In focus: Whose Vote Counts: Voting Technology and Election Accuracy

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An inclusive election process, one in which the outcome accurately reflects the preferences of all voters, is vital for maintaining trust in democracy. The presence of null votes, which are excluded from the election results because they cannot be unambiguously assigned to a party or a candidate, means that the preferences of some voters go unrepresented.[1] In Bulgaria's 2017 general election null votes accounted for 4.6 percent of all ballots cast.[2] Whether due to unintentional mistakes or other factors, this high share indicates a significant problem in the electoral process.

Partly motivated by this issue, Bulgaria introduced voting via Direct Recording Electronic (DRE) machines in 2021. This technology mechanically prevents ambiguities in vote choices and can, thus, significantly reduce the share of null votes. Indeed, evidence from Brazil's introduction of machine voting in the 1990s shows that the technology reduced the share of null votes and led to a de-facto enfranchisement of illiterate voters.[3] Recent research finds similar evidence for Bulgaria in elections that mandate machine voting with the

exception of small polling stations (the general elections conducted in July 2021, November 2021 and October 2022).[4] Machine voting reduced the share of null votes particularly in disadvantaged areas – ones with lower levels of education, higher share of ethnic minorities, and higher share of elderly population.

Yet, Bulgaria's implementation of machine voting in recent elections does not mandate voting with a machine; instead, voters are given a choice between a machine and a paper ballot (we refer to such elections as *Mixed* elections). We study the effectiveness of this mixed system in reducing the share of null votes and find that it succeeds in doing so when and where machine take-up is high. However, machine take-up is strongly negatively correlated with socio-economic status, while the share of null votes is highest in localities with lower socio-economic profiles. So, although the mixed system helps reduce null voting to some extent, it is significantly less effective in areas where this problem is most acute compared to a system which mandates machine voting.

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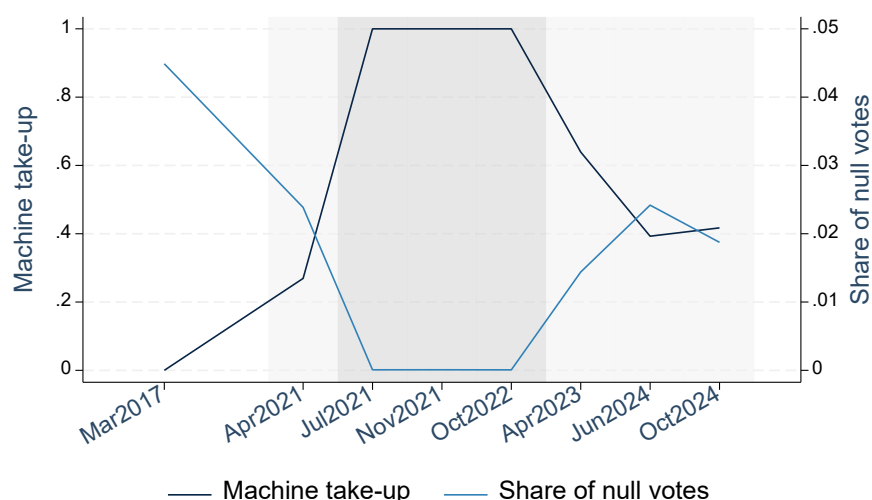
[1] Note that null votes exclude blank votes, i.e. instances where the voter selected the "I don't support anyone" option.
[2] For comparison, the threshold for a party to enter the National Assembly is 4%.
[3] See Fujiwara (2015).
[4] See Djourelova and Tsankova (2025).

1. Machine take-up and share of null votes in the last eight general elections

Notes: The dark gray area shows values for *Machine* elections and the light gray area shows values for *Mixed* elections. *Source*: Central Electoral Commission (CIK).

How did machine take-up and the share of null votes change over time? Figure 1 plots the trends in machine take-up and the share of null votes over the last eight general elections. Throughout the analysis, we focus on polling stations with 300 or more ex-ante registered voters located in Bulgaria.

In the first *Mixed* election of April 2021, 27 percent of the voters who had the option decided to cast their vote using a machine. The next three elections (held in July 2021, November 2021 and October 2022, and referred to as *Machine elections*) mandated machine voting, except in small polling stations. When the mixed system was reintroduced in April 2023, machine take-up reached 64 percent but then declined to around 40 percent in the last two elections held in 2024.

In March 2017, before the introduction of machine voting, the share of null votes in machine stations was at its highest – 4.5 percent. It then dropped mechanically down to zero in the three *Machine* elections. In *Mixed* elections, this share tends to

move inversely with machine take-up. For instance, in April 2023 when take-up was highest the share of null votes was just 1.4 percent.

Which locality characteristics predict machine take-up and the share of null votes? The left panel of Figure 2 reports the relationship between locality characteristics – drawn from the 2011 census – and machine take-up in *Mixed* elections. Take-up is significantly lower in villages and in localities with an above-median share of the population without secondary education, a higher share of elderly population, a higher share of ethnic minorities and a higher unemployment rate.[5] [6]

The right panel of Figure 2 presents differences in the share of null votes during the 2017 general election across polling stations with varying characteristics. The share of null votes varies substantially depending on locality characteristics – it is higher in villages, and in areas with a lower educational attainment, higher share of the elderly, higher share of ethnic minorities and greater unemployment.

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[5] The share of elderly is the share of residents that are 65 years of age or older. The share of ethnic minorities is the share of individuals who are Roma or Turkish.
[6] The confidence intervals are derived from polling station level regressions comparing means between the two groups of stations. Standard errors are heteroskedasticity robust throughout the analysis.

