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Texto para Discussão

Série Economia

TD-E 02 / 2016

Does education play a role in strategic voting behavior? Evidence form Brazil

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Does education play a role in strategic voting behavior? Evidence form Brazil

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August 2016

Preliminary version.

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Abstract

In a seminal work about strategic voting, Duverger suggested that single-ballot electoral systems generate incentives for voters to behave strategically, which leads to two-party systems. Dual-ballot electoral systems, in turn, allow voters to behave sincerely, which favors multi-party systems. Even though several works have found results consistent with strategic voting behavior, there are no evidence that this affects party structure as suggested by Duverger, which might be an indicator that not all voters behave the same way. This leads to the question on who exactly are the voters behaving strategically and why some voters do not behave this way. This paper investigates whether voters with different levels of education behave differently when choosing their candidates in Brazilian mayoral elections. The results proposed by Duverger should hold only if voters are fully informed about the ranking of the candidates. If this is not the case, then one should not expect a voter to behave strategically. Therefore, less educated voters, those with arguably less access to information, might behave differently. We test this hypothesis exploiting an exogenous variation in Brazilian electoral rules and using a unique database with information disaggregated at the polling station level, that allows us to identify votes and characteristics of small groups of voters. Our results show that voting behavior indeed varies greatly between high and low educated voters. While less educated voters seem to vote sincerely, more educated voter tend to vote strategically. We also present evidence that the results are related to education and not to other voters' characteristics such as age, which indicates that strategic voting depends more on gathering and processing information about candidates and less on learning about electoral institutions.

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1 Introduction

Strategic voting has long been a topic of interest in both economics and political science literature. Whether people vote sincerely, choosing their favorite candidate, or strategically, aiming at defeat their least-preferred candidate, is a relevant question to understand and evaluate electoral systems' rules. In a seminal work about this topic, Duverger [1954] states that single-ballot electoral systems generate incentives for voters to behave strategically, which ultimately leads to two-party systems. In turn, dual-ballot electoral systems allow voters to behave sincerely, which favors multi-party systems. Even though several works in the literature have found results consistent with strategic voting behavior, there are no evidence that this affects party structure as suggested by Duverger, which might be an indicator that not all voters behave the same way. This leads to the question on who exactly are the voters behaving strategically and, more importantly, why some voters do not behave this way.

The present work takes a step towards this understanding and investigates whether voters with different levels of education behave differently when choosing their candidates in Brazilian mayoral elections. According to Duverger's argument, in a single-ballot plurality election if a rational voter believes that candidates 1 and 2 have the highest probability of winning an election, to maximize his chances of being a pivotal voter, he strategically chooses to vote for his preferred choice between 1 and 2, even if his preferred choice was, say, candidate 3. Since all voters go through a similar logic, all other candidates are deserted by her supporters, and all votes end up going for the top two ranked candidates. This result, however, should hold only if voters are fully informed about candidates' ranking - or at least are able to form priors about each candidate probability of winning. If this is not the case, then one should not expect a voter to behave strategically. Therefore, less educated voters, those with arguably less access to information, might behave differently than more educated ones.

We test this hypothesis exploiting an exogenous variation in Brazilian electoral rules. According to the Brazilian Constitution, municipalities with less than 200,000 voters function under a single-ballot electoral system, while those with a higher number of voters function under dual-ballot elections. Therefore, we perform a regression discontinuity design using a rich database of electoral outcomes and voters characteristics to examine: (i) whether there exists strategic behavior when voting in single-ballot elections compared with dual-ballot ones, and (ii) if such behavior varies systematically among municipalities with higher and lower shares of illiterate voters. Additionally, using a unique database with information disaggregated at the polling station level, that allows us to identify votes and characteristics of small group of voters[1], we were able to explore variations in voters' characteristics in an even more precise way. This dataset allows us to employ a Difference-in-Difference strategy

[1]Brazilian legislation (*Código Eleitoral, art. 117*) dictates that polling station has at most 400 voters in the states' capital cities or 300 voters in other cities, and at least 50 voters.

comparing the effect of a change from single to dual ballot election across different polling stations.

Our results show that voting behavior indeed varies greatly between high and low educated voters, in both municipalities and polling stations. While for the group of more educated voters a change from single-ballot to dual-ballot decreases voting for the top two and raises it for the third and lower placed candidates, for the group of less educated voters we do not find evidence of this behavior. Taking advantage of the detailed dataset at the polling station level, we present evidences that the results are related to education and not to other voters' characteristics, specially age, a characteristic highly correlated to education, which suggests that strategic voting depends more on gathering and processing information about candidates and less on other phenomena that could be related to age such as habit formation or learning about electoral institutions.

This paper communicates with both political science and political economy literature. First, it communicates with the theoretical literature that, following the hypothesis first proposed by Duverger, study strategic voting under single and dual-ballot rules on a game-theoretic framework. (Cox [1994, 1997], Myerson [2002], Cox [1997], Boutona [2013]). We believe we contribute to this literature by providing empirical evidence that voters behave differently according to their characteristics (or to their ability to access and process information). In this sense, the implications of our findings may be important to future theoretical work on the field.

Our work is also closely related to the large empirical literature that tests the implications of the hypothesis first postulated by Duverger (Fujiwara [2011], Cox [1997], Ordeshook and Zeng [1997], Boutona [2013], Ordeshook and Zeng [1997]). In general, these literature documents evidence consistent with Duverger's hypothesis. As pointed by Merolla and Stephenson [2007], however, even though several studies have found evidence of strategic voting behavior, the persistence of minor parties in some contexts suggests that the forces outlined by Duverger might not be at work. This might be the case of Brazil, for instance. While Fujiwara [2011] finds evidence of strategic voting in single-ballot mayors' elections in Brazil, he does not find any impact of such behavior on party affiliation or the number of candidates. Our contribution to this particular strand of the literature is twofold. First, we provide a more clear evidence consistent with strategic voting, showing results similar to the one documented by Fujiwara [2011] but using more updated econometric techniques. Second, we contribute by providing a possible explanation of why even though we observe some evidence of strategic voting behavior we do not observe convergence to a two-party system (or even significant decrease in the number of parties) in some contexts.

