Endogenous Enforcement Institutions

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Invalid Ballots and Electoral Competition*

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Abstract

In close elections, a sufficiently high share of invalid ballots - if driven by voter mistakes or electoral fraud - can jeopardize the electoral outcome. We study how the closeness of electoral race relates to the share of invalid ballots, under the traditional paper-ballot hand-counted voting technology. Using a large dataset from the Italian parliamentary elections in 1994-2001, we find a strong robust negative relationship between the margin of victory of the leading candidate over the nearest rival and the share of invalid ballots. We argue that this relationship is not driven by voter mistakes, protest, or electoral fraud. The explanation that garners most support is that of rational allocation of effort by election officers and party representatives, with higher rates of *detection* of invalid ballots in close elections.

Keywords: vote counting; invalid ballots; election officers; party representatives
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"It's not the voting that's democracy, it's the counting" (Stoppard, 1972)

The heated debate in policy-making and academic circles following vote-counting problems at the 2000 U.S. Presidential elections (Caltech and MIT Voting Technology Project, 2001, Knack and Kropf, 2003, Ansolabehere and Stewart III, 2005, Wand et al., 2001, Card and Moretti, 2007) indicates that the organization of ballot casting and counting is at the heart of democratic elections. During the last decade, numerous countries carried out important policy changes regarding how voting and vote counting is organized. Under the Help America Vote Act (HAVA), for instance, the U.S. invested around 3 billion USD into improving and replacing voting technologies (Stewart III, 2011).

In general, in most large elections, there is a relatively small fraction of votes that is counted as invalid. When electoral race is tight, even a small number of votes can make a difference for the electoral outcome, and thus the importance of invalid ballots increases disproportionately. Intuitively, if the share of invalid ballots is sufficiently high as compared to the margin of victory of the winning candidate, and is driven by voter mistakes or electoral fraud, then invalid ballots might seriously undermine the correct functioning of the electoral system.

The validity of this common-sense intuition crucially depends on the origin of invalid ballots and the relationship between the fraction of invalid ballots and electoral competition. In this paper, we study how the closeness of electoral race relates to the fraction of invalid ballots under the traditional paper-ballot hand-counted voting technology. Using a large dataset from the Italian parliamentary elections in 1994-2001, we find a strong robust negative correlation between the margin of victory of the leading candidate over the nearest rival and the fraction of invalid ballots.

We then investigate the possible theoretical explanations for this relationship and argue, on the basis of econometric evidence, that this relationship is unlikely to be driven by voter mistakes, protest, or electoral fraud. The explanation that garners most support is that election officers and party representatives rationally allocate more effort in detecting invalid ballots when the stakes are highest, i.e. when the electoral race is closer. In other words, the relationship that we document corresponds to higher rates of *detection* of invalid ballots in closer elections.

To the best of our knowledge, this is the first paper that documents and analyzes the

relation between electoral competition and invalid ballots. Numerous papers in economics and political science (e.g. Ansolabehere and Stewart III, 2005, Shue and Luttmer, 2009, Dee, 2007, Card and Moretti, 2007, Fujiwara, 2011) have studied the electoral outcomes, including the number of invalid or residual votes, under different voting technologies.[1] However, what matters for electoral outcomes is not so much the average level of ballots counted as invalid under different technologies, but whether the number of (truly) invalid ballots increases or decreases when the electoral race is closer. Having a substantial fraction of invalid ballots or misvotes in a landslide election clearly matters less (as noted by Dee (2007) and Shue and Luttmer (2009) for the California recall election in 2003) than a much smaller fraction of invalid ballots in a close election (as, for instance, in the case of misvotes in Palm Beach County, Florida, during the 2000 Presidential election). This issue is exactly the focus of our paper.

Another related strand of literature studies vote buying and ballot rigging (see the collection of papers in Schaffer 2007 and Lehoucq 2003 for a good survey). In a fascinating study of Chilean elections before 1965, Baland and Robinson (2008) find that the introduction of the secret ballot in 1958 has effectively destroyed the "market" for votes that existed between landed aristocracy and agricultural workers, thus sharply decreasing the votes for the right-wing parties. Lehoucq and Molina (2002) study the accusation of ballot-rigging filed in Costa Rica, and find that such accusations where substantially more numerous in close-race districts. This finding does not, however, imply that fraud is more frequent in close-race districts: it might as well be that, holding the number of rigged ballots constant, there are higher incentives for parties to file an accusation of ballot-rigging in close-race districts. Thus, understanding whether the correlation between the fraction of invalid ballots and the closeness of electoral race is driven by fraud is a crucial question. The additional contribution of this paper lies in providing an answer to this question.

1 Invalid Ballots: What Are They?

In any election based on a paper ballot system, all ballots cast by voters belong to one of the three categories: valid, blank (the voter did not express any preference), or invalid (election officer considers that the voter did not express her preference correctly). Under

[1] See Stewart III (2011) for an excellent survey.

the traditional hand-counted paper ballot system, after the vote count is completed, the election administration reports the number of ballots belonging to each category. A ballot can be considered invalid for different reasons: for instance, the voter over-votes (i.e. casts more than one preference when only one preference is allowed) or takes an action that undermines the secrecy of the vote (e.g. she signs the ballot). The duty of an election officer is to invalidate any ballot on which the voter does not uniquely identify her preference. These rules apply to most, if not all, democratic elections using the paper-ballot system. The stated objective of this procedure is to avoid antidemocratic and illegal voting behavior.

The Institute for Democracy and Electoral Assistance, which maintains a database on parliamentary and presidential elections across most countries in the world, reports that the fraction of invalid votes for about 100 countries over the last 10 years. The average fraction of invalid ballots is around 3 percent. However, looking across countries (see Figure 1), one sees a large variation in this measure. In all the developed countries the fraction of invalid ballots is a single-digit number, typically below 5 percent. The number is much higher for the developing countries, with double-digit numbers in several developing countries, in particular in Latin America and Western Africa.

Political scientists have tried to correlate the variation in the fraction of invalid ballots to some principal characteristics of the political system. Power and Garand (2007) analyze, using an aggregate-level panel-data analysis from 80 legislative elections held in 18 Latin American democracies between 1980 and 2000, the influence of three sets of factors on the number of invalid ballots: socio-demographic (literacy, education, wealth), institutional (electoral system and ballot structure), and political (alienation and protest). They find some support for all the three sets of factors: socioeconomic factors (urbanization and income inequality) correlate with the number of invalid votes, institutional factors (compulsory voting, electoral disproportionality, and the combination of high district magnitude with personalized voting) increase the number of blank and spoiled ballots, whereas political factors such as political violence and the level and direction of democratic change also correlate with the fraction of invalid votes. Uggla (2008) also conducts an aggregate study by looking at over 200 elections in Western Europe, Australia, New Zealand, and the Americas in the 1980-2000 period. He finds support for the hypothesis that the variation in the fraction of invalid ballots reflect the voters' reaction to the

perceived absence of political choice.

The key problem with these aggregate studies is that one cannot rule out the influence of third unobserved factors (e.g. political culture) that influences simultaneously the number of invalid ballots and the institutional factors. We are able to overcome this problem by using highly disaggregated data from a setting with homogeneous formal political institutions, but with sufficiently large variation (both across time and space) in political behavior.[2]

2 Context and Data

2.1 Organization of Italian Parliamentary Elections

In this section, we describe the political and institutional context from which our data comes. We analyze electoral data from the three Italian parliamentary elections (1994, 1996, and 2001), during which three-quarters of the Chamber of Deputies (the lower chamber) was elected through the first-past-the-post majoritarian system, in 475 uninominal electoral districts (explained in detail below). We restrict our dataset to this period because these elections exhibit a natural measure of the closeness of the electoral competition: the margin of victory between the first and the second candidate.