2. Machine take-up (left panel) and share of null votes (right panel) by characteristics of the locality where the polling station is located
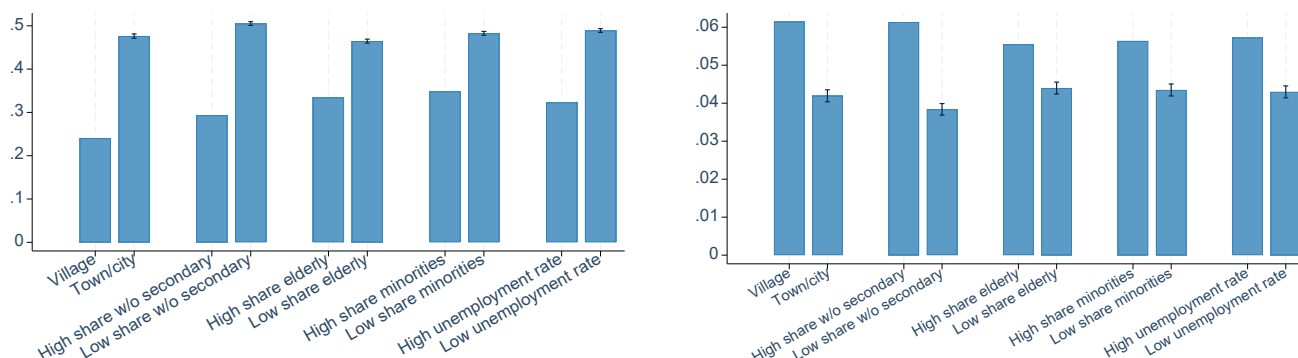
Notes: The figure in the left panel is based on data from *Mixed* elections and the figure in the right panel is based on data from the 2017 general election. *Source:* CIK, Census 2011 and own calculations.

Thus, the characteristics that predict machine take-up are opposite to those associated with the prevalence of null votes.[7] This suggests that the voters who would benefit the most from the new technology in terms of an increased likelihood that their vote will count towards the election results, are also the ones least likely to adopt it.

3. Changes in machine take-up against changes in the share of null votes
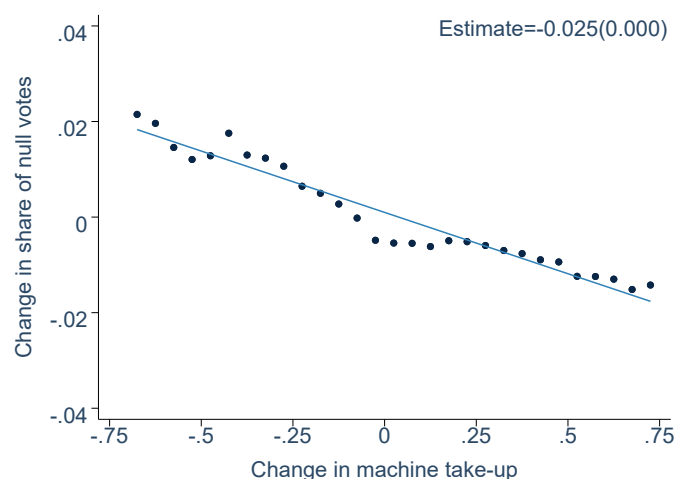
Notes: The figure shows changes between consecutive Mixed elections in machine take-up on the horizontal axis (binned in bins of width of 0.05) against changes in the share of null votes on the vertical axis (averages within bin). Standard error shown in parentheses in the upper right corner. Source: CIK and own calculations.

Does higher machine take-up lead to a lower share of null votes? To approximate the causal effect of increasing machine take-up, we analyze how polling-station-level changes in machine use relate to changes in the share of null votes between consecutive *Mixed* elections. In Figure 3, changes in machine take-up are plotted on the horizontal axis, and changes in the share of null votes on the vertical axis. We find a strong and significant negative relationship. The estimate suggests that a 10 percentage point increase in machine voting corresponds to a 0.25 percentage point decrease in null votes.

We further examine how this effect varies with the characteristics of polling station localities. The results indicate that increases in machine take-up have a stronger impact where the share of null votes is initially higher — specifically, in polling stations located in areas with lower socio-economic profiles. Overall, the marginal returns to machine take-up, in terms of reducing null votes, are greater in more disadvantaged areas.

What are the main conclusions and policy implications? Since 2023, most Bulgarian voters have the option to cast their vote using a voting machine or a traditional paper ballot. In this focus piece, we show that, relative to paper-ballot-only elections, the mixed system tends to reduce the

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[7] Indeed, the polling-station level correlation between the share of null votes in 2017 and machine take-up in *Mixed* elections is negative and significant at -0.46 (p-value=0.000).

share of null votes. However, allowing voter discretion results in negative selection – those most likely to cast a null vote are also the ones least likely to opt for the machine. This limits the potential benefits of the technology.

Machine voting has been the subject of heated debates, which likely influenced voter behavior. Most voters continue to choose the paper ballot, and machine take-up shows no increase over time. While the reasons for this hesitancy lie beyond the scope of our analysis, they are crucial to address, as the effectiveness of the mixed system ultimately hinges on widespread adoption.

One implication of our results is that increasing machine take-up – particularly in places where null votes are most prevalent – can improve election accuracy. In practice, however, voters never find out whether their own vote was null. They may also not be aware of the likelihood of casting a null vote, or of the fact that choosing machine voting reduces this risk. An information campaign that addresses these misperceptions could be effective in encouraging machine take-up if it reaches those currently most hesitant to adopt the technology.

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