The remaining of this work is divided as follows. After this introduction, we present in Section 2 a brief description of Brazilian electoral system. Section 3 describes and present some important features of our datasets. Section 4 presents the empirical strategy we employ. Section 5 presents the

results. Finally, section 6 concludes.

2 Institutional Framework

Brazil is a federation with more than 5,500 municipalities – the smallest administrative unit of the federation – distributed across 26 states and the Federal District. Each municipality has its own elected mayor and a legislative house. Similarly, each state has a state assembly and a governor. Each state also elects representatives for both the federal senate and for the lower chamber of congress.

Federal law dictates that Brazilian elections for each position occur every four years and that all state and federal elections are held jointly. Local elections, in turn, are held between general elections and, since 1988, are held simultaneously across municipalities. Federal law also requires that all citizens aged 18 or older to register to vote in their municipality of residence. For citizens between 16-18 years old, older than 70 years old and illiterate people voting (and registering) is facilitative. Voters who fail to vote to have to pay a small fine (around US$1,00). In case it does not pay it the voter can experience a series of difficulties such when applying for a job in a state-managed company, when having a passport issued, or when trying to obtaining a loan from a public bank, to name a few.[2]

Moreover, the Brazilian Constitution states that the system ruling mayoral elections depend on the number of voters in each municipality. In municipalities with less than 200,000 voters, mayoral elections should be run under the single-ballot plurality rule system, while in municipalities with 200,000 voters or more, mayoral elections must be run under dual-ballot plurality rule.

This threshold-based rule enables us to implement a regression discontinuity design technique since, under some mild assumptions, municipalities just below and just above the threshold should be, on average, similar to each other in relevant (political) characteristics. In other words, this threshold-based rule creates a quasi-random assignment of municipalities to the treatment, that is the reason that municipalities are on a particular side of the threshold is due to random (uncontrollable) events that should not be related to the outcome of interest.

For the sake of our empirical strategy, it is important to emphasize that this threshold-based rule is independent of municipalities' preferences about their electoral system. That is, municipalities cannot choose to have a single or dual-ballot system. This is a function of their population and, therefore, near the threshold of 200,000 voters, the assignment to one system or another is quasi-random and not related to any kind of voters' behavior. Considering that voting in Brazil is mandatory the number of voters in a municipality should be highly correlated to population, therefore it is reasonable to believe

[2] Available at http://www.tse.jus.br/legislacao/codigo-eleitoral/codigo-eleitoral-1/sumarios/sumario-codigo-eleitoral-lei-nb0-4.737-de-15-de-julho-de-1965

on the quasi-random assignment to the treatment.

Finally, it is worth highlighting that in order to better organize election procedures, each state is divided into polling districts (*Zona Eleitoral*) which are, in their turn, composed of several polling stations (*Seção Eleitoral*). Polling districts have their limits defined according to geographical and demographic characteristics and are managed by electoral judges charged with taking care of electoral registers. Each district may either cover more than one municipality, have its area coincide with one, or be a smaller part of a municipality.[3]. A polling station, on the other hand, consists of a very specific place in the polling district where each voter is designated to cast his or her vote, usually a specific room in a school or public service center. Brazilian legislation[4] dictates that polling stations should have at most 400 voters in states' capital or 300 voters in other municipalities, and at least 50 voters. As such, polling stations represent a highly disaggregated level of observation.

3 Data

The data used for this work was provided by the Federal Electoral Authority (*Tribunal Superior Eleitoral*), and contains information on both electoral outcomes and electorate characteristics, such as education, age, and gender. We rely mainly on two sources of data from the TSE, one at the municipal level and another at the polling station level.

In both databases we built variables containing the share of votes received by each candidate and a set of variables containing the sum of shares received by lower placed candidates - 3^{rd} and lower, 4^{th} and lower, and 5^{th} and lower placed candidates. These are our main dependent variables, especially the share of votes going to 3^{rd} and lower placed candidates, as it is reasonable to assume they are good measures of whether or not people choose to vote for the top two candidates instead of voting for those with fewer chances of winning, that is whether or not people vote strategically.

The data on municipal level comprises elections from 2000 and 2012. As previously mentioned, all municipalities have municipal elections in the same day every four years in Brazil. Table 1 shows the number of municipalities existing in Brazil in each electoral year and the number of municipalities with more than two candidates, which are the municipalities we are interested in. It also presents the number of municipalities where runoff was a possibility - those are the municipalities that will (possibly) be on the right side of the cutoff when we employ our RD strategy. It is important to highlight that Brazilian constitution mandates that a runoff happens only when a candidate does not achieve 50% plus one of the totals of the valid votes. This means that the figures presented in Table 1 do not represent the number of municipalities that actually had a runoff in the refereed year but

[3]Source: http://www.tse.jus.br/eleitor/zonas-eleitorais
[4]Código Eleitoral, art. 117

the number of municipalities that were under the runoff rule.