Our dataset has several advantages over similar data from other settings. First, our data is highly disaggregated: the unit of observation is a municipality (for the electoral districts that contain more than one municipality) or an electoral district (for large municipalities that contain more than one district); this substantially increases the power of statistical analysis. Second, it counts separately blank ballots and invalid ballots. This is important because under the traditional paper-ballot voting, a blank ballot clearly indicates intentional abstention by the voter, whereas in settings that use other technologies (such as, for instance, in most elections in the U.S.), it is difficult to separate clearly the voter intention from the malfunctioning of the voting technology, in case of an empty ballot (see Ansolabehere and Stewart III, 2005). In such settings, the election data usually lumps together blank and invalid ballots into the category of "residual votes." Third, in Italian elections, invalid ballots represent a relatively small but non-negligible fraction of

[2]Two other studies (McAllister and Makkai, 1993, Power and Roberts, 1995) study within-country variation in invalid ballots (in Australia and Brazil, respectively). They do not attempt to test alternative hypotheses for the relationship between electoral competition and invalid ballots.

total votes. However, the quality of democratic institutions and voter literacy are high, and therefore it is unlikely that the overwhelming majority of invalid ballots are driven by protest or voter mistake (as, for instance, in most Latin American countries). Finally, while the electoral system is uniform throughout the country, there is rich geographic variation in the measures of electoral behavior and outcomes, both across large (regions and provinces) and small (municipalities and within-city electoral districts) administrative units.

For three legislatures, the ones that started in 1994, 1996, and 2001, Italian citizens elected their representatives using a two-tier system (75 percent of representatives via the majoritarian system and the remaining 25 percent via the proportional system). Before 1994 and after 2001 the entire Italian electoral system was proportional.

On election day, each voter received two ballots: one to cast a vote for a candidate in her single-member district, and another to cast a vote for a party list in her larger proportional district. Figure 2 shows a typical ballot, for the majoritarian and proportional-representation systems in Italy. In the districts with the majoritarian system, the voter has to put a cross on the name of the candidate of her preference, whereas in the districts under the PR system, she has to put a cross on the party/coalition symbol.

475 out of the 630 House members were elected in single-member majoritarian-election districts, while the rest was elected from closed party lists in 26 multiple-member districts (with 2 to 12 seats per district).[3] We focus on these 475 majoritarian-election single-member districts.

The polling stations during the elections operated in the following way. Parliamentary elections in Italy take place on a Sunday between 8 AM and 10 PM, and on the following Monday between 7 AM and 3 PM. As soon as the elections end (i.e. on Monday afternoon), election officers start counting the ballots. The counts typically last uninterrupted until late Monday night or, sometimes, up to Tuesday morning.

Each polling station has 3 types of election officers: the president of the polling station a secretary and three canvassers.[4] Party list representatives, at most two for each list,

[3]For the Senate elections, instead, voters received only one ballot to cast their vote for a candidate in a single-member district, and the non-elected candidates with the highest numbers of votes in the 232 majoritarian districts were later assigned to the remaining 83 seats according to the proportional-representation rule.

[4]Our description is based on Article 34 of the Electoral Law ("Testo unico delle leggi per l'elezione della Camera dei deputati"), approved by the Decree of the President of the Republic on 30 March 1957

can also assist the vote count. At least three election officers, including the president or the vice-president (chosen by the president among the canvassers), have to be present through the entire count. The president of the polling station decides (after consulting the canvassers) on the outcome of any disputes related to the vote count, including those about the validity of any given ballot. She then registers her provisional decision (the Parliament has the last word about official protests). The secretary keeps the official record about all the activities during the count. At the end of the counting all members of the polling stations sign the record. Both the election officers and party list representatives can contest ballots, i.e. question the decision about the validity of any given vote.

When working at the polling stations, each election officer receives a monetary compensation which corresponds, approximately, to 100 euros. In addition, both election officers and party representatives are compensated by their employers with (at most) 3 days of paid leave.

Each ballot is scrutinized by all the canvassers, the president, and - if present - by party representatives. The number of valid votes for each candidate are marked (typically on the board) and regularly updated as the count proceeds. This implies that people present at the count can observe the evolution of the number of votes for each candidate, and have a perception of the margin (at their polling station) between the leading candidate and the nearest rival.

Given that voters are instructed to put just one sign ("x") on the ballot (no other mark is allowed), detection of any visible irregularity on the ballot (e.g. more than one preference expressed, a signature, an additional mark made by mistake) implies that the president declares the ballot as invalid. However, given the large number of ballots that have to be scrutinized and the fact that often the count continues late into the Monday night, there is no guarantee that each ballot containing an irregularity (e.g. a minor additional sign) gets detected.

According to the Electoral Law the president is a public official and has the authority to arrest those who disturb the voting process, including the party representatives and the other canvassers. The president, the secretary and the canvassers are all obliged to denounce any criminal act related to the voting and the vote counting. If the president is involved in such acts, the secretary and the canvassers are supposed to contact the

(No. 361).

judicial authorities. Public officials who deliberately alter the ballots or the final counting risk between 2 and 8 years of jail.

2.2 Data

We extracted information on three majoritarian parliamentary elections from the Historical Electoral Atlas of Italy (Corbetta and Piretti, 2008). An observation in our dataset represents the smallest level of aggregation of polling stations available, that is the smallest unit between a municipality and a district (hereafter, we refer to this as 'the electoral unit'). Larger cities have several districts: for instance, the municipality of Rome has 24 and the municipality of Milan has 11. In most cases, several municipalities (there are more than 8,000 of them in Italy) belong to the same district.

Each polling station is responsible for 500 to 1,200 eligible voters, though there can be exceptions to this rule for isolated territories that are hard to reach. While in general we do not know whether an electoral unit corresponds to a polling stations, electoral units with an electorate that is smaller than 1,200 (there are 32 percent of such units) are, due to the previous rule, likely to be single polling stations. In order to avoid any selection based on the size of the electorate we are going to use all the electoral units and later check whether the results are robust to the use of electoral units that are likely to be single polling stations.

Table 1 presents the summary statistics for the key variables used in our empirical analysis. Overall, our dataset contains 8,224 electoral units for the three election years, which gives a (slightly unbalanced) panel of 23,126 observations. Our main variable of interest, i.e. ballots reported as invalid, represent a non-negligible fraction of votes. On average, in a typical district or municipality, 3.9 percent of all the ballots is reported as invalid. We also see that there is substantial variation in this measure: the standard deviation is 2.2 percent. A slightly higher fraction of ballots (4.6 percent) is cast blanc. Turnout rate is relatively high (which is a traditional characteristic of Italian elections): in a typical district, 82 percent of all eligible voters participate. The average leading margin is substantial, at the electoral unit level (i.e. the difference in share of votes between the candidate with the highest number of votes and the nearest rival) is 18.4 percent; however, the variation is large (the standard deviation is 14.8 percentage points). The electoral unit with the smallest leading margin in our dataset exhibits a vote difference

of zero percent, whereas in the one with the largest margin, the first candidate leads by 96.1 percent.

The main two party coalitions (center-left and center-right) lead the electoral competition in most electoral units (in a typical unit, they obtain 36.2 and 38 percent of votes, respectively). We observe a strong party incumbency effect: in 94.4 per cent of cases, the candidate from the incumbent coalition is the one with the highest number of votes. The incumbent politician effect is, however, much smaller: in 46.5 percent of cases, the voting ballot contains the name of the incumbent politician, and in slightly more than half of these cases (or in 26.4 percent of the total), the incumbent politician leads. The number of candidates also varies across districts. On average, a voter is confronted to a ballot with 4.14 candidates.

