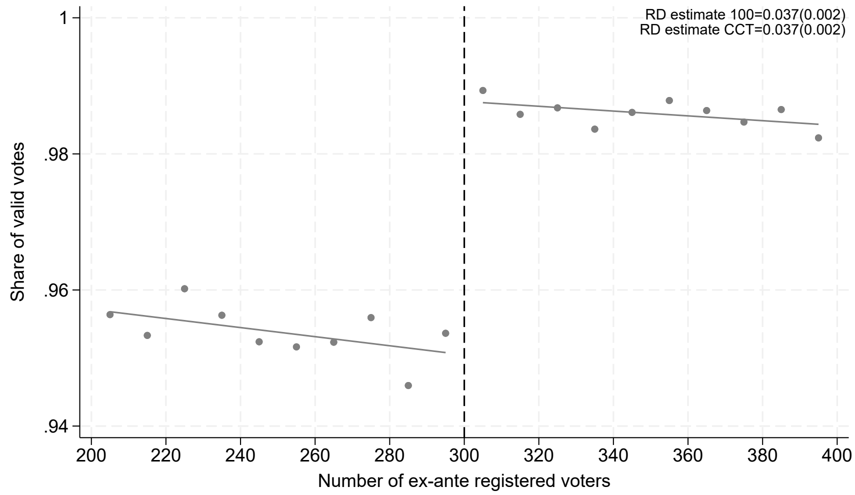
RDD results. We start by examining the effects of voting technology on the share of valid votes. Figure 2 compares polling stations below and above the threshold of 300 registered voters, pooling the three machine elections in panel (a), and the four mixed elections in panel (b). Figure 3 presents separate RDD coefficients for each of the nine elections we consider, estimated either using the optimal bandwidth suggested by the procedure of Calonico et al. (2015), or with a bandwidth uniformly set to 100.

In machine elections, the share of valid votes fluctuates around 95% in polling stations just below the machine-voting threshold, but jumps to 99% in stations just above. This discontinuity is statistically significant, with a similar magnitude in all three machine elections. For mixed elections, on the other hand, we find a smaller but still statistically significant discontinuity of about 0.8 percentage points. Since machine take-up in mixed elections is around 40% on average, this implies a treatment effect that is roughly proportional to the one estimated for machine elections. Indeed, Appendix Table C1 shows that the pooled effect for mixed elections is driven mostly by the two elections with the highest machine take-up (April 2023 and October 2024).

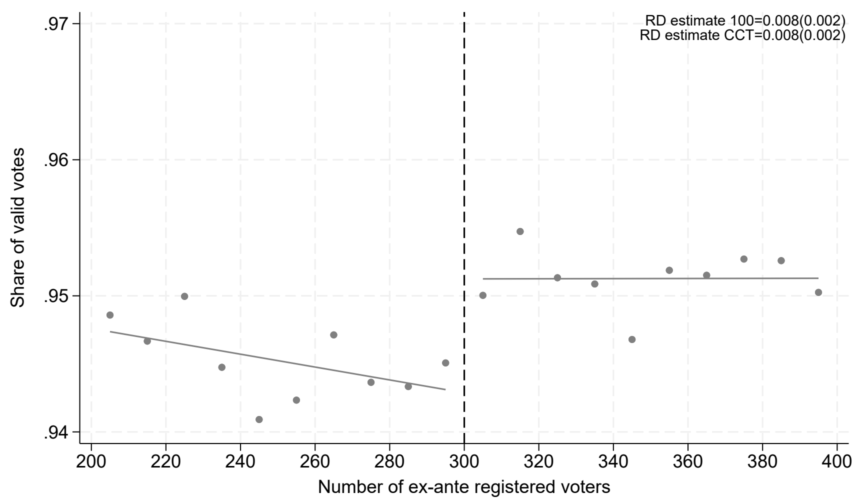
We can further decompose these effects into a reduction in null votes and a reduction in blank votes (Appendix Tables C2 and C3). We find that the increased share of valid votes in both machine and mixed elections is almost fully accounted for by a reduction in null votes, whereas we find a significant but quantitatively small reduction in blank votes. We interpret this evidence as consistent with a mechanical prevention of null votes enabled by

Figure 2: Share valid votes: RDD estimates

(a): Machine elections (pooled)



(b): Mixed elections (pooled)

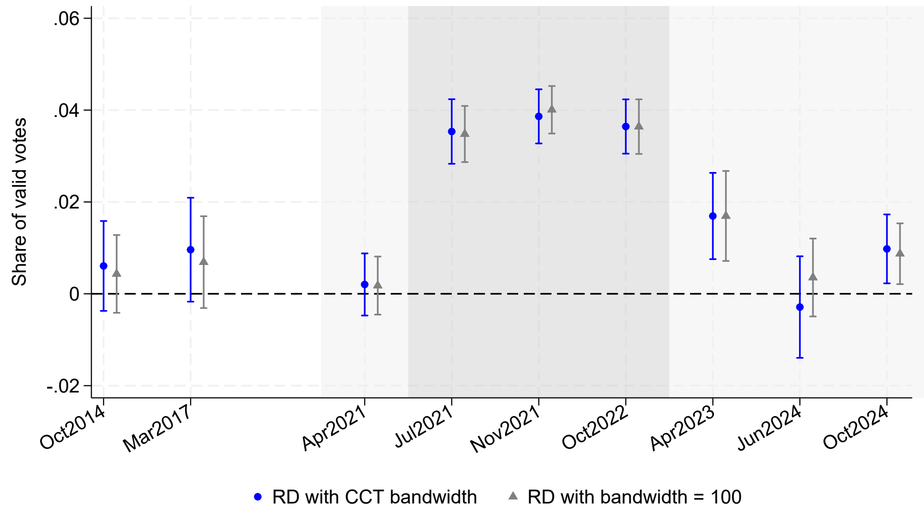


Notes: Binned scatter plot: Share of valid votes over turnout by bin of the number of ex-ante registered voters. The vertical line indicates the threshold that determines the allocation of voting machines across polling stations. The sample in panel (a) consists of the three elections with machine voting in polling stations above the threshold. The sample in panel (b) consists of the four elections with a choice of machine or paper voting in polling stations above the threshold.

the machine technology – an effect that is ubiquitous under full machine voting but also detectable in mixed elections, provided that machine take-up is sufficiently high.

Heterogeneity. This mechanical effect can have a different bite for different types of voters, depending on their propensity to cast a null vote. We examine this heterogeneity in Appendix D.1, by estimating separate RDD regressions for polling stations in localities with different

Figure 3: Share valid votes: RDD estimates by election



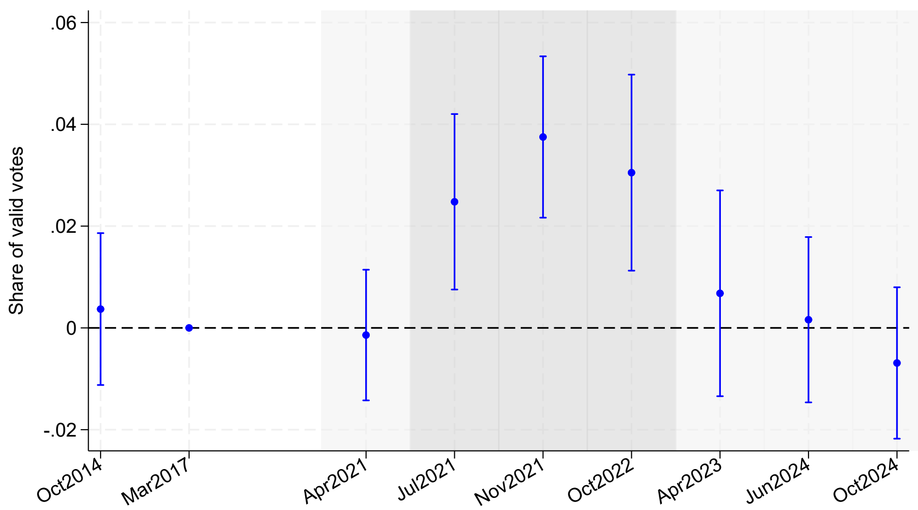
Notes: The plot shows RDD estimates of the effect of voting technology on the share of valid votes, estimated separately for each election. Estimates in the dark gray area show effects in machine elections and estimates in the light gray area show effects in mixed elections.

socio-economic characteristics. Specifically, we consider rural versus urban localities, and ones with below- versus above-median share of population without secondary education, share of ethnic minorities, share of individuals older than 65, and unemployment rate. The increase in the share of valid votes under machine voting is significant in all localities. It is, however, significantly larger in magnitude in locations with lower educational attainment (p-val = 0.05), higher share of ethnic minorities (p-val = 0.02), and higher share of elderly population (p-val = 0.01). We find the same patterns for mixed elections, with the difference that in this case localities with lower socio-economic status on these dimensions *fully* account for the increase in the share of valid votes. This is despite the fact that machine take-up is much lower in localities with these characteristics (see Appendix Figure D1).

Overall, these results show that machine voting is most effective in preventing null votes among vulnerable groups and, thus, increases the likelihood that their preferences are reflected in the election results.

Municipality-level DiD results. We further probe the robustness of the above results to the alternative empirical strategy, which exploits variation across municipalities in exposure to machine voting and over-time variation in its implementation. Figure 4 presents election-specific estimates from equation 2, and Appendix Table C4 reports estimates pooled by election type. Note that our preferred specification controls flexibly for the number of registered voters in a municipality. The results mimic closely those from the RDD analysis – they suggest a 3 percentage point increase in the share of valid votes in machine elections (compared to a 3.7 percentage points increase estimated in the RDD analysis), though in this case we do not detect a significant municipality-level effect for mixed elections.

Figure 4: Share valid votes: Municipality-level event study estimates (DiD)



Notes: The plot shows event-study estimates of the effect of voting technology on the share of valid votes. Estimates in the dark gray area show effects in machine elections and estimates in the light gray area show effects in mixed elections.