Table 1: Number of candidates and ballot structure in municipal elections

	2000	2004	2008	2012
Total number of municipalities	5,656	5,656	5,659	5,730
Municipalities with at least 3 candidates	2,544	2,773	2,351	2,428
Plurality rule	2,487	2,773	2,351	2,428
Runoff	57	66	75	83

In our estimates at the municipal level, we also create a variable containing the share of illiterate voters in each municipality. As we show ahead, in order to test for heterogeneities at the educational level, we split our sample of municipalities into two sub-samples: those with higher and lower share of illiterates than the median.

The database on polling stations, also provided by the TSE, comprises the 2008 and 2012 municipal elections. The electoral outcomes at polling station level are provided by the TSE since 2000. Data on electorate characteristics, however, crucial for us to identify heterogeneous effects and to test our hypothesis, is available only since 2008. This data is crucial for us to test for heterogeneous effects on other characteristics than illiteracy. Particularly, we are able to construct other measures of education (i.e: share of voters with high school, bachelor degree), and measures of age (i.e: share of voters under 18, the share of voters older than 70, etc) for each polling station.

The number of polling stations in each municipality is relatively high: on average each municipality has 118 polling stations. Given the fact that the allocation of each voter in a polling station in not subject to (self) selection, if there is a significant variation in voters' characteristics across polling stations, it is possible to identify potential heterogeneous effects on strategic voting. Figures 1 and 2 present the density of voters' characteristics across polling stations. Except for people under 18, for whom registration is facultative, there is significant variation in all characteristics. It is important to note, however, that the data on polling station does not increase our identification power, it only allows us to identify heterogeneity within municipalities. As it is gonna be explained later in section 4.2, our identification comes from municipalities changing from plurality rule to a runoff system, as in Gonçalves et al. [2012]. As it can be seen in Table 1, only eight municipalities changed from its electoral system between 2008 and 2012. However, two of those municipalities did not have more than two candidates in one of these elections, which narrows down even more the identification power of our exercise.

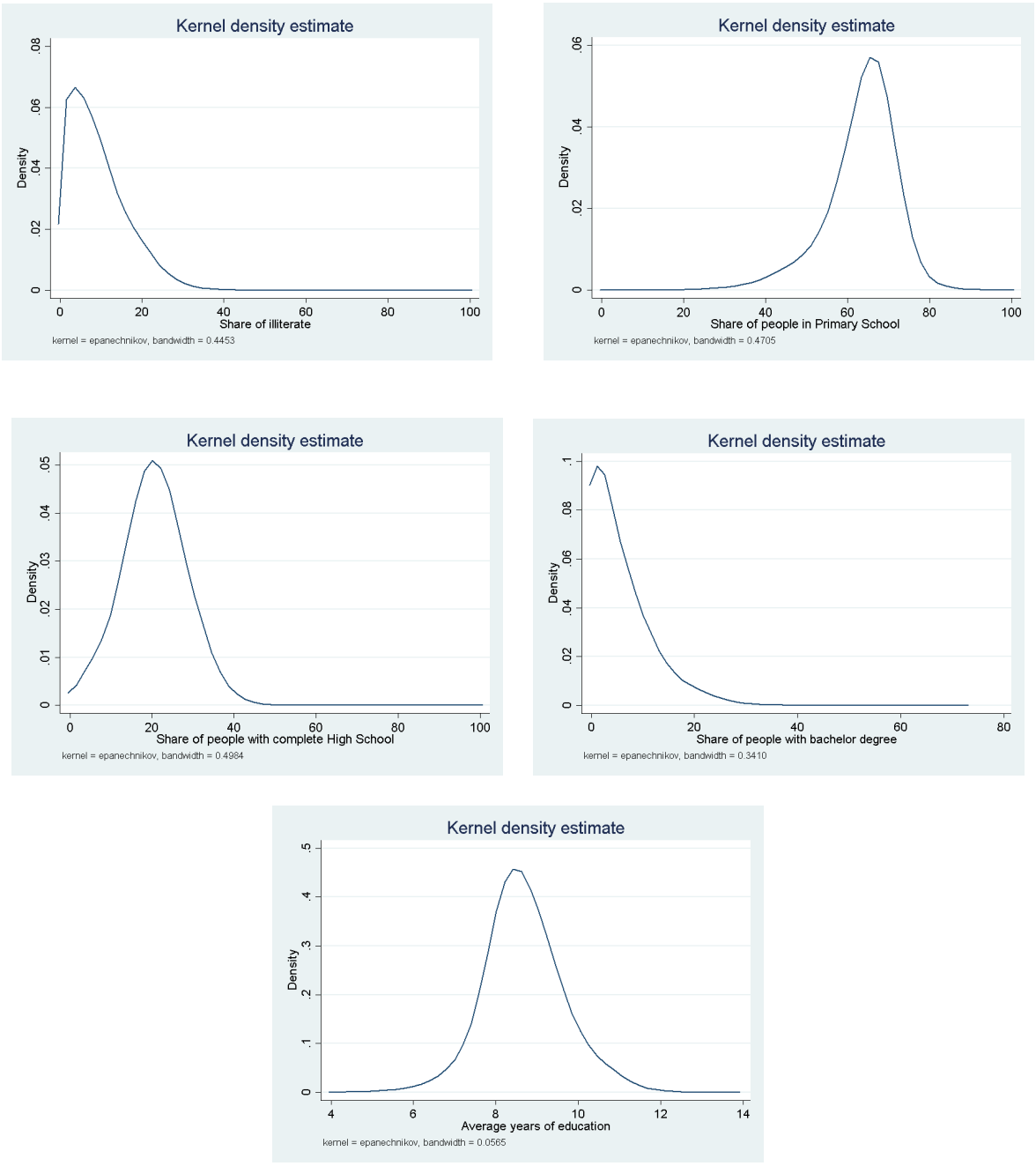


Figure 1: Density of voters' characteristics by education across polling stations