Figure 3 indicate that the fraction of invalid ballots varies substantially across different regions. Southern regions exhibit the highest levels of invalid ballots, followed by the North-West. The Northern and Central regions exhibit the lowest levels of invalid ballots. While North-South divide is large, there is also substantial region-level variation within the North and the South of Italy.

3 Invalid Ballots and Electoral Competition

Figure 4 presents graphically the relationship between the leading margin (the difference in share of votes between the candidate with the highest number of votes and the nearest rival) and the fraction of ballots reported as invalid (out of the total number of ballots). Each dot represents the fraction of invalid ballots for a given percentile of the margin of victory. For the levels of leading margin that are close to zero, invalid ballots represent almost 4.5 percent of all votes, whereas to the largest percentiles of the leading margin correspond the lowest fractions of invalid ballots (around 2.5 percent). Overall, there is a clear negative correlation between the two variables: the larger is the leading margin, the smaller is the fraction of invalid ballots. This is also confirmed in column 1 of Table 2: the regression coefficient on the leading margin is negative and highly statistically significant.[5] The effect is quantitatively important: one standard deviation increase in the leading margin (14.8 percentage points) corresponds to a reduction in the fraction of

[5]This result is robust to using the logarithms of the variables instead of their levels on one or both sides of the regression equation.

invalid ballots of about one-sixth of a standard deviation (0.35 percent of total votes). Restricting the analysis to the 2,704 electoral units with less than 1,200 eligible voters leads to very similar results (see Table 3).

4 Competing Explanations

What are the possible explanations for the empirical relationship that we have established above?

The prime suspect is the behavior of voters. Consider a simple cost-benefit calculation of an individual voter. Suppose that filling out the ballot requires concentration, and filling it out correctly implies some attention cost. Moreover, suppose that the probability of making a mistake (and, therefore, submitting an invalid ballot) decreases with the attention allocated by the voter. On the benefit side, if the voter prefers one candidate over the other, she might perceive a benefit from feeling that her vote helped to increase the chances of victory of her preferred candidate. This might be justified by either the fact that a voter considers her probability of being pivotal (see Ch. 14 in Mueller 2003), or - more realistically - by the fact that the voter might feel the moral duty to "do her part" in helping her preferred party to win (as in the models by Feddersen and Sandroni 2006a,b).

The higher is the expected margin of victory of one of the candidates in the district, the lower is the voter's expected benefit of casting a valid vote. Given that the margin of victory does not affect the cost side, the higher is the margin, the lower is the attention that the voter devotes to casting a valid vote, and thus the higher is the probability of submitting an invalid ballot.

Under this simple opportunity-cost theory of voter behavior, we would obtain a prediction that a higher margin of victory should be *positively* correlated with the fraction of invalid ballots. However, as we have seen above, the relationship is negative. Thus, this correlation cannot be explained by voters' attention.

Another explanation is based on voter protest. Voters might have feelings about the choice that they are facing, and may act in the voting booth in reaction to these feelings. For instance, Brighenti (2003) analyzes a selection of invalid ballots in a regional election in Italy, and finds that a part of the invalid ballots report emotionally-charged (typically,

negative) messages written by voters on their ballots. These are examples of voluntary invalidation.

If the expected margin of victory is sufficiently large, some of the voters that support the losing candidate might feel that, de facto, their electoral choice is constrained. If this triggers negative emotions in them, some of the voters might voluntarily invalidate their ballots. A related possibility is that of expressive voting (Brennan and Lomasky, 1993, Schuessler, 2000). If voters want to express their general discontent about the political system, they might want to cast an invalid ballot as a protest. At the same time, each voter might have a political preference for some party. The closer is the electoral race, the higher is the opportunity cost of invalidating the ballot to express one's discontent. Under this theory as well, we should observe a positive correlation between the margin of victory and the fraction of invalid ballots (which goes against what we find in the data).

We can further refine our analysis, if we consider that ballot invalidation is not the only way of expressing one's protest. Some of the voters might express their feelings by leaving their ballots blank. Then, the fraction of invalid ballots and that of blank ballots should be correlated. Based on this intuition, we can use the fraction of blank ballots as a regressor, so as to capture, at least in part, the voters' protest.

Our empirical results show that this explanation based on voter protest does not fit the data. First, in columns 1 and 2 of Table 2, the coefficient on the leading margin is negative (which is the opposite to the prediction of this theory). Second, while blank ballots correlate positively with the fraction of invalid ballots, even when we include the blank ballots and the number of candidates in the regression, the negative coefficient on the leading margin remains highly statistically significant.

In column 3, we verify how robust our main finding is to the inclusion of a series of local (province-level) characteristics that can affect the benefits and costs for voters of casting valid ballots: the level of education (measured by the fraction of the population with university and high-school degrees), social capital (measured by the average turnout at national referenda), income (measured by labor activity and unemployment rates, and GDP per capita), crime (the extent of mafia-related crimes), and urbanization. While some of these variables capture a part of the variation in invalid ballots, the coefficient on the leading margin remains highly significant. In column 4, we perform an even more stringent test, by adding year and electoral unit fixed effects. This means that the

remaining variation in invalid ballots is within the same electoral unit (the smallest unit between the municipality and the district) over time. The coefficient on the leading margin remain basically unchanged (both in terms of size and significance). In other words, if the leading margin increases from one election to the other within the same electoral unit, the fraction of invalid ballots reported at this unit decreases.

Logically, if the explanation for the negative correlation that we observe cannot come from voters' behavior, it should come from the behavior of those who count the votes, i.e. election officers. Let's suppose that election officers act rationally. Given that they are called to act as public officials to ensure that all the ballots cast are counted correctly (which, in particular, includes detecting ballots that are cast incorrectly), we can model the problem of the officer as follows.[6]

Suppose that each officer considers all the ballots that have to be counted, one by one. Each ballot that he scrutinizes can be either valid or invalid. The objective of the election officer is to minimize the likelihood that the victory is incorrectly adjudicated to the candidate that, in reality, has fewer valid ballots in her favor. However, the officers might make mistakes. There are two types of error that the officer might commit. Type I error consists in invalidating a truly valid ballot. Type II error consists in counting as valid a ballot which is in reality invalid. Given that the type I error is very unlikely to happen (it is impossible to see a non-existent irregularity in a ballot which has been correctly filled out by the voter), we can assume such errors away. Instead, the type II error - missing an existing irregularity - is much more important. Moreover, the likelihood of this error is affected by the effort that the officer exerts. These type-II errors might jeopardize the true outcome of the elections if they are sufficiently numerous as compared to the difference in the number of valid votes between the two candidates.[7]

In other words, the officer exerts the effort of attention to minimize the number of type-II errors. However, the effort is costly, and the higher is the number of ballots to scrutinize, the higher is the marginal cost of effort. On the other hand, the risk of jeopardizing the election outcome depends on the expected margin of victory: the higher

[6]In the Appendix, we present a simple formal model of an election officer's behavior, along the lines discussed here.

[7]This implicitly assumes that the election officer acts taking into account the worst-case scenario: that, if let pass, all the invalid ballots are counted as votes for the same candidate. While this assumption is unrealistic in its pure form, our reasoning remains valid as far as the election officer considers as possible a scenario sufficiently close to the worst case.

is this margin, the less it is likely that a given number of type-II errors influence the election outcome.