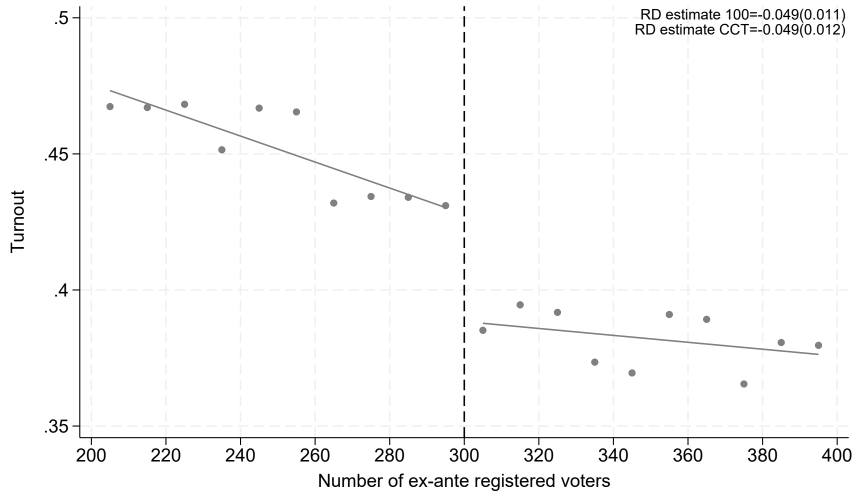
5.2 Turnout.

RDD results. Next, we turn to the effects of voting technology on turnout, defined as total votes cast (valid or invalid) as a share of the number of registered voters. Figure 5 presents scatter plots of turnout around the machine-voting threshold, pooling machine elections in panel (a), and mixed elections in panel (b). Figure 6 presents separate RDD estimates for each election.

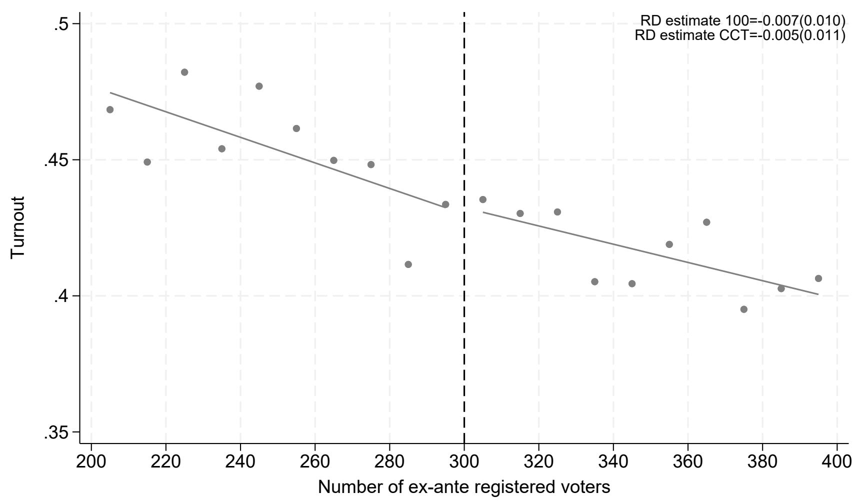
The results show a significant negative impact of machine voting on turnout – pooling

Figure 5: Turnout: RDD estimates

(a): Machine elections (pooled)



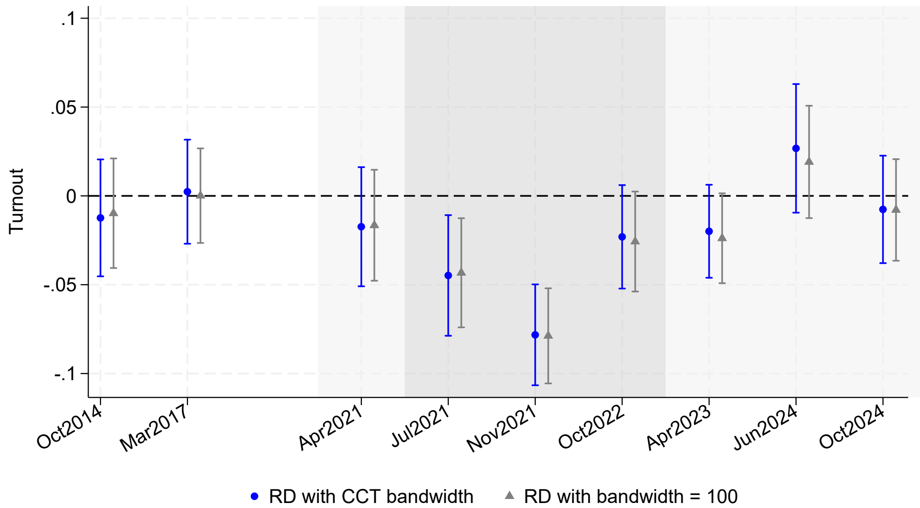
(b): mixed elections (pooled)



Notes: Binned scatter plot: Share of turnout over registered voters by bin of the number of ex-ante registered voters. The vertical line indicates the threshold that determines the allocation of voting machines across polling stations. The sample in panel (a) consists of the three elections with machine voting in polling stations above the threshold. The sample in panel (b) consists of the four elections with a choice of machine or paper voting in polling stations above the threshold.

the three machine elections, we find that turnout is, on average, 4.9 percentage points lower in polling stations just above the machine voting threshold compared to those just below. This corresponds to a 12% decline relative to the mean. The negative effect holds for each of the three machine elections, but is largest and most precisely estimated for the general elections of July 2021 and November 2021. Indeed, we find similar effects in both rounds

Figure 6: Turnout: RDD estimates by election



of the presidential election held November 2021 with the same voting technology (Appendix Figure C2).[15]

Yet, giving voters the choice between machine and paper has no effect on turnout – the estimates for the four mixed elections are noisy and switch signs but are always insignificant, and the pooled sample estimate rules out a negative reduced form effect larger than 1.6 percentage points (Appendix Table C5).

Heterogeneity. Appendix section D.2 presents heterogeneity analysis of these effects, splitting the sample based on the socio-economic characteristics of polling station localities. For machine elections, these results consistently show that the decline in turnout is driven by polling stations located in disadvantaged areas – it is more pronounced in villages compared to towns or cities (p-val = 0.14), in localities with higher unemployment rates (p-val = 0.27), and ones with lower educational attainment (p-val = 0.07).

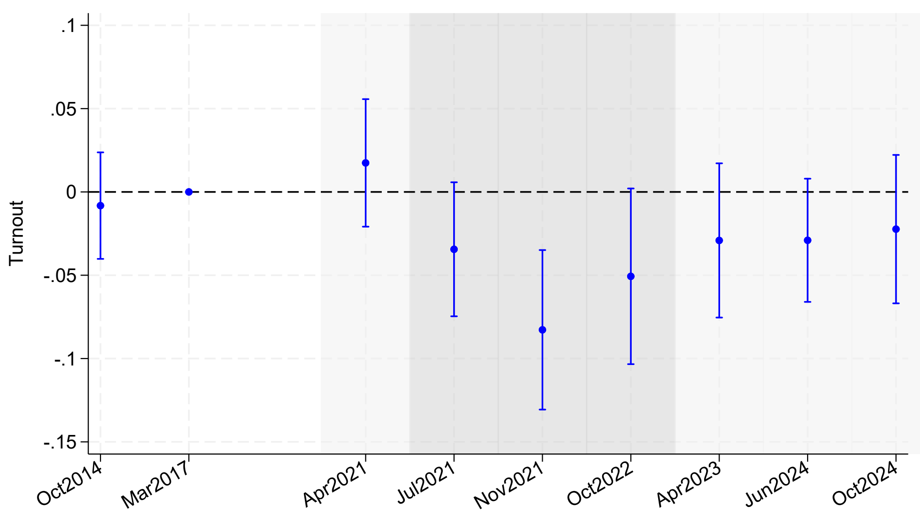
For mixed elections, the heterogeneity analysis supports the conclusion that giving voters a choice between machine and paper does not affect turnout – we find no significant effect in any of the sub-samples we examine.

[15]The first round of the presidential election was held concurrently with the general election; the run-off was held one week later.

Municipality-level DiD results. As mentioned above, one limitation of the RDD analysis is that the estimated decline may reflect a reallocation of vote buying from polling stations above the machine threshold towards ones below. To make this distinction, we turn to the municipality-level analysis. If there are negative spillovers from one side of the threshold to the other, and if they operate locally – i.e. within a municipality – we would expect that aggregating the analysis up to this level should lead to attenuation of the estimated effects.

Figure 7 and Appendix Table C6 report the results of specification 2. The estimated effects are remarkably similar to the RDD ones, suggesting a decline in turnout in machine elections by about 5 percentage points. We again find no impact on turnout in mixed elections. This indicates that the RDD results documented in the previous section are unlikely to be due to a reallocation of voting or vote-buying activity from one side of the threshold to the other.

Figure 7: Turnout: Municipality-level event study estimates (DiD)



Notes: The plot shows event-study estimates of the effect of voting technology on turnout. Estimates in the dark gray area show effects in machine elections and estimates in the light gray area show effects in mixed elections.

6 Mechanism

Our results so far are surprising from a Downsian calculus-of-voting perspective: they suggest that despite increasing the likelihood that votes cast are counted towards the election results and thus increasing the probability of being pivotal (conditional on turning out), machine voting leads to a significant reduction in turnout. In this section, we investigate two potential interpretations of this result.

First, this result may be driven by a reduction in bought or fictitious votes – an effect that would be in line with the motivations behind the introduction of machine voting described in section 2. Alternatively, it is possible that the new technology discourages some voters from turning out – either because they find it difficult to navigate, or because they don't trust it. Distinguishing between these mechanisms is challenging because we lack direct measures of vote-buying activity and of voters' aversion to the machine technology. Therefore, we take an indirect approach to provide suggestive evidence for or against these alternative interpretations.