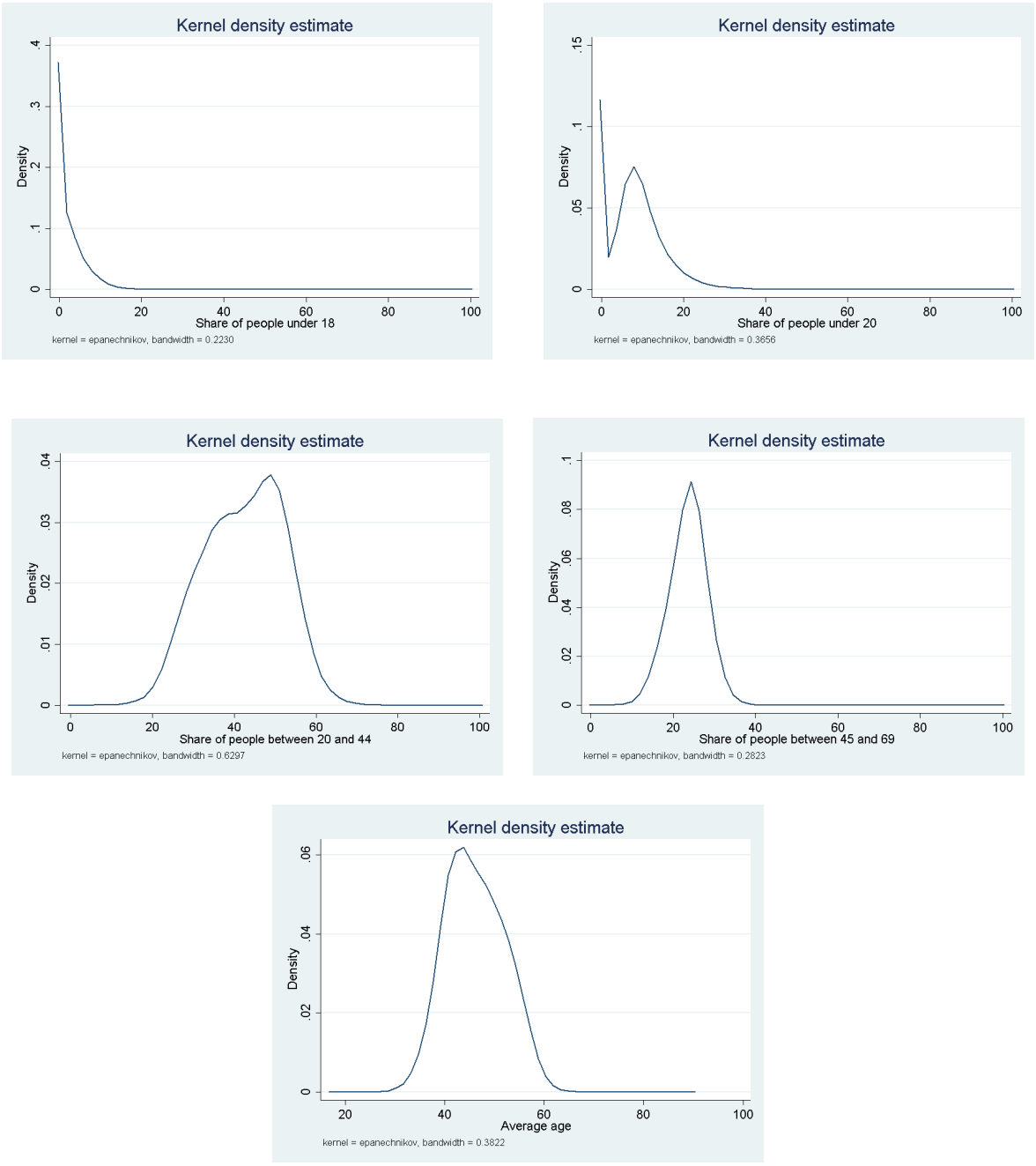


Figure 2: Density of voters' characteristics by age across polling stations

4 Empirical strategy

4.1 Analysis at municipal level

The main purpose if this work is to identify whether people voting in plurality elections behave differently than those voting in runoffs and, once this difference is established, verify whether it depends or not on the level of education of voters. A central problem in this kind of study, however, is that it is not possible to simply compare municipalities functioning under different electoral systems because those places might differ in other characteristics that, potentially, also affect their voters' behavior. In particular, we could face a reverse causality issue if larger municipalities are also those where voters behave more strategically. In this case, OLS estimates would overestimate our coefficients.

In order to address this problem, we explore the discontinuity in electoral rules determining whether municipalities have single or dual-ballot mayoral elections, reassembling the work of Fujiwara [2011]. As described above, municipalities with less than 200,000 registered voters function under single-ballot elections, while places with more than 200,000 voters function under a dual-ballot system. Under the hypothesis that this threshold-based rule is not either chosen nor manipulated by municipalities and that there is no other municipal rule based on this same threshold[5], municipalities in both sides of the cutoff's neighborhood should be very similar, differing only on their electoral rule. In other words, assignment to single or dual-ballot systems can be considered quasi-random near the threshold of 200,000 voters.

Therefore, letting v be the number of registered voters in a municipality, the treatment effect of passing from a plurality to a runoff electoral system is given by:

$$\beta^{RDD} = \lim_{v \to 200{,}000^+} E[y|v] - \lim_{v \to 200{,}000^-} E[y|v] \tag{1}$$

where y is the share of votes received by lower placed candidates. The first term on the right-hand side of the equation is the expected value of y in municipalities with more than 200,000 - and, therefore, under runoff elections - but very close to this figure. The second term is the expected value of y in municipalities with less than 200,000 - and thus under plurality elections - but also very close to this threshold. Hence, the treatment effect is exactly the difference of vote share for lower placed candidates between municipalities differing only by their electoral rules.