The rational officer chooses the level of effort that equates the marginal cost of effort to its marginal benefit. If the expected margin of victory increases, the benefit of effort falls, and thus the officer puts lower effort. This, in turn, implies a lower number of truly invalid ballots that are counted as invalid. Thus, this theory can explain the negative correlation between the margin of victory and the fraction of invalid ballots: election officers rationally allocate effort, depending on the (expected) closeness of elections, which implies higher rates of *detection* of invalid ballots in relatively closer races.

Let's now consider the effect of a variation in turnout. Given that the number of election officers is fixed (i.e. it is not adjusted on the basis of turnout), a higher number of voters showing up at the polls implies a higher number of ballots that each officer has to scrutinize. This means (under the standard convexity assumption on the cost function) that the incremental cost of effort increases. The officer then finds it optimal to reduce the effort that she puts in scrutinizing the ballots, which, in turn, leads to a lower fraction of invalid ballots. Moreover, this effort-reducing effect is stronger when the electoral competition is weaker. Thus, we should observe that the fraction of invalid ballots is negatively correlated with higher voter turnout, and that the negative correlation between invalid ballots and margin of victory is stronger for higher-turnout electoral units.

Table 4 reports the estimates with this interaction term included in the regression. Consistent with the above hypotheses, we indeed find that the coefficients on turnout and the interaction between turnout and leading margin are negative and highly statistically significant. Both coefficients remain significant when we add year fixed effects (column 2). Notably, the coefficient on the interaction term remains significant (and even increases in absolute value) in the most stringent specification (column 3), i.e. when we add both the year fixed effects and the electoral unit fixed effects (the coefficient on turnout loses significance, probably because the within-unit variation in turnout is fairly small).

The explanations above disregard the role of political parties. However, as we discussed in the previous section, party representatives can attend the vote count, and it is highly plausible that parties act strategically in this respect and try to actively use their resources to influence the intensity of vote counting, depending on the incentives. In particular, if the total number of representatives that each party can allocate to any given election

is limited (parties either have to pay the representatives to do this job, or to mobilize volunteers), parties are likely to allocate their representatives in units that give them the highest expected return.

The institutional organization of the electoral system allows us to obtain a set of additional predictions. For candidates, what matters is not winning the race at each municipality, but to obtain the highest number of votes at the district level. However, the closeness of electoral race at the district level does not necessarily coincide with that in each electoral unit within that district. Election officers do not have access to information about the evolution of the vote count in other units (and thus at the district level), they have to use the vote numbers in their own units as the best predictors of what happens at the district level. Parties, however, have a clear informational advantage in this respect. Clearly, allocating representatives (even in locally competitive races) in districts that are won or lost almost for sure (i.e. those with wide expected margins of victory at the district level) makes little strategic sense. Thus, parties allocate disproportionately more representatives - in both locally competitive and non-competitive units - in districts where the (district-level) competition is more tight, and where even a few votes counted mistakenly might imply winning or losing the parliamentary seat. Then, in a two-party elections, if both parties act similarly, we should expect that ballots are scrutinized much more closely in the districts with lower victory margins. This would imply a higher fraction of ballots invalidated in such districts, and this, independently of the closeness of the electoral race at the unit level.

We start exploring the role of parties in Table 5, by comparing the regression coefficients for specifications with and without the dummies for the identity of the leading coalition (center-right and center-left). Column 1 is the same specification as the one reported in column 4 of Table 2. In column 2 we add the dummies for the identity of the leading coalition. We see that the coefficient on the leading margin does not change; however, when the leading coalition is the center-right one, the fraction of invalid ballots is significantly smaller. This could be because center-right coalition has more resources to devote to observing the vote counts (note that the specification includes the electoral unit fixed effects; therefore, the remaining variation is within units, so this right-wing effect cannot be driven by fixed characteristic of voters at the unit level).

Column 3 includes the measure of electoral competition at both the local and district

level. We see that the increase in either leading margin significantly reduces the fraction of invalid ballots. In column 4 we also add the interaction term between the two margins. The coefficient on the interaction term is negative and highly statistically significant. What does this mean? Figure 5 resumes this finding in the graphical form. Defining a race to be competitive at the district level when the margin of victory is below the overall median margin of victory across all districts and elections, the slope of the relationship between the fraction of invalid ballots and the (unit-level) leading margin is very different in competitive and non-competitive parliamentary districts. In particular, in non-competitive districts, larger leading margin at the electoral unit level implies smaller fraction of the invalid ballots. This is consistent with the explanation of the rational allocation of detection effort by election officers, who do not observe what happens in other units and thus consider their own units as representative of the district-level race. Contrarily, in competitive districts, larger leading margins at the electoral unit level do not lead to the reduction of invalid ballots. This is likely to be because of the attention that party representatives devote to all (or most) electoral units in such districts, regardless of the intensity of competition locally. Party representatives thus keep putting pressure on election officers so that these latter detect all the invalid ballots possible, even in units with large local margins, given that the race is very close at the district level.

In the above discussion, we have implicitly assumed that election officers are motivated by duty. A plausible alternative is that they have preferences over candidates or parties, and - given the difficulty to monitor their behavior during the count - try to help their preferred candidates or parties to win by invalidating some of the valid ballots that are in favor of their less-preferred candidates. Researchers in political science have been aware of this possibility for a long time. For example, in his analysis of voting in the U.S. elections, Harris (1934) writes:

> "The use of paper ballots undoubtedly is conducive to voting frauds. The paper ballots must be counted by hand, frequently requiring several hours or longer, under conditions late at night which are likely to facilitate frauds. The election officers are quite exhausted after the long day at the polls, and are not fit to carry on the count for hours afterwards. The watchers are likely to leave if the count lasts for hours, and various short cuts may be used. In

> the confusion, poor light, mingling of ballots, etc., it is easy for ballots to be altered or substituted, and for the count to be falsified. If the ballot is short and the count can be completed within a very few hours, these dangers are not present" (Harris, 1934, pg.380)

Given that electoral fraud is an illegal activity, it implies the risk of getting punished if the illegal action of the election officer is discovered. Unless the three canvassers, the secretary, the president, as well as the party representatives that are present in the polling station agree to forge the elections, the decision problem of a law-breaking officer can be described as follows. Each incremental valid ballot that the officer invalidates increases the risk of getting caught. Moreover, it is plausible to assume that this risk increases more than proportionally with each additional ballot. If the officer invalidates just a few valid ballots, the likelihood that the authorities discover this misbehavior are very low. However, if she invalidates a few more ballots, this likelihoods starts to increase relatively quickly, as - for instance - the discrepancy of the election outcomes with exit polls starts to increase.

On the benefit side, the biased officer wanting to increase the likelihood that her preferred party wins the election understands that this likelihood is large when the expected margin of victory of one candidate over the other is slim. Contrarily, when the expected margin of victory is wide (either in favor of her preferred candidate or against), additional invalidated ballots do not contribute to increasing this likelihood. Given that the risk of getting caught for invalidation does not depend on the expected margin of victory, wider expected margin of victory implies lower number of invalidations by the biased officer. This explanation predicts that higher margin of victory should be negatively correlated with the fraction of invalid ballots, just like the explanation based on duty-driven election officers that we have described above.

How can one discern empirically between these two alternative explanations? Suppose that the electoral fraud is an important driver of the variation in invalid ballots. Under an auxiliary assumption that the extent of electoral fraud is correlated with other measures of crime, we then should normally observe a stronger effect of electoral competition on invalid ballots in areas with higher rates of crime. We report in Table 6 the results of the estimations in which we add as regressors different measures of crime (at province level),

as well as the interaction terms between crime rates and margin of victory. If the electoral fraud mechanism is empirically important, we should find a significant negative coefficient on the interaction term. In neither of the three specifications (in which crime is measured with the rate of extortions, mafia-related crimes, and total crimes) the coefficient on the interaction term is statistically different from zero. We can see this clearly also on Figure 6, in which we plot the relationship between electoral competition and invalid ballots in high-crime and low-crime areas. Independently of how we measure the crime rates, the slopes of the relationship between electoral competition and invalid ballots in two areas are very similar. This implies that electoral fraud cannot be the leading explanation for the empirical relationship that we have established.

