Electronic voting and Social Spending:

The impact of enfranchisement on municipal public spending in Brazil

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Abstract

This article studies the effect of voting enfranchisement biased towards the low-income voters in Brazil and its consequences on municipal level public spending. According to the model constructed, enfranchisement of the poor increases social spending. This prediction is empirically tested by using electronic voting (EV) in Brazil as an instrument, which has positively affected voting enfranchisement without directly influencing public spending. We apply two different methodologies: a 2SLS regression and a differences-in-differences methodology to show that municipalities that used EV spent more on health, education and public employment compared to the ones that did not, which confirmed the hypothesis presented in our model.

Key words: Electronic voting; political participation; politically motivated intergovernmental transfers; social public spending.

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1- Introduction

The discussion associating voters' demands to their income level has an early tradition. Alexis de Tocqueville in his seminal book "Democracy in America" argued that allowing those who do not own property to vote would increase the proportion of voters who are in favor of income redistribution. Theoretical models have also predicted that an increase in voting participation of poorer voters would increase social spending. Meltzer & Richards (1981) is perhaps the most influential work. The authors attempted in a later paper (Meltzer & Richards, 1983) to confirm empirically their own model prediction. However, by using the income of the median income earner in the United States as a proxy for the income of the median voter, they did not take into account that voter turnout of the poor is lower than the average in the US. Although there are several empirical works supporting Meltzer & Richards' (1981) prediction (Lindert, 2004; Mueller & Stratmann, 2003; and Oliveira 2005), it has remained a challenge to find an identification strategy that solves the reverse causality problem of regressing directly government spending on voting participation. The more the government spends, the more likely poor people will be to vote in the elections to maintain status quo.

Following Fujiwara (2015), the present work uses the electronic voting (EV) introduction in Brazil, which positively affected poor voters' enfranchisement without directly affecting social spending, in order to solve the reverse causality problem aforementioned and answer the subsequent question: does voting enfranchisement biased toward poor increase social spending? Our main contribution is to expand Fujiwara's analysis to municipalities and to other social

spending outcomes.[1] In addition, we construct a model that is tested empirically and we also address Schneider's (2016) findings that EV decreased turnout.

Before the EV, Brazil's high turnout (80% on average) did not correspond to a high valid vote to turnout ratio, especially for Representatives. As the proportional representation system imposes each one of the 27 Brazilian states to act as a multi-member district,[2] the pool of Representative candidates to be chosen by a voter is large, which makes it impractical to print all their names in a ballot (not the case for the executive positions). Therefore, before EV, the voter had to actually write in a specific blank space on the ballot their candidate's name or respective number in order to cast a valid vote for her. That way, knowing how to read and clearly write was essential to cast a vote. As pointed by Hidalgo (2010), for a country with an electorate's functional illiteracy rate close to a third, this was not a trivial task.

[Consolidation of the Brazilian democracy, hence, came only with the introduction of EV, which has allowed voters, mainly the poor, to exercise their right to vote.[3]] Electronic voting was introduced in Brazil in order to make voting easier to all citizens and, consequently, increase the power of the Brazilian democracy. For instance, in the 1994 elections, before EV, the valid vote to turnout ratio for Federal Representatives was only 58%. While in 2002, when EV was used in all polling stations in the country this number increased to 92% according to the Supreme Electoral Court (*Tribunal Superior Eleitoral*, TSE).

[1] Fujiwara (2015) focused his analysis to Brazilian states and measured the impact of poor citizens' enfranchisement on health spending and health outcomes.
[2] Holding at least 8 and at most 70 seats in congress (lower chamber).
[3] There will be further discussion on the connection between EV and voter enfranchisement.

The main purpose of this work is to associate enfranchisement through EV usage in the 1998 federal elections, where EV became a feature for some municipalities in Brazil,[4] to municipal level public spending. Therefore, EV is used as an instrument to show how changes in enfranchisement (measured here as the number of correctly cast votes) affects social spending at the municipal level. The connection between the federal and municipal election is established taking into account how mayors respond to the federal elections in the middle of their terms in office. In order to be reelected,[5] the mayor of the municipality which used EV in 1998, is going to respond to the poor voter enfranchisement by increasing public spending.[6] At the same time, Representatives elected in 1998 will be willing to help mayors from municipalities that used EV through intergovernmental transfers, mostly used in social spending, in exchange for support in the next federal elections as these mayors can now deliver more votes to them. As argued by Novaes (2015), in multi-member districts, mayors are important brokers for Representatives.