In order to estimate this effect, we use nonparametric local polynomial estimations, which perform regressions functions above and below the threshold of 200,000 voters, through weighted polynomial regressions. We choose to perform local linear regressions, given by

[5] Those conditions were verified by Fujiwara [2011].

$$y = \beta_0 + \beta_1.1\{v > 200,000\} + \beta_2(v - 200,000) + \beta_3(v - 200,000).1\{v > 200,000\} + \varepsilon \qquad (2)$$

where $1\{v > 200,000\}$ is a dummy variable that takes value one only if the municipality has a runoff electoral system. Therefore, the estimate of β_1 is the treatment effect, since it identifies exactly the passage from plurality to runoff.

A central decision in this kind of estimation concerns the choice of sample bandwidths inside which regressions are performed. According to Calonico et al. [2014], a usual procedure is to use bandwidth selectors which balance squared-bias and variance of the RD estimator. However, bandwidths delivered by those selectors are usually too large and might lead to bias due to the inclusion of observations too far from the cutoff. As a result, confidence intervals might converge to values well bellow the true ones and we have a problem of over-rejection of the null hypothesis of absence of impact. To address this problem, Calonico et al. [2014] propose corrections for confidence intervals that allow for optimal bandwidth choices.

In order to ensure robustness of our estimations, we choose two different selections of bandwidth, those proposed by Calonico et al. [2014] and by Imbens and Kalyanaraman [2012]. Moreover, for the sake of comparability, we also use the bandwidths employed by Fujiwara [2011]: 25,000, 50,000 and 75,000 voters.

4.2 Analysis at the polling station level

Our analysis at the polling station level is not restricted to municipalities close to 200,000 voters. If in the RD described in the previous subsection the underlying hypothesis was that municipalities bellow and above the cut-off were similar, in this case, this is not a requirement. In this analysis, we estimate a Difference-in-Difference regression with municipality fixed-effects. Therefore, we compare municipalities in 2012 with themselves in 2008.

In order to consistently identify the effect of a change from single to a dual-ballot system, it is required an exogenous variation in the ballot structure within a municipality. As already anticipated, that variation comes from municipalities changing from a single to a dual-ballot system between 2008 to 2012. The identification hypothesis underlying this approach is that the discrete change from less than 200,000 voters to more than 200,000 voters is not correlated to any relevant variable that might affect electoral outcomes. Our approach in this section reassembles the approach adopted by Gonçalves et al. [2012]. This hypothesis is mathematically identical to the requirement that treated and non-treated groups - in this case, municipalities functioning under single ballot rule and municipalities functioning under dual ballot rule, respectively - do not show different pre-trends in

relevant observable characteristics.

Formally, we estimate the following model:

$$y_{i,s,t} = \beta_0 + \beta_1 R_{i,t} + \beta_2 x_{i,s,t} + \beta_3 R_{i,t} * x_{i,s,t} + \mu_i + \delta_t + \varepsilon i, s, t \tag{3}$$

Where $y_{i,s,t}$ is our dependent variables in municipality i, polling station s at time t. $R_{i,t}$ is a dummy that assumes value 1 if there is a possibility of a runoff in the municipality i in year t - that is, if it has more than 200,000 voters - and 0 otherwise. $x_{i,s,t}$ is a measure of characteristics at the polling station level (i.e: the share of illiterate voters, the share of voters under/above a certain age, etc). Our coefficient of interest, β_3, captures how changes in ballot structure vary according to polling station characteristics.

It is important to stress that since we are employing municipality fixed effects, municipalities that do not have their ballot structure changed between 2008 and 2012 do not contribute to our identification. Therefore, we will have low power to identify our effects. The data on polling station contributes in the sense that allows us to identify heterogeneous effects but it does not increase our identification power.

5 Results

5.1 Results at the municipal level

We now proceed to present the main results of the paper. First, we report the results of the exercise described in Section 4.1, an exercise similar to the one conducted by Fujiwara [2011]. As previously mentioned our investigation consists in verifying whether there exists strategic voting in Brazil and whether such a behavior depends on voters' education. The first set of results is reported in Table 2. Column (1) presents the results using nonparametric local polynomial estimator with robust standard errors and bandwidth selection procedure as proposed in Calonico et al. [2014] while column (2) reports the estimates using the bandwidth selection procedure proposed by Imbens and Kalyanaraman [2012]. For the sake of comparison in columns (3)-(5) we present the results replicating the linear OLS specification and the bandwidth selection used by Fujiwara [2011].

As already documented by previous works, Table 2 shows that individuals under plurality system are more likely to desert candidates with lower chances of winning. The coefficients of the change from the single ballot to the dual ballot system are positive, indicating that the share of votes for lower placed candidates, on average, increases in runoff systems. Even though few coefficients are significant, the results are quite consistent throughout the estimations. Looking at column (1) we see that the share of votes for third and lower placed candidates increases on average in about 6.3

percentage points in dual-ballot elections when compared with single-ballot elections. This result is smaller than the one found by Fujiwara [2011], who estimated an impact of 8.8 pp. It is important to note, however, that the sample used in his work is different since he uses data from 1996 to 2008 and the specification employed in the first two columns are also different than the one employed in his work. When replicating his empirical exercises - columns (3) - (5) - however, even using a slightly different sample, we find that our results are similar to theirs. In fact, our point estimates are slightly higher.