5 Conclusion

Invalid ballots have been considered a problem for democratic elections, as they might jeopardize the electoral outcome when the electoral race is close. This paper challenges this view. Using a detailed micro-level dataset from the Italian parliamentary elections in 1994-2001 (which use the traditional paper-ballot hand-counted voting technology), we find a strong robust negative correlation between the margin of victory of the leading candidate over the nearest rival and the fraction of invalid ballots. We then show that this relationship is unlikely to be driven by voter mistakes, protest, or electoral fraud. The explanation that garners most support is that election officers and party representatives rationally allocate more effort in *detecting* invalid ballots when the stakes are higher, i.e. when the electoral race is closer. In other words, under hand-counted voting technology, in closer elections there are higher rates of *detection* of invalid ballots.

Our findings imply that the traditional paper-based hand-counted ballot system seems to has a correction mechanism that adjusts the likelihood that the victor is announced correctly to the closeness of electoral race. This mechanism functions thanks to the increased attention that the election officers and parties allocate to making sure that invalid ballots are not counted as valid ones when the electoral race becomes closer. Clearly, in machine-counted voting systems such correction is absent (unless vote re-counting by hand is added to the machine count in districts with particularly close elections). Thus, while it is true that hand-counting technology is more expensive than the alternatives in settings where

there are relatively frequent elections at many levels, such as the US (Stewart III, 2011), this higher cost should be evaluated against the benefit of this correction mechanism that we have established in this paper.

Natural next steps are to investigate whether similar behavior is present in other settings where ballots are counted by hand, as well as quantifying the benefit of the correction mechanism as compared to other voting technologies. This would then allow to design a fully fledged welfare evaluation of the recent voting-technology reforms.

6 Appendix

In this Appendix, we construct a simple formal model of the behavior of an civic-duty motivated election officer.

The officer's objective function is to maximize her utility, which consists of two terms. The first term captures the fact that she wants to reduce the risk of jeopardizing the true outcome of the elections. The probability of this event depends negatively on the effort exerted by the officer when scrutinizing the ballots. The second term represents the standard convex cost of effort.

Let's denote with n the number of true invalid ballots. Faced with a ballot (valid or invalid), the officer might commit one of the two type of errors. Type I error consists in invalidating a valid ballot. Type II error consists in counting as valid a ballot which is truly invalid. Given that the type I error is very unlikely to happen (one can hardly spot an inexistent irregularity in a ballot correctly filled by the voter), we will assume these errors away. Instead, the type II error, i.e. missing an existing irregularity, is much more important and the probability of this error is affected by the effort that the officer exerts. Let's denote this probability with p.

These type-II errors might jeopardize the true outcome of the elections if they are sufficiently numerous as compared to the difference in the number of valid votes between the two candidates with the highest number of votes. Let's denote with d and d^e the true and the expected difference in the number of valid votes between the two candidates, respectively. Let's assume, moreover, that

$$d = d^e \varepsilon, \tag{1}$$

where ε is the noise which is a random variable drawn from a uniform distribution:

$$\varepsilon \sim U\left[1 - \frac{1}{2\phi}, 1 + \frac{1}{2\phi}\right]. \tag{2}$$

Then, the problem of the officer can thus be written as:

$$\max_x U = -\Pr\left[np(x) > d\right] - c(x, \alpha), \tag{3}$$

where α is the parameter that captures the election-specific objective difficulty of scrutinizing the ballots (for instance, it is higher in a district with a larger number of candidates).

Using (1) and (2) in (3), and dropping the constant terms, the problem becomes

$$\max_{x} -\frac{\phi}{d^e} np(x) - c(x, \alpha). \tag{4}$$

The first-order condition of this problem is

$$-\frac{\phi}{d^e} np'(x) = c_x(x, \alpha). \tag{5}$$

The left-hand side is the marginal benefit of effort, measured in terms of reduced risk of jeopardizing the true election outcome. Higher effort reduces the probability of error by $\left(-\frac{dp}{dx}\right)$, for each invalid ballot. Given that there are n truly invalid ballots, this translates into $n\left(-\frac{dp}{dx}\right)$ less miscounted ballots. The lower is the expected vote difference between the two candidates with the highest number of votes (lower d^e) and the higher is the precision of the estimate of the vote difference (higher ϕ), the higher is the effect of this reduction in miscounted ballots on the risk of jeopardizing the true election outcome. The right-hand side simply represents the increasing marginal cost of effort.

From (5), we easily get the comparative statics on the optimal effort of the officer:

$$x^* = x(\overset{+}{\phi}, \overset{-}{d^e}, \overset{+}{n}, \overset{-}{\alpha}). \tag{6}$$

Higher number of truly invalid ballots and a higher precision of the estimate of the vote difference increase the effort of the officer. Higher expected vote difference and the steeper increase in the cost of effort reduce the effort of the officer.

To get a closed-form solution that is needed for x^* to have a tractable empirical specification, we assume that $p(x)$ has the shape of the exponential cumulative distribution $1 - e^{\lambda x}$, with $\lambda > 0$, and that the cost function has the shape of an exponential function $c(x, \alpha) = e^{\alpha x} - 1$, with $\alpha > 0$. Without loss of generality, we assume that $\alpha > \lambda$. These functions fit our purpose particularly well, given that they capture the decreasing returns to effort for the probability of committing the type-II errors and the more than proportional cost of effort. With these functional forms the first-order condition becomes:

$$\frac{\phi}{d^e} n\lambda e^{\lambda x} = \alpha e^{\alpha x},$$

and, solving for x^*, we obtain

$$x^* = \frac{1}{\alpha - \lambda} \log\left(\frac{\phi n \lambda}{d^e \alpha}\right).$$

Empirically, we can not observe the officer's effort directly, but only the number of ballots reported as invalid. In terms of our model, denoting this number as n^v, we get

$$n^v = n\left[1 - p(x^*)\right] = n^v(\overset{+}{\phi}, \overset{-}{d^e}, \overset{+}{n}, \overset{-}{x}), \tag{7}$$

which, taking logs, becomes

$$\begin{aligned} \log n^v &= \log n + \lambda x^* = \log n + \frac{\lambda}{\alpha - \lambda} \log\left(\frac{\phi n \lambda}{d^e \alpha}\right) && (8) \\ &= a + b_1 \log d^e + b_2 \log n + e, && (9) \end{aligned}$$

where $a = -\frac{\lambda}{\alpha-\lambda}\log\alpha$, $b_1 = -\frac{\lambda}{\alpha-\lambda}$, and $b_2 = \frac{\alpha}{\alpha-\lambda}$, and e is an unobserved component equal to $\frac{\lambda}{\alpha-\lambda}\log\phi$.

Three points are worth noting. First, a higher vote difference (between the two candidates with the highest number of votes) negatively correlates with the number of reported invalid ballots, i.e. $b_1 = -\frac{\lambda}{\alpha-\lambda} < 0$. Second, a higher number of invalid votes positively correlates with the true number of reported invalid ballots, i.e. $b_2 = \frac{\alpha}{\alpha-\lambda} > 0$. Finally, for higher values of α (i.e. when the cost function is steeper) the number of invalid votes decreases.