6.1 Votes for dominant parties versus other parties

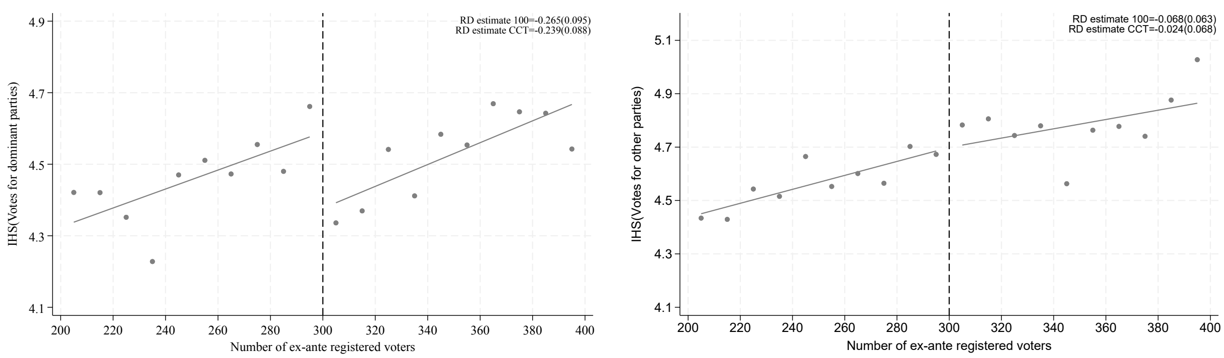
First, we consider the implications of a reduction in vote-buying and voter coercion for the distribution of votes across parties. Bulgaria has a proportional representation system, which means that where within the 31 constituencies in the country parties get their votes has relatively little bearing on their overall results. Therefore, we assume that the main determinant of where and to what extent parties engage in vote buying is the strength of established party networks – i.e., their ability to mobilize brokers and/ or electoral commissions. This leads to the prediction that, if machine voting prevents vote-buying and coercion, we should see a reduction in votes particularly for parties that were traditionally dominant in the respective locality.

We take this prediction to the data by decomposing the total number of valid votes cast on either side of the machine voting threshold into votes for parties that were locally dominant in the respective polling station under the paper ballot regime, versus votes for other parties. We do this classification using the two elections taking place prior to the introduction of machine voting, and consider as "dominant" parties that received the highest share of votes in the polling station in either one of these two elections. Note that this classification is not party-specific – the same party can be a "dominant" party in one polling station, but fall in the "other" category in another.

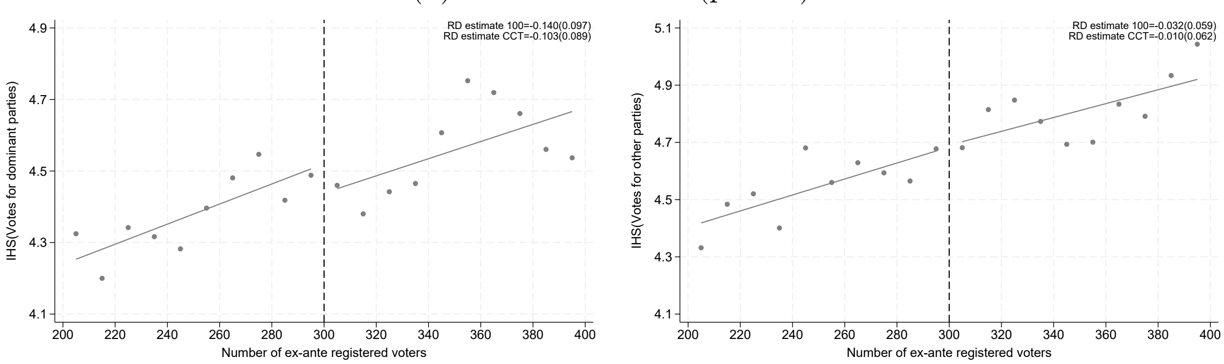
Table 2 presents these results for the pooled sample of the three machine elections in panel (a), and for the pooled sample of the four mixed elections in panel (b). Column (1) reports the effects of machine voting on the total number of valid votes, and columns (2) and (3) breaks down this number into votes for traditionally dominant parties versus other parties. Figure 8 presents scatter plots corresponding to these pooled effects, and Figure 9 presents the estimated effects broken down by election.

Figure 8: Votes for locally dominant parties versus other parties: RDD estimates

(a): Machine elections (pooled)



(b): Mixed elections (pooled)



Notes: Binned scatter plot: The vertical line indicates the threshold that determines the allocation of voting machines across polling stations. The sample in panel (a) consists of the three elections with machine voting in polling stations above the threshold. The sample in panel (b) consists of the four elections with a choice of machine or paper voting in polling stations above the threshold.

The results show that, in machine elections, there are about 10% fewer votes cast in polling stations above the machine voting threshold compared to ones below, indicating that the negative turnout effect dominates the increase in the share of valid votes. But this decline

Table 2: Votes for locally dominant parties versus other parties: RDD estimates

(a): Machine elections

	(1) IHS(Total valid votes)	(2) IHS(Votes for dominant parties)	(3) IHS(Votes for other parties)
Machine voting	-0.0984***	-0.241***	-0.0313
	(0.0380)	(0.0887)	(0.0669)
Province × election FEs	Yes	Yes	Yes
Mean dep var (levels)	125.07	55.65	69.36
Effective observations left	1,296	1,737	1,168
Effective observations right	1,507	2,068	1,352
Bandwidth	85	114	79
p-value (2) = (3)			0.06

(b): Mixed elections

	(1) IHS(Total valid votes)	(2) IHS(Votes for dominant parties)	(3) IHS(Votes for other parties)
Choice machine or paper	-0.0271	-0.0999	-0.00832
	(0.0319)	(0.0878)	(0.0617)
Province × election FEs	Yes	Yes	Yes
Mean dep var (levels)	128.04	57.58	70.12
Effective observations left	1,672	2,482	1,718
Effective observations right	1,854	2,992	1,912
Bandwidth	80	121	85
p-value (2) = (3)			0.39

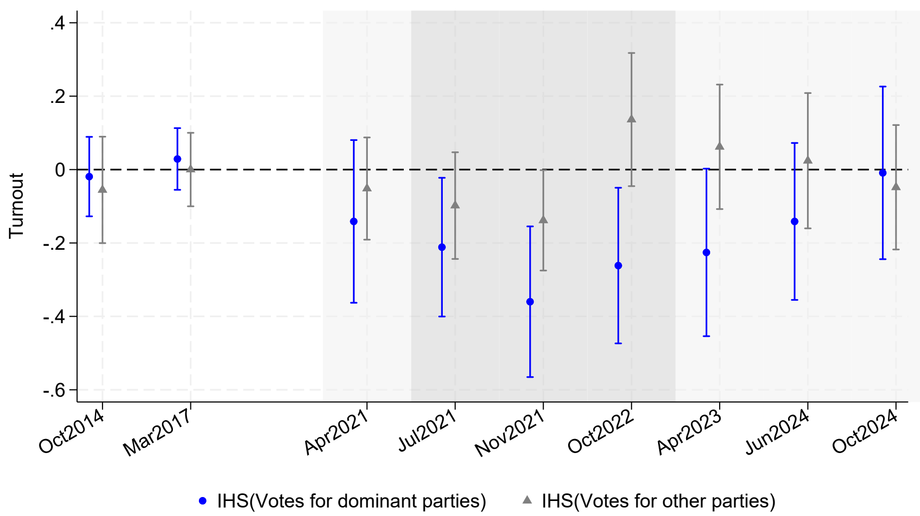
Notes: RDD estimates of the effects of voting technology on the number of votes for parties that are locally dominant at baseline, versus other parties. The table presents β coefficients estimated from equation 1. The sample in panel (a) consists of the three elections with machine voting in polling stations above the threshold. The sample in panel (b) consists of the four elections with a choice of machine or paper voting in polling stations above the threshold. The bandwidth in each regression is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Standard errors clustered by polling station. Significance levels: * p < 0.1, ** p < 0.05, *** p < 0.01.

is not uniform across parties. We find that it is driven entirely by a decline in votes for parties that were dominant in the respective polling station at baseline (a decline of 24%), while votes for other parties are unaffected.[16] We find no significant effects looking at the pooled sample of mixed elections – neither on total valid votes cast, nor on votes for locally dominant or

[16] We can reject the null hypothesis of equality of the coefficients estimated for these two outcomes at the 6% level.

other parties, although we estimate a negative and marginally significant coefficient for votes for dominant parties in April 2023.

Figure 9: Votes for locally dominant parties versus other parties: RDD estimates by election



Notes: The plot shows RDD estimates of the effect of voting technology on the number of votes for parties that are locally dominant at baseline, versus other parties, estimated separately for each election. Estimates in the dark gray area show effects in machine elections and estimates in the light gray area show effects in mixed elections.

Importantly, this heterogeneity is not driven by generally lower turnout among supporters of established versus new parties, which may be correlated with skepticism toward the new technology. Rather, established parties lose votes only in areas where they were initially dominant, but not elsewhere. We show this in Appendix Table C7 by disaggregating votes for non-dominant parties into those for established parties that were not dominant in the respective polling station at baseline, and those for new parties – i.e., parties that were either created or began receiving significant vote shares only after 2017. We find no significant effect of the voting technology on votes for either group.

As a robustness check, we also consider alternative definitions of party dominance. First, in Appendix Table C8 we define as locally "dominant" parties that *consistently* obtained the highest number of votes in the respective polling station in both baseline elections. Second, in Appendix Table C9, we use the party affiliation of the incumbent municipal mayor. The latter measure has the advantage that it looks at contemporaneous rather than past party presence (note that local elections in the period of interest take place only with paper ballots, with the exception of runoffs in 2023). We find similar results using both definitions – parties that were locally dominant in past general elections, as well as those holding the mayoral office, tend to lose votes under the new voting technology.

6.2 Survey evidence

Finally, we turn to the survey data collected in collaboration with Gallup, in which we elicit respondents' views on machine voting and reports of local electoral irregularities. The goal of this analysis is to test whether technology-induced discouragement or vote-buying reports differ between respondents assigned to machine versus paper-ballot polling stations. While the survey sample size is not sufficient to apply an RDD strategy, we can estimate linear probability regressions of the dependent variables of interest on an indicator for self-reported machine versus paper polling station assignment, controlling for locality type fixed effects and respondents' socio-economic characteristics.