Table 3 present the most important results of the analysis at the municipal level. Columns (1) - (3) report the same estimation for third and lower placed candidates as above for a sub-sample of municipalities with the share of illiterate voters above the median of the sample used in the specification used in column (1) of Table 2. Columns (4)-(6), in turn, present the estimates for the sub-sample of municipalities with the share of illiterate voters bellow this median. The results show a pretty clear pattern: strategic behavior is a feature present only in municipalities with a low proportion of illiterate voters: estimations in columns (1) - (3), on one hand, are neither consistent nor significant. For some of them, the coefficients are largely negative while for other, they approach zero. Therefore, it is reasonable to state that on average voters at less educated municipalities vote sincerely, regardless the electoral system they are subject to. On the other hand, results in columns (4) - (6) are positive, highly significant and much larger than those reported in Table 2, ranging from 10.5 to 25.9. Therefore, the effect associated with changing from a single ballot to a dual ballot system in the vote share of third and lower placed candidates can be as large as 25.9 percentage points according to the specification used in column (1).

Figures 3 present the general result, without splitting municipalities by the share of illiterate voters and it shows a discontinuous increase in the share of votes going to either third, fourth, or fifth and lower placed candidates when a municipality passes from a single to a dual ballot system. This discontinuous increase, however, is only significant in the share of votes going to the third and lower candidates, as already seen in the previous tables.

Figure 4 illustrates the results when we split the sample by the share of illiterate voters in the municipality. In this case, the discontinuity disappears in Figure 4a, where we plot the results only for municipalities with a higher share of illiterate voters. At the same time, the discontinuity is accentuated in Figure 4b, which includes only municipalities with a lower share of illiterate voters.

Table 2: Treatment effect on electoral outcomes

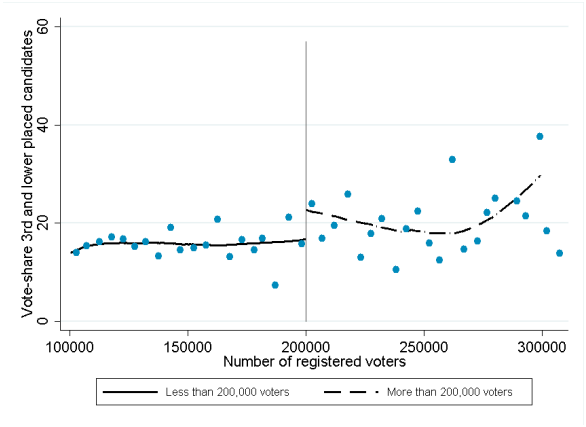
	(1)	(2)	(3)	(4)	(5)
Vote-share 3rd and lower	6.3612*	3.0435	4.9014	5.9276	6.2357**
	(3.6286)	(1.9520)	(5.2807)	(3.7389)	(3.0609)
Bandwidth	CCT	IK	25,000	50,000	75,000
Observations	251	10,222	87	187	308
Vote-share 4th and lower	2.7187	2.9620**	-0.5375	2.4211	3.2961*
	(2.2636)	(1.4581)	(3.2382)	(2.2827)	(1.9312)
Bandwidth	CCT	IK	25,000	50,000	75,000
Observations	258	1,159	73	152	249
Vote-share 5th and lower	1.7614	1.9932***	1.0260	1.8109	1.8109
	(1.2500)	(0.6515)	(1.7126)	(1.2410)	(1.0931)
Bandwidth	CCT	IK	25,000	50,000	75,000
Observations	138	1258	50	101	161

Note: Specifications in collumns (3)-(5) are linear. Standard errors in parentheses:
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

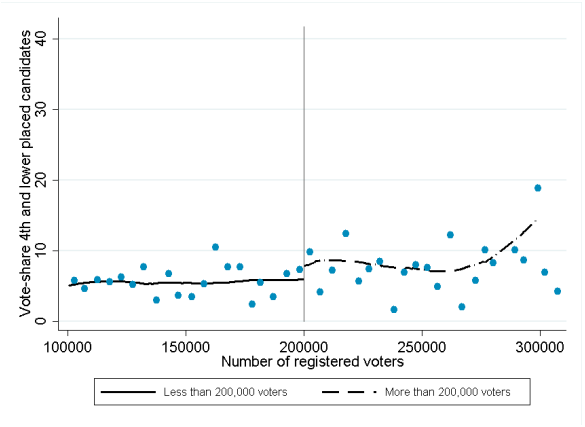
Table 3: Heterogeneity by share of illiterate people in the municipality

	Above median			Below median		
	(1)	(2)	(3)	(4)	(5)	(6)
Vote-share 3rd and lower	-7.1961	-2.5978	-0.7055	25.8732***	10.5497**	10.8899**
	(15.2824)	(9.1096)	(5.3109)	(6.5620)	(4.6045)	(4.8793)
Bandwidth	CCT	IK	50,000	CCT	IK	50,000
Observations	27	60	91	21	114	96

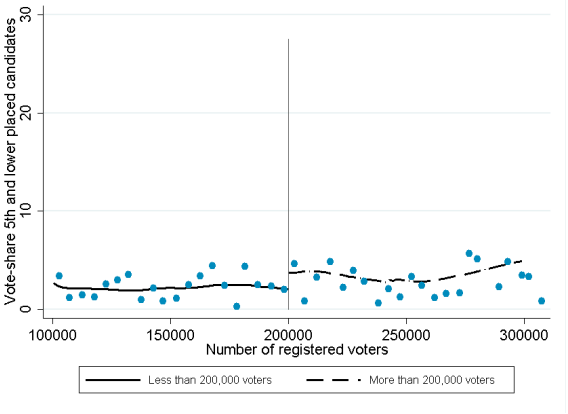
Note: Specifications in collumns (3) and (6) are linear. Standard errors in parentheses:
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$