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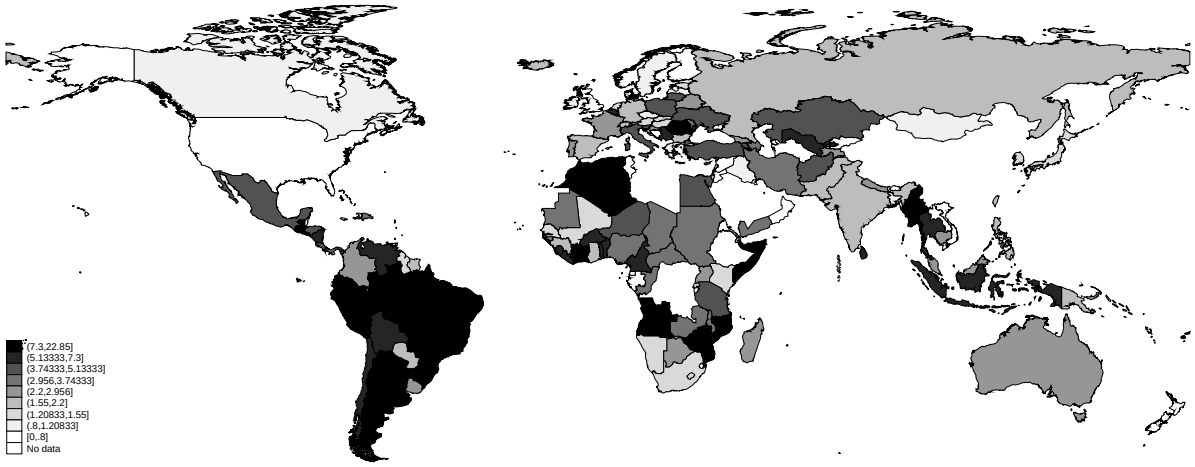

Figure 1: Invalid ballots (as a fraction of total ballots) in the parliamentary elections around the world

Source: Institute for Democracy and Electoral Assistance (www.idea.int)

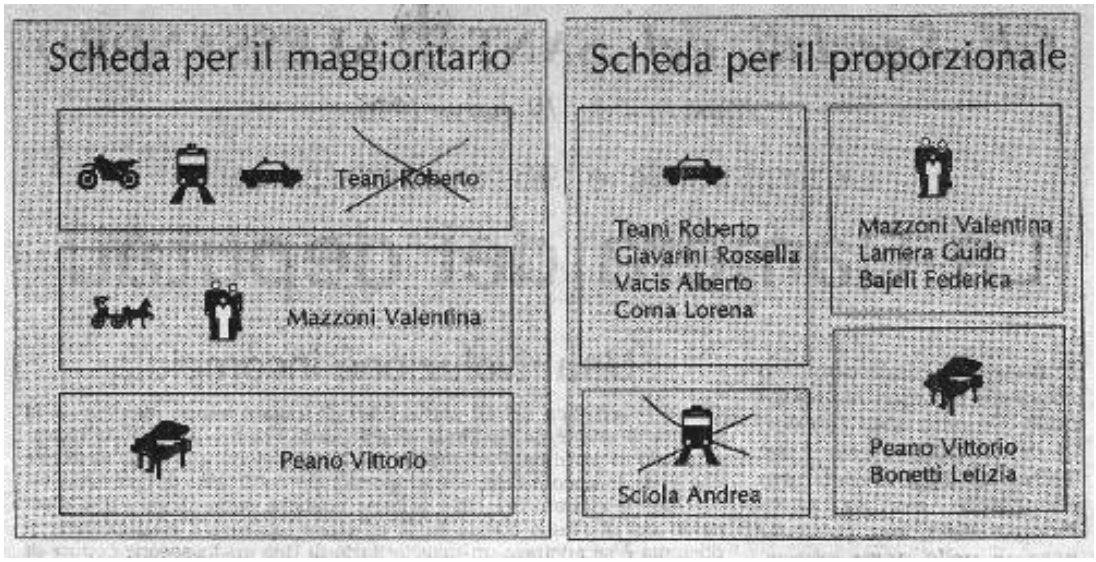

Figure 2: A typical ballot in Italian parliamentary elections

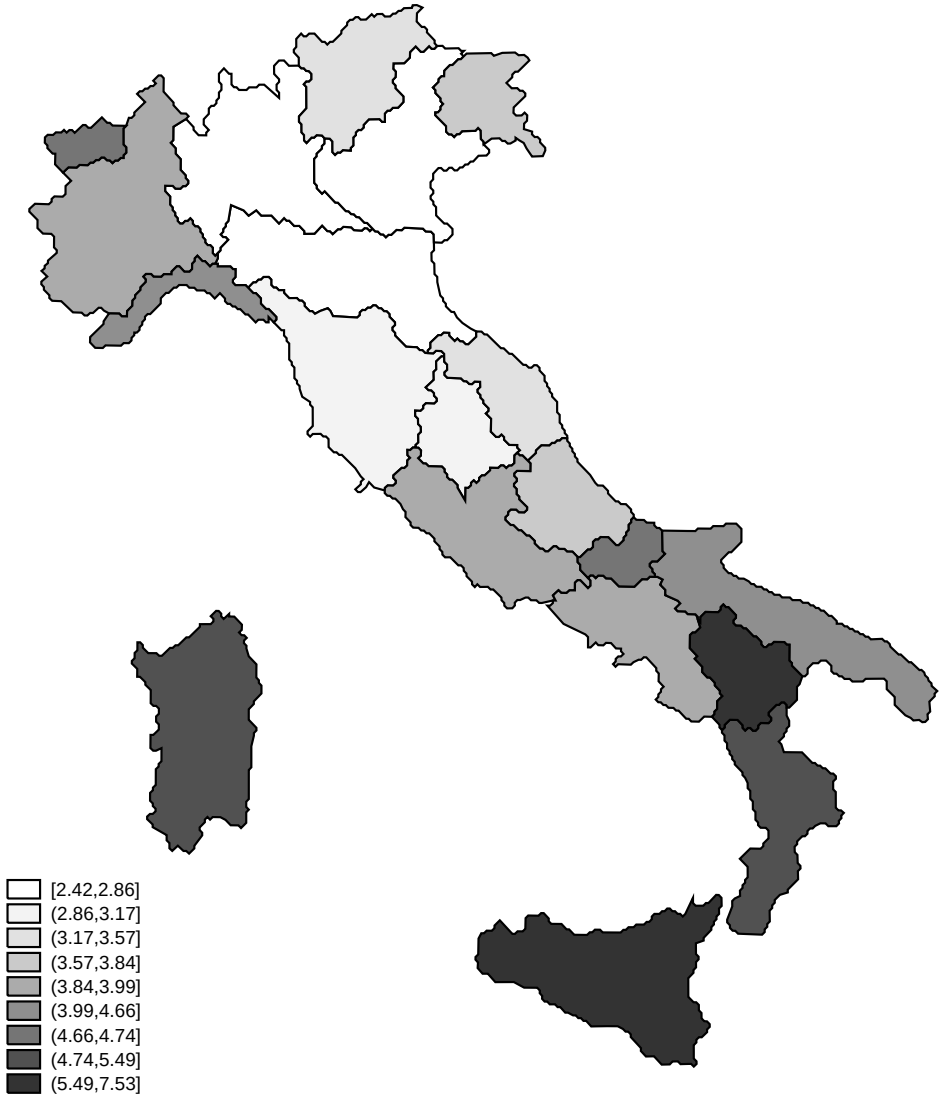

Figure 3: Invalid ballots (as a fraction of total ballots) in Italian parliamentary elections, 1994-2001 (majoritarian districts)

Notes: Author's calculation based on Italian national elections data (Corbetta and Piretti, 2008).