Table 3 reports the results. Panel (a) suggests that, although discouragement exists (impacting about 8% of all respondents), its rate does not differ between respondents assigned to machine versus paper stations. Panel (b) shows that, on the other hand, reports of vote-buying differ substantially between respondents assigned to machine versus paper stations. This difference is particularly strong in villages, where respondents assigned to machine stations are 26 percentage points (i.e. over 50%) less likely to report vote-buying activity.

7 Conclusion

In this paper, we evaluate the promise of voting technology to improve the integrity of elections in developing democracies. Using data on electoral outcomes in Bulgaria and a regression-discontinuity design, we document that machine voting is associated with a higher share of valid votes but also with a substantially lower turnout rate. While the increase in valid votes appears nearly universal, the effect on turnout is driven by poor and rural areas of

Table 3: Survey evidence

(a): Discouragement

	Full sample		Villages		Towns/ Cities	
	(1)	(2)	(3)	(4)	(5)	(6)
	Discouraged from voting					
Machine present in polling station	-0.010	0.005	0.041	-0.011	-0.042	0.001
	(0.040)	(0.047)	(0.066)	(0.096)	(0.049)	(0.053)
Respondent controls	No	Yes	No	Yes	No	Yes
Locality type FEs	Yes	Yes	No	No	No	No
Observations	1,224	1,047	250	201	974	846
R^2	0.01	0.03	0.00	0.03	0.00	0.02
Mean dep var	0.09	0.10	0.13	0.13	0.09	0.09

(b): Prevention of vote-buying

	Full sample		Villages		Towns/ Cities	
	(1)	(2)	(3)	(4)	(5)	(6)
	Heard of vote-buying / coercion in locality					
Machine present in polling station	-0.084	-0.094	-0.223**	-0.262**	0.023	0.014
	(0.058)	(0.067)	(0.094)	(0.105)	(0.071)	(0.080)
Respondent controls	No	Yes	No	Yes	No	Yes
Locality type FEs	Yes	Yes	No	No	No	No
Observations	1,236	1,052	258	205	978	847
R^2	0.03	0.03	0.02	0.04	0.00	0.00
Mean dep var	0.55	0.56	0.50	0.50	0.56	0.57

Notes: This table presents respondent-level regressions of an indicator for self-reported discouragement from turning out (panel a), or knowledge of local vote-buying (panel b), on an indicator for machine presence in the respondent's polling station. Respondent controls include gender, age, education and employment status. Locality type refers to village, small town, large town or the capital. Columns (1) and (2) report estimates for the full sample of survey respondents; Columns (3) and (4) report estimates for the sub-sample of rural areas; Columns (5) and (6) report estimates for the sub-sample of towns and cities. Robust standard errors in parenthesis. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

the country, and is present only when machine voting is mandatory rather than left to voter discretion. The turnout decline is driven by a decrease in the number of votes received by parties that were locally dominant at baseline. A representative survey suggests that these effects are unlikely to be driven by discouragement of voters averse to new technology, and points to the prevention of vote-buying activity as a plausible mechanism.

Overall, our results suggest that machine voting may indeed reduce opportunities for electoral manipulation when fully implemented. Although we conclude that voters' doubts over the accessibility and security of machine voting are unlikely to fully explain our results, we document that such concerns are non-negligible. The drivers of these concerns remain one important question for future research.

Finally, we note that our analysis applies to a setting with independent electoral institutions and strong electoral competition. Whether and how voting technology can be (mis)-used by authoritarian regimes remains an open question.

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A Background

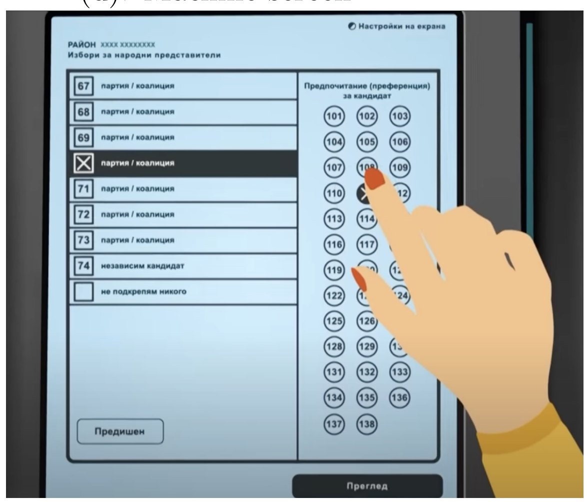
Figure A1: Logistics of paper-ballot versus machine voting

(a): Voting with paper ballot

(b): Voting with machine

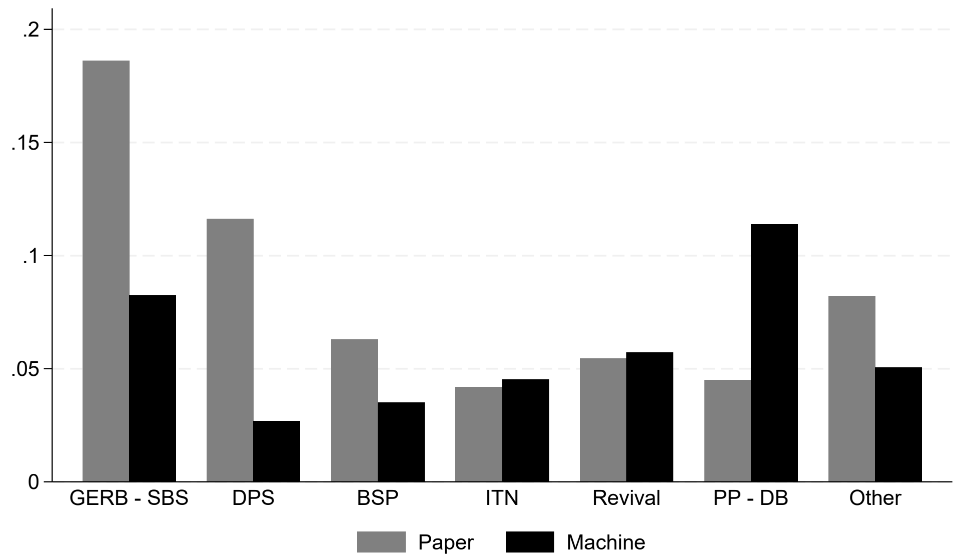
(c): Paper ballot

(d): Machine screen



Notes: The figure illustrates the logistics of paper-ballot and machine voting in Bulgarian general elections. Panels (a) and (b) depict the polling station setup for each type of voting technology, while panels (c) and (d) show the respective ballot formats.

Figure A2: Machine take-up in mixed elections by party

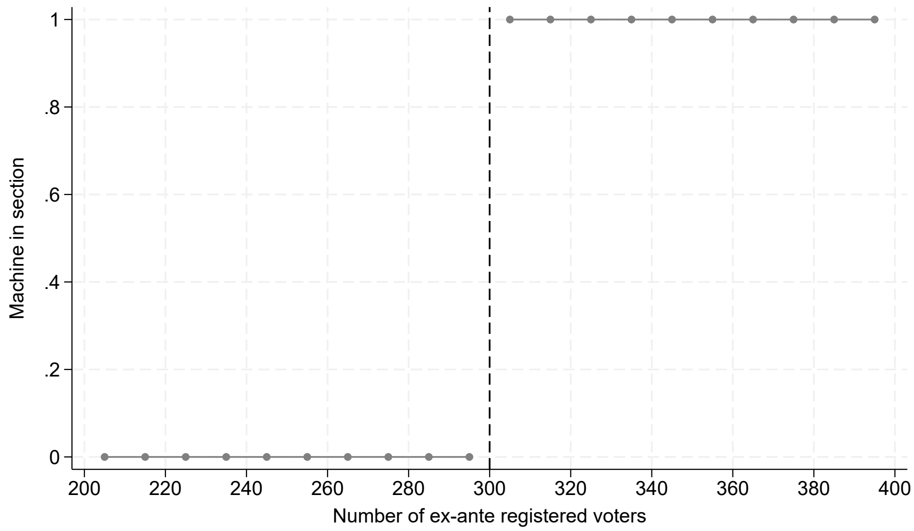


Notes: The figure plots party vote shares in mixed elections separately for votes cast with paper ballots (in gray) and machine votes (in black) in polling stations above the 300 ex-ante registered voters threshold.