(a) 3^{rd} and lower placed candidates

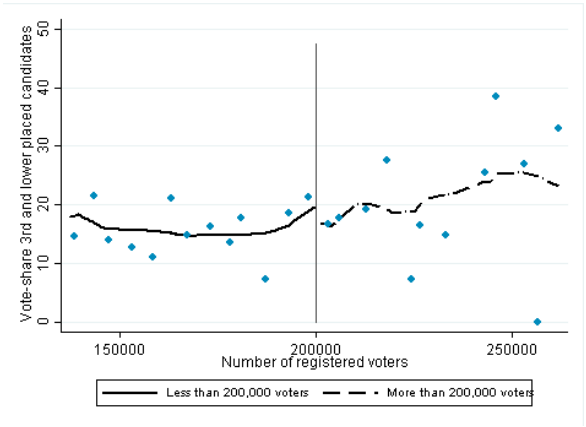


(b) 4^{th} and lower placed candidates

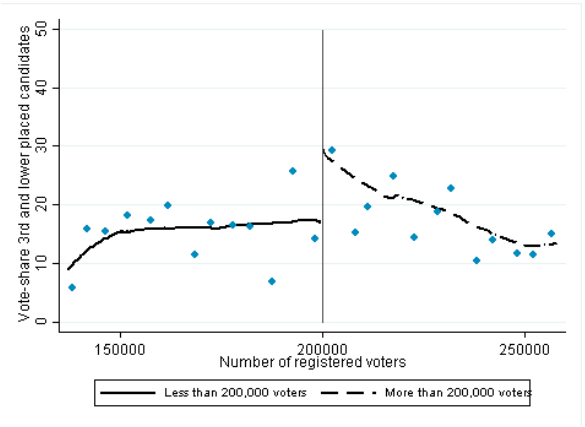


(c) 5^{th} and lower placed candidates

Figure 3: Global effect of shifting from plurality to runoff systems



(a) Municipalities above the median



(b) Municipalities below the median

Figure 4: Heterogeneous effect by share of illiterate people on the municipality

5.2 Results at the polling station level

The objective of this section is twofold. First, we aim at verifying if the pattern observed in the previous subsection also holds at a more disaggregated level of data, that is using data at the polling station level. Second, we also check for possible competing mechanisms that could lead to this same pattern through drivers different than education.

Table 4 present the results of the exercise described in Section 4.2 for different levels of education. Column (1) present the heterogeneity of the response to a change in the electoral system by the share of illiterate voters in the polling station. The coefficient is negative and significant at a 10% level, indicating that the effect of a change from a single ballot system to a dual ballot system on the share of votes received by the third and lower placed candidates is stronger in polling stations with a lower share of illiterate voters - or with a higher share of non-illiterate voters. To have an idea about the size of this impact, one can think that when a municipality changes from a single to a dual ballot system if we compare a polling station with 25% of illiterate voters with a station with only 5% of illiterate voters we could expect, on average, that the last one would have 1.4 p.p fewer votes to lower placed candidates.

Column (2) - (5) present results of similar exercises using different measures of education. Even though the coefficients are not significant, the point estimates are consistent with our hypothesis. Column (2) suggests that the effect is decreasing in the share of voters with primary school, another measure of poorly educated voters. Columns (3) and (4), in turn, suggests the effect is increasing in the share of voters with high school and bachelor degree, respectively, both measures of well-educated voters. Finally column (5) suggests the effect is increasing in the average years of education of the voters in the polling station. All the point estimates, therefore, are consistent with our previous findings and suggest that education plays an important role in strategic voting.

5.2.1 Competing Mechanisms

A potential problem in our estimation is that the aforementioned results leave open the possibility that the heterogeneous impact observed on voters' strategic behavior is driven by channels others than education. There are at least two other elements that could generate differences in strategic voting for distinct levels of education. The first is that, as explained above, voting is not mandatory for illiterate people. Therefore, we could be capturing in our exercises simply the effect of non-mandatory voting on strategic behavior. The second element is that, as shown in Ferraro [2002], the share if illiterate is much higher among elderly people. Therefore it can be the case that the effect we identify is not related to voters' level of education but to voters' age. If this is the case, these findings are less consistent with a story of how the ability of voters to gather and process information about candidates

Table 4: Heterogeneous effects by education (at the polling station level)

	(1) Sh. of illiterate	(2) Sh. primary school	(3) Sh. High school	(4) Sh. Bachelor	(5) Avg. years of schooling
Runoff	-0.0264	-0.0007	-0.0499	-0.0370	-0.0736
	(0.0370)	(0.0373)	(0.0434)	(0.0388)	(0.0584)
Measure of Educ.	0.0065	0.0049	-0.0073	-0.0098	-0.0007
	(0.0187)	(0.0202)	(0.0285)	(0.0273)	(0.0018)
Runoff * Measure of Educ.	-0.0773*	-0.0504	0.0797	0.0675	0.0047
	(0.0406)	(0.0443)	(0.0571)	(0.0606)	(0.0038)
Statistics of measures of education:					
Mean	0.0942	0.6327	0.2056	0.0645	8.6797
Standard deviation	0.0707	0.0891	0.0806	0.0593	0.9975
Observations	586984	586984	586984	586984	586972
R-squared	0.68	0.68	0.68	0.68	0.68

Note: All specifications include municipality fixed-effects.

Standard errors clustered at the municipality level in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

influence strategic voting behavior and more consistent with a story on how other phenomena that could be related to age - such as habit formation or learning about electoral institutions - influence such behaviour.