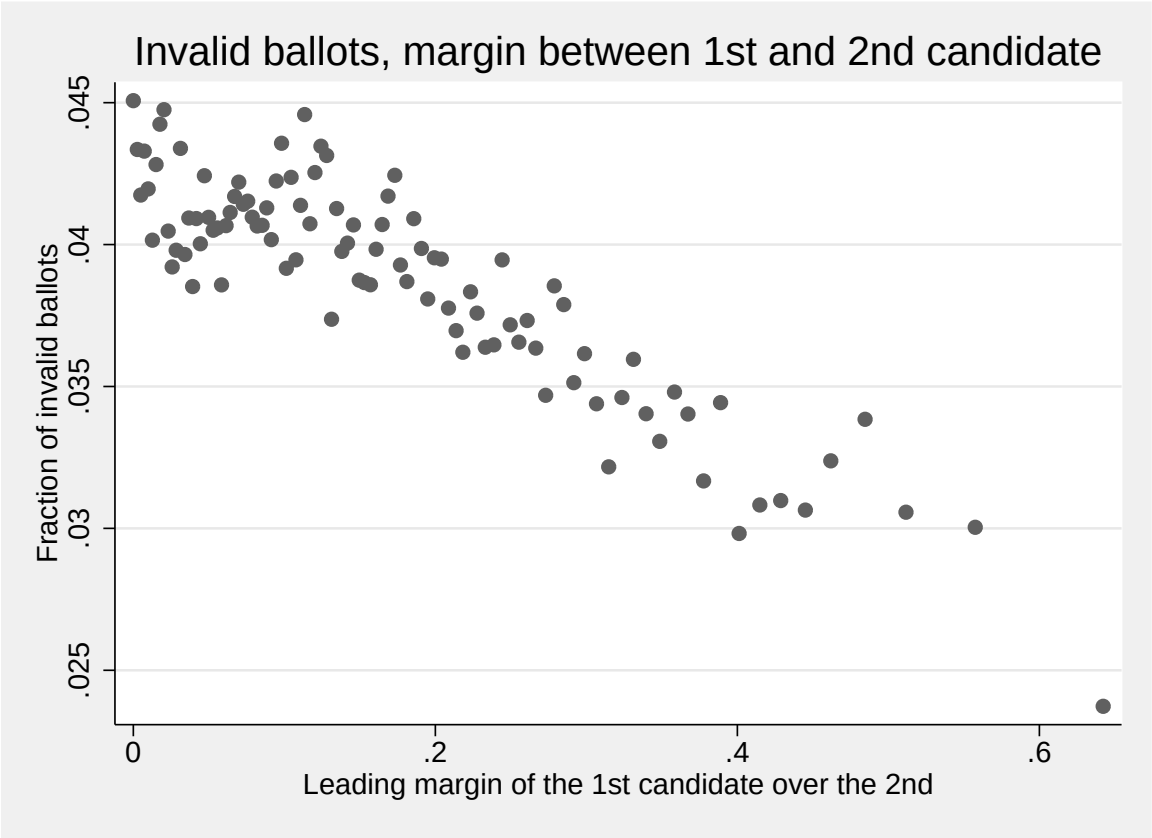

Figure 4: Fraction of invalid ballots by percentile of leading margin

Notes: Author's calculation based on Italian national elections data (Corbetta and Piretti, 2008).

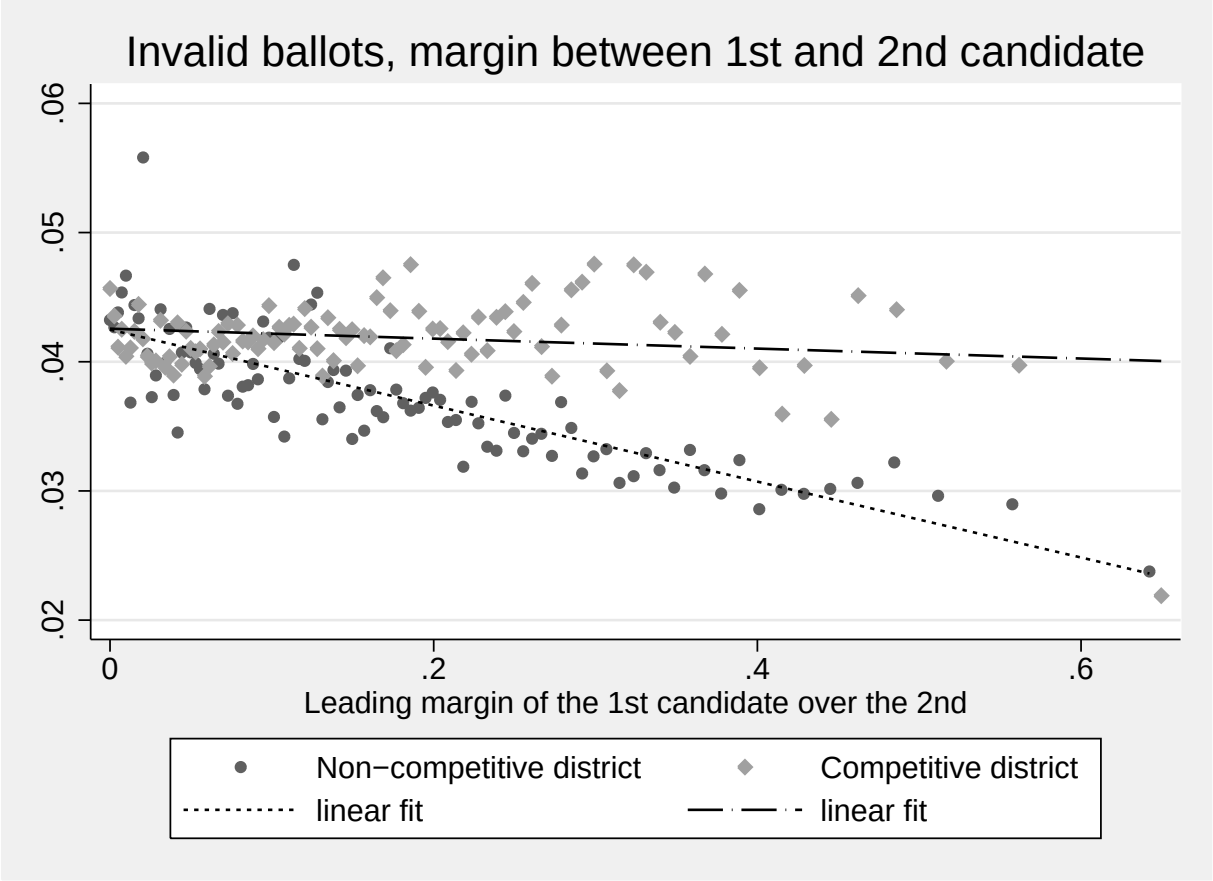

Figure 5: Fraction of invalid ballots by percentile of leading margin and district-level competition

Notes: Author's calculation based on Italian national elections data (Corbetta and Piretti, 2008).

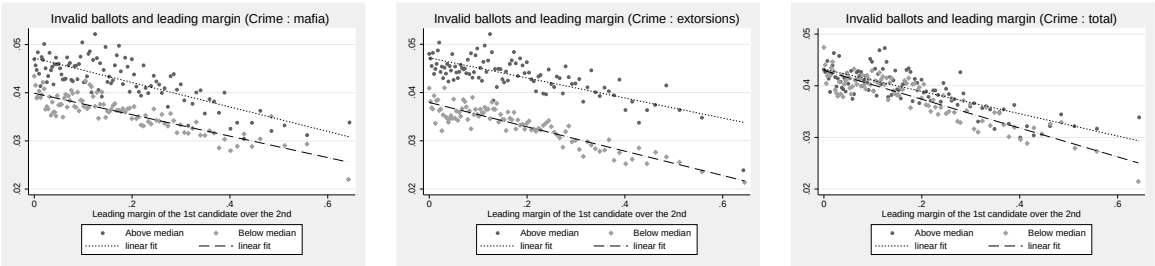

Figure 6: Fraction of invalid ballots by percentile of leading margin, in high-crime versus low-crime provinces

Notes: Author's calculation based on Italian national elections data (Corbetta and Piretti, 2008).