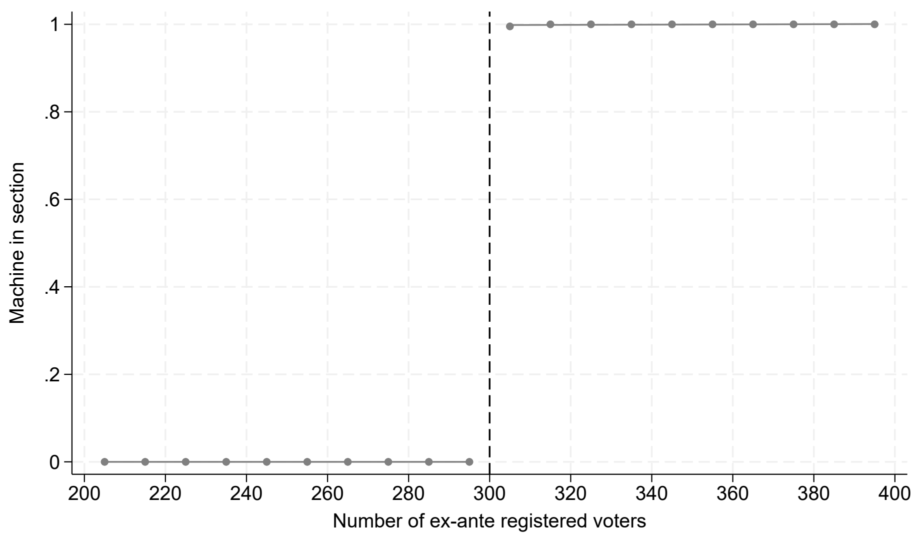
B RDD manipulation and placebo checks

Figure B1: Allocation of voting machines

(a): Machine elections



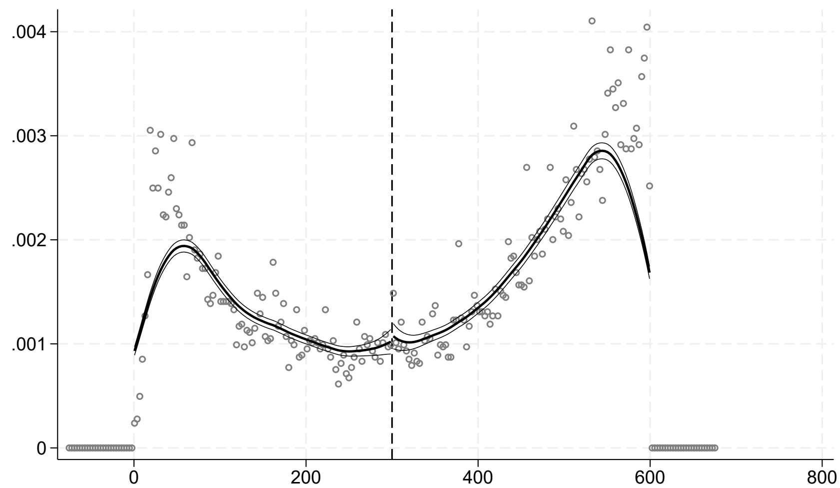
(b): Mixed elections



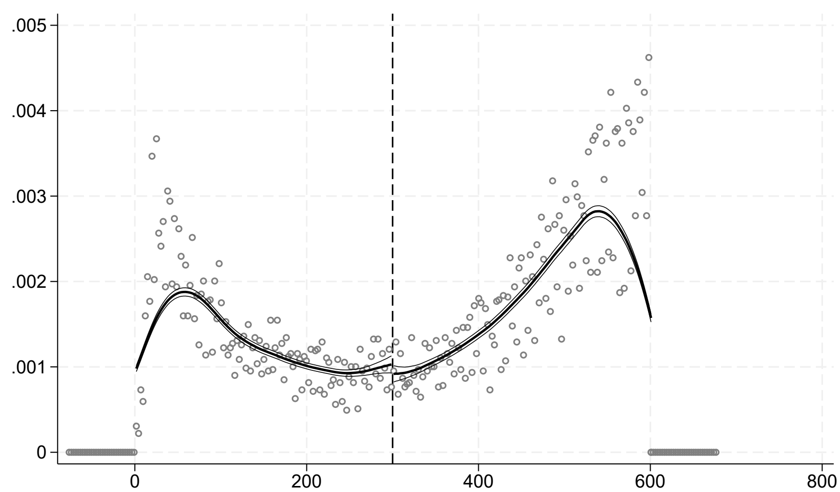
Notes: Binned scatter plot: Share of polling stations with (one or more) machine by bin of the number of ex-ante registered voters. The vertical line indicates the threshold that determines the allocation of voting machines across polling stations. The sample in panel (a) consists of the three elections with machine voting in polling stations above the threshold. The sample in panel (b) consists of the four elections with a choice of machine or paper voting in polling stations above the threshold.

Figure B2: McCrary test for manipulation of the running variable

(a): Machine-only elections



(b): Mixed elections



Notes: McCrary test for discontinuity in the density of the running variable – number of ex-ante registered voters. The vertical line indicates the threshold that determines the allocation of voting machines across polling stations. The sample in panel (a) consists of the three elections with machine-only voting in polling stations above the threshold. The sample in panel (b) consists of the four elections with a choice of machine or paper voting in polling stations above the threshold.

Table B1: Placebo: Baseline outcomes prior to the introduction of machine voting

	Valid votes / turnout	
	(1) Oct2014	(2) Mar2017
$\geq$ 300 ex-ante registered voters	0.00520	0.00956*
	(0.00492)	(0.00576)
Province × election FEs	Yes	Yes
Mean dep var	0.92	0.92
Effective observations left	381	410
Effective observations right	402	406
Bandwidth	75	76

	Turnout / registered voters	
	(1) Oct2014	(2) Mar2017
$\geq$ 300 ex-ante registered voters	-0.00902	0.00236
	(0.0162)	(0.0149)
Province × election FEs	Yes	Yes
Mean dep var	0.54	0.56
Effective observations left	515	432
Effective observations right	522	432
Bandwidth	96	79

	IHS(Num. votes for dominant party)	
	(1) Oct2014	(2) Mar2017
$\geq$ 300 ex-ante registered voters	-0.0192	0.0289
	(0.0552)	(0.0429)
Province × election FEs	Yes	Yes
Mean dep var	5.18	5.23
Effective observations left	442	499
Effective observations right	462	535
Bandwidth	87	93

Notes: Placebo test for pre-treatment discontinuity in outcomes of interest. The table presents β coefficients estimated from equation 1 for the baseline period prior to the introduction of machine voting. The dependent variables are the number of valid votes over turnout in the upper panel, turnout over the number of registered voters in the middle panel, and the IHS-transformed number of votes for the dominant party (i.e., the party obtaining most votes in the respective polling station) in the lower panel. The bandwidth in each regression is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table B2: Placebo: Socio-economic characteristics of polling station localities

(a): Machine elections

	(1) Log population	(2) Unemployment rate	(3) Share minority population	(4) Share without secondary education
$\geq$ 300 ex-ante registered voters	-0.223*	-0.0139	0.0179	0.00655
	(0.119)	(0.0187)	(0.0239)	(0.00990)
Province $\times$ election FEs	Yes	Yes	Yes	Yes
Mean dep var	6.66	0.22	0.29	0.21
Effective observations left	1,845	1,559	2,187	2,088
Effective observations right	2,192	1,839	2,624	2,499
Bandwidth	116	101	135	129

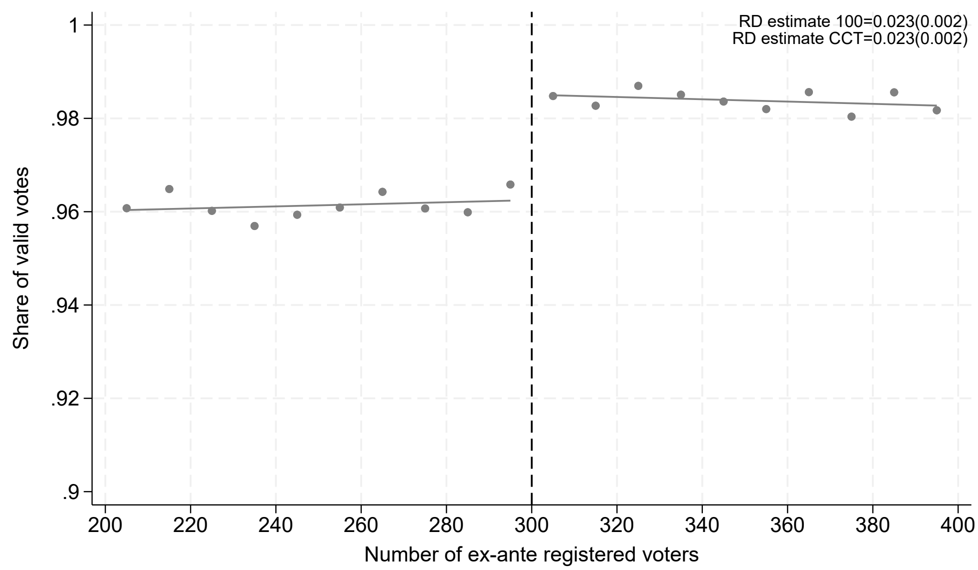
(b): Mixed elections

	(1) Log population	(2) Unemployment rate	(3) Share minority population	(4) Share without secondary education
$\geq$ 300 ex-ante registered voters	-0.186*	-0.0117	0.0168	0.00979
	(0.109)	(0.0176)	(0.0228)	(0.00939)
Province $\times$ election FEs	Yes	Yes	Yes	Yes
Mean dep var	6.70	0.22	0.28	0.21
Effective observations left	2,421	2,185	3,029	2,751
Effective observations right	2,866	2,565	3,668	3,309
Bandwidth	114	104	137	128

Notes: Placebo test for discontinuity in the socio-economic characteristics of polling station localities. The table presents β coefficients estimated from equation 1. The dependent variables are from the 2011 census and are measured at the locality level. The sample in panel (a) consists of the three elections with machine voting in polling stations above the threshold. The sample in panel (b) consists of the four elections with a choice of machine or paper voting in polling stations above the threshold. The bandwidth in each regression is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Standard errors are clustered by locality. Significance levels: * p < 0.1, ** p < 0.05, *** p < 0.01.

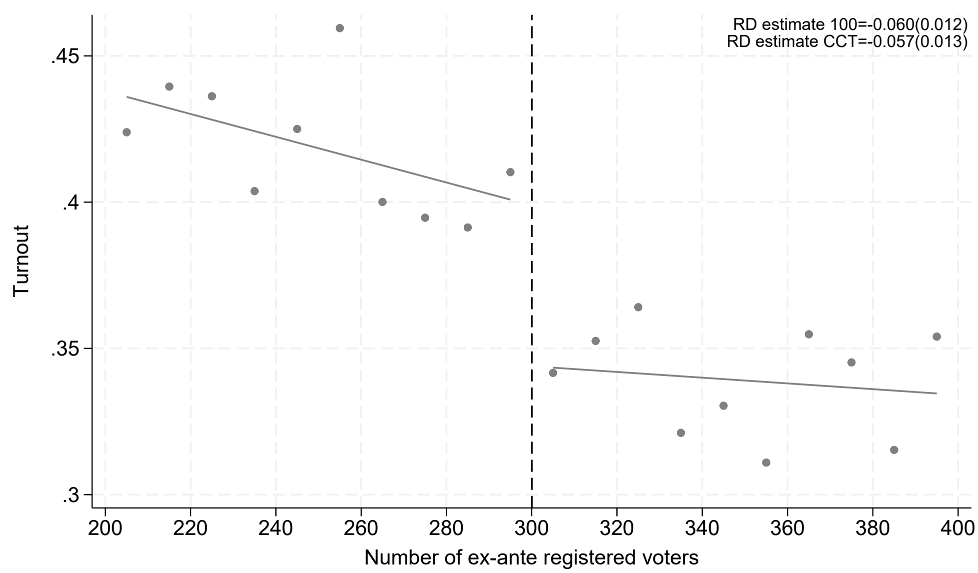
C Additional results

Figure C1: Share valid votes: Presidential election



Notes: Binned scatter plot: Share of valid votes over turnout by bin of the number of ex-ante registered voters. The vertical line indicates the threshold that determines the allocation of voting machines across polling stations. Sample: first and second round of the presidential election of November 2021.