In order to test for this competing mechanism, we repeat the same exercise documented in the previous subsection but now using measures of age instead of measures of education. Table 5 present the results. Columns (1) and (2) present the results for the share of voters under 18 years old and the share of voters under 20 years old respectively. Columns (3) and (4) present the results for the share of voters between 20 and 44 and for the share of voters between 45 and 69. Although only the coefficient in column (3) is significant it is not yet possible to rule out the possibility that age plays an important role in strategic voting behavior. The coefficients associated with younger voters are negative whereas the coefficient associated with older voters are positive, suggesting that strategic voting could be a feature that happens more for older voters. In order to test for that, we construct a measure of the average age of voters at the polling station and conduct the same exercise using this measure. The results are presented in column (6) and suggest that there is no effect of age on strategic voting behaviour.

Even though we can somewhat rule out the hypothesis that age plays an important role in strategic voting behavior the estimates in columns (1) and (5) seem to present an important message. Both measures are measures of voters not obliged to vote and, although not significant, both coefficients are negative. This leaves room to investigates if our results are related to facultative voting. We test this hypothesis by creating a measure of voters not obliged to vote, excluding illiterate voters. The results are presented in column (7). Although the result is not significant, the point estimate is considerably high. Considering the low power of identification it is not possible to rule out the hypothesis that facultative voting is an important feature - not the only one, however, considering our previous findings - affecting strategic voting.

Even though the result reported in column (6) suggest that age does not play an important role in our results, since the coefficient in column (4) is highly significant, we perform a triple differences exercise in which we not only interact the runoff variable with both the share of illiterate voters and the share of voters between 45 and 69 years old, but we also interact those three variables with each other in order to deeply investigate if our result is driven by age or by education. Table 6 present the results of this estimation. It is important to observe that, even though the coefficient are not significant, the interaction of the share of illiterates with the runoff variable is barely significant, with a p-value of 0.11. Moreover, while the interaction of share of voters between 45 and 69 with the runoff variable decreases in this specification, the interaction of the former variable with the share of illiterate voters increases 150%. This is a good indicator that the mechanism behind strategic voting

is indeed education and not another mechanism related to voters' age.

Table 5: Heterogeneous effects by age (at the polling station level)

	(1) Under 18	(2) under 20	(3) 20 - 44	(4) 45 - 69	(5) Over 70	(6) Average age	(7) Facultative
Runoff	-0.0322	-0.0326	-0.0356	-0.0555	-0.0301	-0.0241	-0.0282
	(0.0370)	(0.0366)	(0.0343)	(0.0387)	(0.0382)	(0.0470)	(0.0383)
Measure	0.0040	0.0021	0.0043	-0.0065	-0.0030	-0.0001	-0.0021
	(0.0119)	(0.0068)	(0.0126)	(0.0207)	(0.0097)	(0.0002)	(0.0083)
Runoff * Measure	-0.0456	-0.0091	0.0055	0.0892***	-0.0277	-0.0002	-0.0379
	(0.0490)	(0.0349)	(0.0224)	(0.0318)	(0.0267)	(0.0004)	(0.0278)
Statistics of measures of age:							
Mean	0.0314	0.0856	0.4230	0.2363	0.1258	46.1202	0.1572
S.d	0.0364	0.0659	0.0997	0.0464	0.0771	6.0505	0.0724
Observations	586984	586984	586984	586984	586984	586984	586984
R-squared	0.68	0.68	0.68	0.68	0.68	0.68	0.68

Note: All specifications include municipality fixed-effects.

Standard errors clustered at the municipality level in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: DDD estimator: interaction of share of voters between 45 and 69 years old and share of illiterate voters

	(1)
Runoff	-0.0407
	(0.0382)
Illiterate	0.0124
	(0.0235)
45-69	-0.0018
	(0.0211)
Illiterate * 45-69	-0.0309
	(0.0709)
Runoff * Illiterate	-0.1844
	(0.1156)
Runoff * 45-69	0.0559
	(0.0426)
Runoff * Illiterate * 45-69	0.4560
	(0.5065)
Observations	586,984
R-squared	0.68

Standard errors clustered at the municipality level in parentheses:
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6 Conclusion

The present work aimed at contributing to the literature on strategic voting. More specifically our main purpose was to understand why several studies have found evidence of strategic voting behaviour in some contexts even though there was still the persistence of minor parties, something that is not consistent with what was proposed by Duvergers and the following theoretical works. Our hypothesis was that voters might behave differently according to their characteristics. More specifically, according to their level of education and, consequently, to their ability to process information.

In order to test this hypothesis, we conduct two empirical exercises. First, we explore the discontinuity in electoral rules determining whether municipalities have single or dual-ballot elections to choose their mayors, reassembling the work of Fujiwara [2011]. Our innovation in this exercise is that we conduct an exercise splitting the sample into municipalities with the share of illiterate voters above and bellow the median of illiterate voters which allows us to identify for heterogeneous effects of education.

The second exercise we conduct is at the polling station level. We take advantage of municipalities changing from a single to a dual-ballot system between 2008 to 2012 and from a unique database with information disaggregated at the polling station level, that allows us to identify votes and characteristics of small groups of voters.

Our findings are consistent with our hypothesis and show that voting behavior indeed varies

greatly between high and low educated voters. While less educated voters seem to vote sincerely, more educated voter tend to vote strategically. We also present evidence that the results are related to education and not to other voters' characteristics such as age, which indicates that strategic voting depends more on gathering and processing information about candidates and less on learning about electoral institutions.

Future research should be done in order to verify the exact mechanisms through which education impacts strategic voting. However, the results found in this work are relevant by themselves, due to the understanding they bring to the present literature.

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