Table 1: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Invalid ballots	0.039	0.022	0	0.573	23109
Blank ballots	0.046	0.022	0	0.245	23109
Turnout	0.820	0.108	0.049	1	23109
Leading margin (municipality/district)	0.184	0.148	0	0.961	23109
Leading margin (district)	0.139	0.124	0	0.756	23109
Right coalition leads	0.38	0.485	0	1	23109
Left coalition leads	0.362	0.481	0	1	23109
Incumbent party leads	0.944	0.23	0	1	15020
Incumbent leads	0.264	0.441	0	1	15020
Number of candidates	4.136	1.005	2	9	23109

Table 2: Basic regression results

	(1)	(2)	(3)	(4)
	Fraction of invalid ballots			
Leading margin at electoral unit level	-0.024***	-0.018***	-0.013***	-0.014***
	(0.002)	(0.002)	(0.002)	(0.002)
Turnout		-0.047***	-0.007	0.016
		(0.006)	(0.008)	(0.091)
Blank ballots		0.209***	0.145***	0.135***
		(0.020)	(0.019)	(0.046)
Number of candidates		-0.001	-0.002***	-0.001
		(0.000)	(0.000)	(0.001)
Provinces with mafia-related crimes			-0.001	
			(0.001)	
Fraction of pop. with university degree			0.019	
			(0.182)	
Fraction of pop. with high school degree			-0.114**	
			(0.054)	
Turnout at national referenda			-0.000***	
			(0.000)	
Labor activity rate			-0.054**	
			(0.025)	
Unemployment rate			0.064***	
			(0.017)	
GDP per capita			0.001	
			(0.002)	
Rate of urbanization			0.011**	
			(0.005)	
Year FE				√
Electoral unit FE				√
Observations	23,126	23,126	21,733	23,126
R-squared	0.028	0.158	0.269	0.703

NOTE.– Standard errors, clustered at the district level, are reported in parentheses (there are 475 majoritarian districts). There are 8,224 electoral-unit fixed effects. *,**, and *** denote statistical significance at 10%, 5%, and 1% level.

Table 3: Basic regression results for electoral units with less than 1,200 eligible voters

	(1)	(2)	(3)	(4)
	Fraction of invalid ballots			
Leading margin	-0.018***	-0.014***	-0.014***	-0.009***
	(0.003)	(0.003)	(0.003)	(0.003)
Turnout		-0.031***	-0.012*	-0.040*
		(0.007)	(0.007)	(0.021)
Blank ballots		0.165***	0.143***	0.133***
		(0.022)	(0.020)	(0.027)
Number of candidates		-0.001	-0.002***	-0.001
		(0.001)	(0.001)	(0.001)
Provinces with at mafia related crimes			-0.001	
			(0.002)	
Fraction with uiversity degree			-0.177	
			(0.264)	
Fraction with high school degree			-0.046	
			(0.083)	
Turnout at referenda			-0.000**	
			(0.000)	
Activity rate			0.019	
			(0.044)	
Unemployment rate			0.044*	
			(0.023)	
GDP per capita			0.001	
			(0.005)	
Rate of urbanization			0.014**	
			(0.007)	
Year FE				√
Electoral unit FE				√
Observations	7,320	7,320	6,783	7,320
R-squared	0.017	0.086	0.149	0.690

NOTE.– Standard errors, clustered at the district level, are reported in parentheses (there are 475 majoritarian districts). There are 2,704 electoral-unit fixed effects. *,**, and *** denote statistical significance at 10%, 5%, and 1% level.

Table 4: Regression results with interaction terms

	(1)	(2)	(3)
	Fraction of invalid ballots		
Leading margin at electoral unit level	0.005	0.012	0.036*
	(0.020)	(0.019)	(0.020)
Turnout	-0.047***	-0.048***	0.016
	(0.006)	(0.007)	(0.091)
Blank ballots	0.210***	0.208***	0.135***
	(0.020)	(0.020)	(0.046)
Number of candidates	-0.001	0.000	-0.001
	(0.000)	(0.000)	(0.001)
Leading margin × Turnout	-0.037**	-0.038**	-0.046**
	(0.018)	(0.018)	(0.019)
Leading margin × Number of candidates	0.002	0.001	-0.003*
	(0.002)	(0.002)	(0.002)
Year FE		√	√
Electoral unit FE			√
Observations	23,109	23,109	23,109
R-squared	0.159	0.169	0.704

NOTE.– Standard errors, clustered at the district level, are reported in parentheses (there are 475 majoritarian districts). *,**, and *** denote statistical significance at 10%, 5%, and 1% level.

Table 5: Invalid ballots and competition at electoral-unit and district levels

	(1)	(2)	(3)	(4)
	Fraction of invalid ballots			
Leading margin at electoral unit level	-0.014***	-0.014***	-0.009***	-0.008***
	(0.002)	(0.002)	(0.002)	(0.002)
Leading margin at district level			-0.010*	0.004
			(0.006)	(0.008)
Interaction between the margins				-0.057***
				(0.016)
Turnout	0.016	0.018	0.019	0.020
	(0.091)	(0.091)	(0.091)	(0.091)
Blank ballots	0.135***	0.131***	0.132***	0.130***
	(0.046)	(0.047)	(0.047)	(0.047)
Number of candidates	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Right coalition leads		-0.005***	-0.005***	-0.004***
		(0.001)	(0.001)	(0.001)
Left coalition leads		-0.002	-0.002	-0.001
		(0.001)	(0.001)	(0.001)
Year FE	√	√	√	√
Electoral Unit FE	√	√	√	√
Observations	23,109	23,109	23,109	23,109
R-squared	0.703	0.706	0.707	0.708

NOTE.– Standard errors, clustered at the district level, are reported in parentheses (there are 475 majoritarian districts). *,**, and *** denote statistical significance at 10%, 5%, and 1% level. There are 8,224 electoral-unit fixed effects.

Table 6: Invalid ballots, electoral competition, and crime

	(1)	(2)	(3)
	Fraction invalid ballots		
Leading margin at electoral unit level	-0.013***	-0.013***	-0.013***
	(0.002)	(0.002)	(0.002)
Extorsions (rate X 1,000 inh.)	0.294		
	(1.068)		
Mafia related crimes (rate X 1,000 inh.)		0.005**	
		(0.002)	
Total crimes (rate X 1,000 inh.)			0.000
			(0.001)
Interaction between lead. margin and crime	-0.108	-0.006	-0.000
	(0.098)	(0.005)	(0.000)
Turnout	0.024	0.018	0.024
	(0.100)	(0.091)	(0.100)
Blank ballots	0.141***	0.135***	0.141***
	(0.049)	(0.047)	(0.049)
Number of candidates	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
Year FE	√	√	√
Electoral Unit FE	√	√	√
Observations	21,716	23,109	21,716
R-squared	0.705	0.704	0.705

NOTE.– Standard errors, clustered at the district level, are reported in parentheses (there are 475 majoritarian districts). *,**, and *** denote statistical significance at 10%, 5%, and 1% level. There are 8,224 electoral-unit fixed effects.