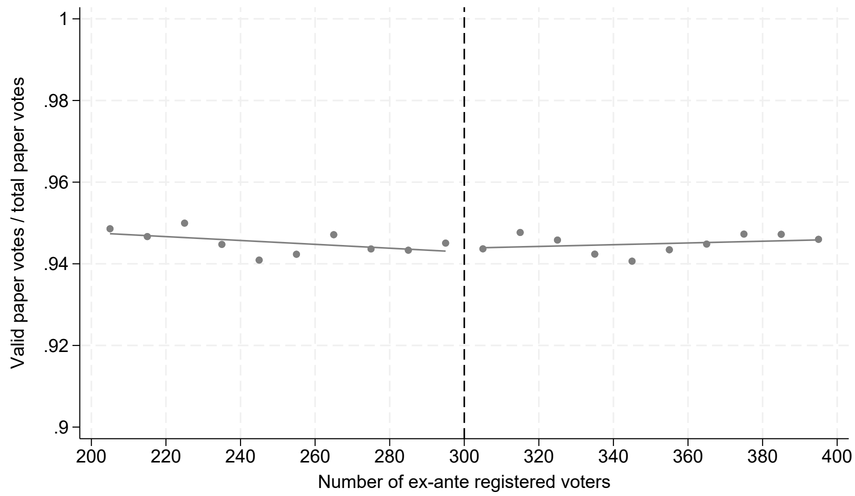
Figure C2: Turnout: Presidential election



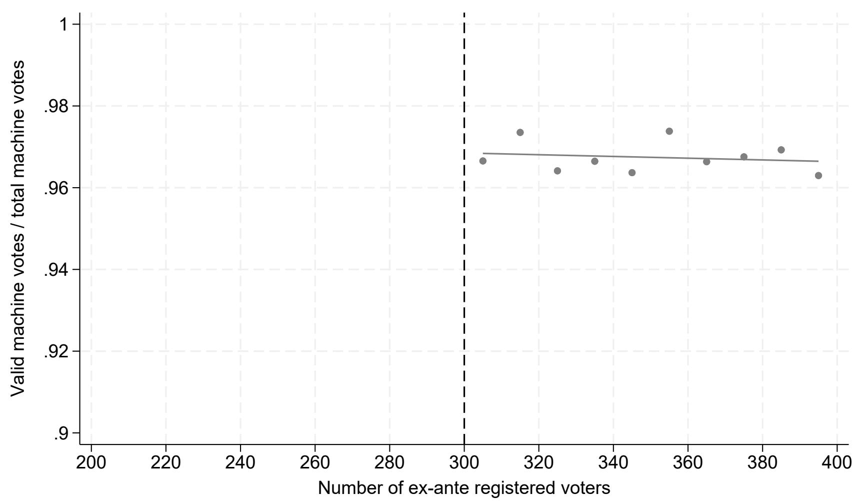
Notes: Binned scatter plot: Share of turnout over registered voters by bin of the number of ex-ante registered voters. The vertical line indicates the threshold that determines the allocation of voting machines across polling stations. Sample: first and second round of the presidential election of November 2021.

Figure C3: Breakdown of valid votes in mixed elections

(a): Valid paper votes/ total paper votes



(b): Valid machine votes/ total machine votes



Notes: Binned scatter plot: Decomposition of the share of valid votes, by bin of the number of ex-ante registered voters. The vertical line indicates the threshold that determines the allocation of voting machines across polling stations. The sample consists of the four elections with a choice of machine or paper voting in polling stations above the threshold.

Table C1: Share of valid votes: RDD estimates

(a): Machine elections

	Valid votes / turnout			
	(1) Jul2021	(2) Nov2021	(3) Oct2022	(4) Pooled
Machine voting	0.0353***	0.0386***	0.0364***	0.0371***
	(0.00359)	(0.00300)	(0.00303)	(0.00202)
Province × election FEs	Yes	Yes	Yes	Yes
Mean dep var	0.98	0.97	0.96	0.97
Effective observations left	399	369	530	1,643
Effective observations right	472	416	610	1,935
Bandwidth	80	74	100	105

(b): Mixed elections

	Valid votes / turnout				
	(1) Apr2021	(2) Apr2023	(3) Jun2024	(4) Oct2024	(5) Pooled
Choice machine or paper	0.00203	0.0169***	-0.00288	0.00982**	0.00788***
	(0.00345)	(0.00480)	(0.00564)	(0.00382)	(0.00231)
Province × election FEs	Yes	Yes	Yes	Yes	Yes
Mean dep var	0.96	0.95	0.94	0.95	0.95
Mean take-up	0.13	0.51	0.20	0.22	0.28
Effective observations left	435	561	321	418	2,531
Effective observations right	503	660	314	447	3,014
Bandwidth	84	106	60	79	118

Notes: RDD estimates for the effects of voting technology on the share of valid votes. The table presents β coefficients estimated from equation 1. The sample in panel (a) consists of the three elections with machine voting in polling stations above the threshold. The sample in panel (b) consists of the four elections with a choice of machine or paper voting in polling stations above the threshold. The bandwidth in each regression is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Standard errors in pooled specifications are clustered by polling station. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table C2: Null votes: RDD estimates

(a): Machine elections

	Null votes / turnout			
	(1) Jul2021	(2) Nov2021	(3) Oct2022	(4) Pooled
Machine voting	-0.0310***	-0.0328***	-0.0329***	-0.0332***
	(0.00307)	(0.00273)	(0.00218)	(0.00166)
Province × election FEs	Yes	Yes	Yes	Yes
Mean dep var	0.01	0.02	0.02	0.01
Effective observations left	425	315	456	1,625
Effective observations right	498	356	502	1,911
Bandwidth	84	62	86	103

(b): Mixed elections

	Null votes / turnout				
	(1) Apr2021	(2) Apr2023	(3) Jun2024	(4) Oct2024	(5) Pooled
Choice machine or paper	-0.000262	-0.0145***	0.00392	-0.0107***	-0.00701***
	(0.00316)	(0.00349)	(0.00537)	(0.00307)	(0.00201)
Province × election FEs	Yes	Yes	Yes	Yes	Yes
Mean dep var	0.04	0.02	0.04	0.03	0.03
Mean take-up	0.13	0.51	0.20	0.22	0.28
Effective observations left	446	566	338	403	2,373
Effective observations right	516	671	336	429	2,817
Bandwidth	87	107	63	76	112

Notes: RDD estimates for the effects of voting technology on the share of null votes. The table presents β coefficients estimated from equation 1. The sample in panel (a) consists of the three elections with machine voting in polling stations above the threshold. The sample in panel (b) consists of the four elections with a choice of machine or paper voting in polling stations above the threshold. The bandwidth in each regression is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Standard errors in pooled specifications are clustered by polling station. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table C3: Blank votes: RDD estimates

(a): Machine elections

	Blank votes / turnout			
	(1) Jul2021	(2) Nov2021	(3) Oct2022	(4) Pooled
Machine voting	-0.00371***	-0.00509***	-0.00253	-0.00391***
	(0.00125)	(0.00128)	(0.00211)	(0.00111)
Province × election FEs	Yes	Yes	Yes	Yes
Mean dep var	0.01	0.01	0.02	0.01
Effective observations left	554	627	707	1,820
Effective observations right	679	745	841	2,147
Bandwidth	108	118	130	115

(b): Mixed elections

	Blank votes / turnout				
	(1) Apr2021	(2) Apr2023	(3) Jun2024	(4) Oct2024	(5) Pooled
Choice machine or paper	-0.00125	-0.00235	-0.00142	0.00142	-0.000779
	(0.00113)	(0.00254)	(0.00224)	(0.00203)	(0.00126)
Province × election FEs	Yes	Yes	Yes	Yes	Yes
Mean dep var	0.01	0.03	0.02	0.02	0.02
Mean take-up	0.14	0.51	0.22	0.25	0.29
Effective observations left	555	639	494	637	2,585
Effective observations right	655	758	556	750	3,080
Bandwidth	106	120	93	118	121

Notes: RDD estimates of the effects of voting technology on the share of blank votes. The table presents β coefficients estimated from equation 1. The sample in panel (a) consists of the three elections with machine voting in polling stations above the threshold. The sample in panel (b) consists of the four elections with a choice of machine or paper voting in polling stations above the threshold. The bandwidth in each regression is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Standard errors in pooled specifications are clustered by polling station. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table C4: Share of valid votes: Municipality-level DiD

	(1)	(2)
Share voters in $\geq$ 300 stations $\times$ Machine election	0.0133*	0.0291***
	(0.00736)	(0.00746)
Share voters in $\geq$ 300 stations$_{\times}$ Mixed election	-0.0124**	-0.00182
	(0.00562)	(0.00571)
Municipality FEs	Yes	Yes
Province $\times$ election FEs	Yes	Yes
Num. registered voters (2017) controls	No	Yes
Mean dep var	0.95	0.95
N	2376	2376

Notes: Panel-analysis estimates from Equation 2. The level of observation is municipality $\times$ election and the sample consists of all elections since 2014. Robust standard clustered by municipality.

Table C5: Turnout: RDD estimates

(a): Machine elections

	Turnout / registered voters			
	(1) Jul2021	(2) Nov2021	(3) Oct2022	(4) Pooled
Machine voting	-0.0448***	-0.0782***	-0.0230	-0.0488***
	(0.0173)	(0.0145)	(0.0149)	(0.0115)
Province × election FEs	Yes	Yes	Yes	Yes
Mean dep var	0.44	0.40	0.40	0.41
Effective observations left	425	427	470	1,538
Effective observations right	498	507	518	1,801
Bandwidth	83	84	90	99

(b): Mixed elections

	Turnout / registered voters				
	(1) Apr2021	(2) Apr2023	(3) Jun2024	(4) Oct2024	(5) Pooled
Choice machine or paper	-0.0174	-0.0199	0.0268	-0.00699	-0.00536
	(0.0171)	(0.0134)	(0.0185)	(0.0152)	(0.0109)
Province × election FEs	Yes	Yes	Yes	Yes	Yes
Mean dep var	0.52	0.41	0.39	0.41	0.43
Mean take-up	0.13	0.50	0.21	0.23	0.27
Effective observations left	435	476	394	499	1,881
Effective observations right	503	536	439	545	2,106
Bandwidth	85	90	77	94	90

Notes: RDD estimates of the effects of voting technology on turnout. The table presents β coefficients estimated from equation 1. The sample in panel (a) consists of the three elections with machine voting in polling stations above the threshold. The sample in panel (b) consists of the four elections with a choice of machine or paper voting in polling stations above the threshold. The bandwidth in each regression is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Standard errors in pooled specifications are clustered by polling station. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table C6: Turnout: Municipality-level DiD

	(1)	(2)
Share voters in $\geq$ 300 stations $\times$ Machine election	-0.0344*	-0.0518**
	(0.0206)	(0.0215)
Share voters in $\geq$ 300 stations$_\times$ Mixed election	-0.0175	-0.0117
	(0.0108)	(0.0126)
Municipality FEs	Yes	Yes
Province $\times$ election FEs	Yes	Yes
Num. registered voters (2017) controls	No	Yes
Mean dep var	0.43	0.43
N	2376	2376

Notes: Panel-analysis estimates from Equation 2. The level of observation is municipality $\times$ election and the sample consists of all elections since 2014. Robust standard clustered by municipality in parenthesis.

Table C7: Votes for non-dominant parties: Established versus new parties

(a): Machine elections

	(1) IHS(Votes for non-dominant established parties)	(2) IHS(Votes for non-dominant new parties)
Machine voting	-0.0463	-0.103
	(0.130)	(0.0791)
Province × election FEs	Yes	Yes
Mean dep var (levels)	23.06	45.24
Effective observations left	1,747	1,365
Effective observations right	2,088	1,577
Bandwidth	116	89

(b): Mixed elections

	(1) IHS(Votes for non-dominant established parties)	(2) IHS(Votes for non-dominant new parties)
Choice machine or paper	0.0346	-0.124*
	(0.112)	(0.0700)
Province × election FEs	Yes	Yes
Mean dep var (levels)	23.23	45.84
Effective observations left	2,222	2,116
Effective observations right	2,651	2,428
Bandwidth	110	99

Notes: RDD estimates of the effects of voting technology on the number of votes for non-dominant parties: other established parties versus new parties. The table presents β coefficients estimated from equation 1. The sample in panel (a) consists of the three elections with machine voting in polling stations above the threshold. The sample in panel (b) consists of the four elections with a choice of machine or paper voting in polling stations above the threshold. The bandwidth in each regression is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Standard errors clustered by polling station. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table C8: Votes for dominant parties versus other parties: Consistent dominance definition

(a): Machine elections

	(1) IHS(Votes for dominant parties)	(2) IHS(Votes for other parties)
Machine voting	-0.187**	-0.0600
	(0.0913)	(0.0863)
Province × election FEs	Yes	Yes
Mean dep var (levels)	55.78	71.17
Effective observations left	1,111	898
Effective observations right	1,321	1,071
Bandwidth	114	95
p-value (1) = (2)		0.31

(b): Mixed elections

	(1) IHS(Votes for dominant parties)	(2) IHS(Votes for other parties)
Choice machine or paper	-0.0721	0.0101
	(0.0813)	(0.0776)
Province × election FEs	Yes	Yes
Mean dep var (levels)	57.41	71.15
Effective observations left	1,462	1,200
Effective observations right	1,727	1,354
Bandwidth	114	93
p-value (1) = (2)		0.46

Notes: RDD estimates of the effects of voting technology on the number of votes for parties that were *consistently* locally dominant in both baseline elections, versus votes for other parties. The sample includes polling stations where the same party received the highest number of votes in both baseline elections. The table presents β coefficients estimated from equation 1. The sample in panel (a) consists of the three elections with machine voting in polling stations above the threshold. The sample in panel (b) consists of the four elections with a choice of machine or paper voting in polling stations above the threshold. The bandwidth in each regression is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Standard errors clustered by polling station. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table C9: Votes for dominant parties versus other parties: Definition based on local incumbency

(a): Machine elections

	(1) IHS(Votes for parties affiliated with incumbent mayor)	(2) IHS(Votes for other parties)
Machine voting	-0.190**	-0.0862
	(0.0820)	(0.0697)
Province × election FEs	Yes	Yes
Mean dep var (levels)	59.72	141.33
Effective observations left	1,574	1,094
Effective observations right	1,850	1,249
Bandwidth	116	83
p-value (1) = (2)		0.34

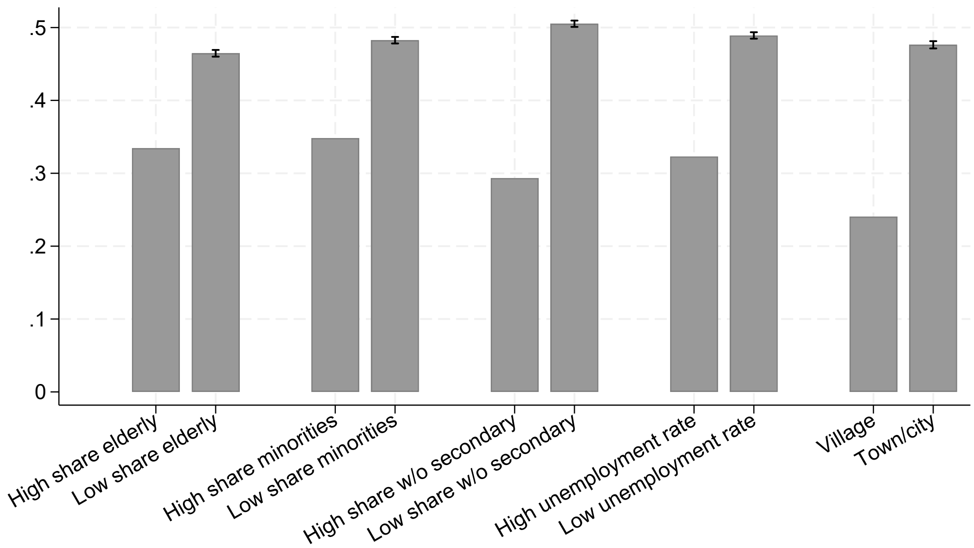
(b): Mixed elections

	(1) IHS(Votes for parties affiliated with incumbent mayor)	(2) IHS(Votes for other parties)
Choice machine or paper	-0.149*	0.0162
	(0.0829)	(0.0667)
Province × election FEs	Yes	Yes
Mean dep var (levels)	65.35	131.52
Effective observations left	1,605	1,201
Effective observations right	1,763	1,283
Bandwidth	92	71
p-value (1) = (2)		0.12

Notes: RDD estimates of the effects of voting technology on the number of votes for parties aligned by the incumbent municipality mayor, versus other parties. The table presents β coefficients estimated from equation 1. The sample in panel (a) consists of the three elections with machine voting in polling stations above the threshold. The sample in panel (b) consists of the four elections with a choice of machine or paper voting in polling stations above the threshold. The bandwidth in each regression is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Standard errors clustered by polling station. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

D Heterogeneity analysis

Figure D1: Machine take-up by locality characteristics



Notes: Bar chart: Machine take-up by locality-level demographic and socio-economic characteristics. "Low" refers to below median and "High" refers to above median. Share elderly is the share of the population that is 65 years of age or older; Share minority is the share of the population that is Roma or Turkish; Share without secondary is the share of the population that has primary education or less. The figure reports the 95 percent confidence intervals from a polling station-level regression of machine take-up on a dummy for "Low share elderly", "Low share minorities", "Low share primary", "Low unemployment rate" and "Town/city", respectively. Standard errors are heteroskedasticity-robust. Sample: Machine polling stations and the four elections with a choice of machine or paper voting in polling stations above the threshold.

D.1 Heterogeneity: Share of valid votes

Table D1: Effects on share of valid votes: By town/ village

	Valid votes / turnout	
	(1) Village	(2) Town/ City
Machine-only voting	0.0381***	0.0304***
	(0.00212)	(0.00875)
Province × election FEs	Yes	Yes
Mean dep var	0.97	0.97
Effective observations left	1,311	71
Effective observations right	1,318	265
Bandwidth	89	88
p-value (1) = (2)		0.39

	Valid votes / turnout	
	(1) Village	(2) Town/ City
Choice machine or paper	0.00892***	-0.0116**
	(0.00270)	(0.00569)
Province × election FEs	Yes	Yes
Mean dep var	0.95	0.94
Effective observations left	1,896	83
Effective observations right	1,793	204
Bandwidth	95	62
p-value (1) = (2)		0.00

Notes: Heterogeneity in the effects of voting technology on the share of valid votes by urbanity. The table presents β coefficients estimated from equation 1 for polling stations with different characteristics – stations in villages in column (1) and in towns or cities in column (2). The sample consists of the three elections with machine voting in polling stations above the cutoff. The dependent variable is the share of valid votes over turnout. The bandwidth is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Robust standard clustered by polling station.

Table D2: Share of valid votes: Heterogeneity by unemployment rate

	Valid votes / turnout	
	(1) Below-median unemployment rate	(2) Above-median unemployment rate
Machine-only voting	0.0347***	0.0373***
	(0.00382)	(0.00224)
Province × election FEs	Yes	Yes
Mean dep var	0.97	0.97
Effective observations left	591	1,136
Effective observations right	674	1,384
Bandwidth	106	112
p-value (1) = (2)		0.57

	Valid votes / turnout	
	(1) Below-median unemployment rate	(2) Above-median unemployment rate
Choice machine or paper	0.00629*	0.00984***
	(0.00376)	(0.00329)
Province × election FEs	Yes	Yes
Mean dep var	0.95	0.95
Effective observations left	870	1,225
Effective observations right	988	1,398
Bandwidth	117	90
p-value (1) = (2)		0.48

Notes: β coefficients estimated from equation 1 for polling stations with different characteristics – stations in municipalities with below-median unemployment rate in column (1) and above-median unemployment rate in column (2). The sample consists of the three elections with machine voting in polling stations above the cutoff. The dependent variable is the share of valid votes over turnout. The bandwidth is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Robust standard clustered by polling station.

Table D3: Share of valid votes: Heterogeneity by share without secondary education

	Valid votes / turnout	
	(1) Below-median share without secondary ed.	(2) Above-median share without secondary ed.
Machine-only voting	0.0260***	0.0366***
	(0.00474)	(0.00245)
Province × election FEs	Yes	Yes
Mean dep var	0.97	0.97
Effective observations left	185	962
Effective observations right	284	1,036
Bandwidth	82	75
p-value (1) = (2)		0.05
	Valid votes / turnout	
	(1) Below-median share without secondary ed.	(2) Above-median share without secondary ed.
Choice machine or paper	0.000736	0.00925***
	(0.00434)	(0.00292)
Province × election FEs	Yes	Yes
Mean dep var	0.95	0.95
Effective observations left	276	1,647
Effective observations right	425	1,714
Bandwidth	86	93
p-value (1) = (2)		0.10

Notes: β coefficients estimated from equation 1 for polling stations with different characteristics – stations in municipalities with below-median share without secondary education in column (1) and above-median share without secondary education in column (2). The sample consists of the three elections with machine voting in polling stations above the cutoff. The dependent variable is the share of valid votes over turnout. The bandwidth is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Robust standard clustered by polling station.

Table D4: Share of valid votes: Heterogeneity by share of ethnic minorities

	Valid votes / turnout	
	(1) Below-median minority share	(2) Above-median minority share
Machine-only voting	0.0306***	0.0397***
	(0.00248)	(0.00303)
Province × election FEs	Yes	Yes
Mean dep var	0.97	0.97
Effective observations left	726	816
Effective observations right	760	1,014
Bandwidth	104	94
p-value (1) = (2)		0.02

	Valid votes / turnout	
	(1) Below-median minority share	(2) Above-median minority share
Choice machine or paper	0.00205	0.0113***
	(0.00270)	(0.00385)
Province × election FEs	Yes	Yes
Mean dep var	0.95	0.95
Effective observations left	938	1,079
Effective observations right	952	1,323
Bandwidth	101	91
p-value (1) = (2)		0.05

Notes: β coefficients estimated from equation 1 for polling stations with different characteristics – stations in municipalities with below-median minority share in column (1) and above-median minority share in column (2). The sample consists of the three elections with machine voting in polling stations above the cutoff. The dependent variable is the share of valid votes over turnout. The bandwidth is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Robust standard clustered by polling station.

Table D5: Share of valid votes: Heterogeneity by share of individuals 65 and above

	Valid votes / turnout	
	(1) Below-median share elderly	(2) Above-median share elderly
Machine-only voting	0.0246***	0.0382***
	(0.00495)	(0.00231)
Province × election FEs	Yes	Yes
Mean dep var	0.98	0.97
Effective observations left	132	1,272
Effective observations right	268	1,242
Bandwidth	67	94
p-value (1) = (2)		0.01

	Valid votes / turnout	
	(1) Below-median share elderly	(2) Above-median share elderly
Choice machine or paper	-0.00583	0.00918***
	(0.00491)	(0.00276)
Province × election FEs	Yes	Yes
Mean dep var	0.95	0.95
Effective observations left	169	1,776
Effective observations right	336	1,659
Bandwidth	65	97
p-value (1) = (2)		0.01

Notes: β coefficients estimated from equation 1 for polling stations with different characteristics – stations in municipalities with below-median share of individuals 65 years of age and above in column (1) and above-median minority share in column (2). The sample consists of the three elections with machine voting in polling stations above the cutoff. The dependent variable is the share of valid votes over turnout. The bandwidth is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Robust standard clustered by polling station.

D.2 Heterogeneity: Turnout

Table D6: Turnout: Heterogeneity by town/ village

	Turnout / registered voters	
	(1) Village	(2) Town/ City
Machine-only voting	-0.0481***	0.0302
	(0.0121)	(0.0518)
Province × election FEs	Yes	Yes
Mean dep var	0.41	0.43
Effective observations left	1,225	71
Effective observations right	1,250	257
Bandwidth	84	85
p-value (1) = (2)		0.14

	Turnout / registered voters	
	(1) Village	(2) Town/ City
Choice machine or paper	-0.00453	0.0262
	(0.0112)	(0.0362)
Province × election FEs	Yes	Yes
Mean dep var	0.43	0.42
Effective observations left	1,675	99
Effective observations right	1,587	458
Bandwidth	84	94
p-value (1) = (2)		0.42

Notes: β coefficients estimated from equation 1 for polling stations with different characteristics – stations in villages in column (1) and in towns or cities in column (2). The sample consists of the three elections with machine voting in polling stations above the cutoff. The dependent variable is turnout over the number of registered voters. The bandwidth is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Robust standard clustered by polling station.

Table D7: Turnout: Heterogeneity by unemployment rate

	Turnout / registered voters	
	(1) Below-median unemployment rate	(2) Above-median unemployment rate
Machine-only voting	-0.0278	-0.0562***
	(0.0221)	(0.0133)
Province × election FEs	Yes	Yes
Mean dep var	0.42	0.41
Effective observations left	538	816
Effective observations right	608	975
Bandwidth	98	82
p-value (1) = (2)		0.27

	Turnout / registered voters	
	(1) Below-median unemployment rate	(2) Above-median unemployment rate
Choice machine or paper	0.0243	-0.0163
	(0.0212)	(0.0114)
Province × election FEs	Yes	Yes
Mean dep var	0.43	0.43
Effective observations left	639	1,525
Effective observations right	689	1,855
Bandwidth	87	112
p-value (1) = (2)		0.09

Notes: β coefficients estimated from equation 1 for polling stations with different characteristics – stations in municipalities with below-median minority share in column (1) and above-median minority share in column (2). The sample consists of the three elections with machine voting in polling stations above the cutoff. The dependent variable is turnout over the number of registered voters. The bandwidth is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Robust standard clustered by polling station.

Table D8: Turnout: Heterogeneity by share without secondary education

	Turnout / registered voters	
	(1) Below-median share without secondary ed.	(2) Above-median share without secondary ed.
Machine-only voting	-0.00273	-0.0512***
	(0.0239)	(0.0130)
Province × election FEs	Yes	Yes
Mean dep var	0.45	0.40
Effective observations left	263	1,036
Effective observations right	443	1,136
Bandwidth	105	80
p-value (1) = (2)		0.07

	Turnout / registered voters	
	(1) Below-median share without secondary ed.	(2) Above-median share without secondary ed.
Choice machine or paper	0.00927	-0.00867
	(0.0220)	(0.0121)
Province × election FEs	Yes	Yes
Mean dep var	0.45	0.43
Effective observations left	380	1,405
Effective observations right	644	1,455
Bandwidth	108	80
p-value (1) = (2)		0.47

Notes: β coefficients estimated from equation 1 for polling stations with different characteristics – stations in municipalities with below-median share without secondary education in column (1) and above-median share without secondary education in column (2). The sample consists of the three elections with machine voting in polling stations above the cutoff. The dependent variable is turnout over the number of registered voters. The bandwidth is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Robust standard clustered by polling station.

Table D9: Turnout: Heterogeneity by share of ethnic minorities

	Turnout / registered voters	
	(1) Below-median minority share	(2) Above-median minority share
Machine-only voting	-0.0561***	-0.0498***
	(0.0155)	(0.0165)
Province × election FEs	Yes	Yes
Mean dep var	0.46	0.38
Effective observations left	674	690
Effective observations right	714	833
Bandwidth	99	78
p-value (1) = (2)		0.78

	Turnout / registered voters	
	(1) Below-median minority share	(2) Above-median minority share
Choice machine or paper	-0.00205	-0.00805
	(0.0150)	(0.0149)
Province × election FEs	Yes	Yes
Mean dep var	0.47	0.41
Effective observations left	739	999
Effective observations right	718	1,202
Bandwidth	82	84
p-value (1) = (2)		0.78

Notes: β coefficients estimated from equation 1 for polling stations with different characteristics – stations in municipalities with below-median minority share in column (1) and above-median minority share in column (2). The sample consists of the three elections with machine voting in polling stations above the cutoff. The dependent variable is turnout over the number of registered voters. The bandwidth is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Robust standard clustered by polling station.

Table D10: Turnout: Heterogeneity by share of individuals 65 and above

	Turnout / registered voters	
	(1) Below-median share elderly	(2) Above-median share elderly
Machine-only voting	-0.0377	-0.0463***
	(0.0306)	(0.0125)
Province × election FEs	Yes	Yes
Mean dep var	0.42	0.41
Effective observations left	211	1,144
Effective observations right	512	1,140
Bandwidth	101	85
p-value (1) = (2)		0.80

	Turnout / registered voters	
	(1) Below-median share elderly	(2) Above-median share elderly
Choice machine or paper	-0.00901	0.000180
	(0.0304)	(0.0117)
Province × election FEs	Yes	Yes
Mean dep var	0.43	0.43
Effective observations left	260	1,438
Effective observations right	621	1,346
Bandwidth	93	80
p-value (1) = (2)		0.78

Notes: β coefficients estimated from equation 1 for polling stations with different characteristics – stations in municipalities with below-median share of individuals 65 years of age and above in column (1) and above-median minority share in column (2). The sample consists of the three elections with machine voting in polling stations above the cutoff. The dependent variable is turnout over the number of registered voters. The bandwidth is chosen using the MSE optimal procedure suggested by Calonico et al. (2014b). Robust standard clustered by polling station.