This hypothesis derives from the intuition provided by our model, similar to the one constructed by Bugarin & Portugal (2015), which concludes that the optimum amount of public provision is biased toward the preferred policy of the socioeconomic class with higher turnout. The difference is that in our model all voters are necessarily going to show up to vote, since voting is mandatory in Brazil. However, they may not correctly cast their votes. Interestingly, as EV not only enfranchises voters, but also bias this enfranchisement disproportionately towards the poor (Fujiwara, 2015), the model predicts that the provision of public goods should therefore increase

[4] In the 1996 municipal elections, only a few municipalities used EV, while in 1998 about 500 municipalities (out of 5,281) used it.
[5] All mayors were able to try reelection in 2000 since the law granting mayor the possibility for reelection started being effective in 1997, one year after the mayoral election of 1996.
[6] Since the Federal elections took place in 1998, the mayor was able to respond to it for two years before trying reelection in the municipal elections of 2000.

because the poor are the ones more likely to demand public goods and at the same time, to be *de facto* enfranchised.

Besides presenting a model to motivate the empirical analysis, this work is going to rely on two econometric methodologies to present empirical evidence. Both of them will explore the fact that, due to a limited supply of voting machines in 1998, only municipalities belonging to four selected states and places with more than 40,500 voters used EV.[7] Assuming that the assignment of EV in 1998 across municipalities with population close to 40,500 is as good as random, this work first estimates a two stage least square regression in order to measure the enfranchisement impact on government spending at the municipal level during the last two years of the mayor's four years term (1999 and 2000). EV assignment is used as instrument and to guarantee that its usage is the only difference between the compared municipalities, the analysis will be restrained to places where the number of eligible voters is close to 40,500. As municipalities that used EV had an increase on valid votes to turnout ratio close to 20 p.p. and 15 p.p. respectively for federal and state representatives (Fujiwara, 2015; Hidalgo, 2010), it should be expected a disproportionately higher amount of public provision in these places.

Secondly, in order to collect a larger sample, as most municipalities (92.3%) had less than 40,500 voters in 1998, we present a difference-in-differences analysis, taking into account these places. To use this methodology, we use four states that had EV in all their territories as the treatment group and the remaining ones as the control group. Our focus will be only on municipalities with less than 40,500 voters in order to avoid heterogeneity between the two groups. The EV's impact on government spending will be found by comparing the differences between

[7] EV was then used in all municipalities after the 1998 elections.

the amount of public expenditure on the treatment and control groups before the EV usage (last two years of the mayoral term that ended in 1996) and after it (last two years of the mayoral term that ended in 2000). It should be expected a much larger and significant public spending increase on the municipalities that used EV in 1998.

Besides the introduction, this work is divided as follows. Section 2 presents a literature review on the connection between voting participation and public spending and discusses the EV implementation. Section 3 presents a model that motivates the empirical analysis. Section 4 briefly discusses the data collection. Section 5 presents the 2SLS model and Section 6 the differences-in-differences. Finally, section 7 concludes the work.

2- Background

2.1. Voters' enfranchisement and public spending

Meltzer & Richard (1981) show that voting enfranchisement increases public spending. Using a model of electoral competition, they argue that the median income voter is the one imposing her preferences on public spending. Moreover, the electoral equilibrium shows that the poorer the median income voter is the larger will be her public spending optimum provision demanded. This result comes from the fact that, the poorer the citizen is, the lower will be her tax contribution to finance the public provision. Lindert (2004) developed an econometric study using decennial data from OECD countries between 1880 and 1930 to confirm the positive relationship between government size and vote participation. In Latin America, Brown & Hunter (1999) study the relationship between democracy and public social spending using panel data for 17 countries between 1980 and 1992. The authors conclude that, especially in poor and economic instable

countries, democracy increases the allocation of public spending on social programs when compared to dictatorship regimes.

In the United States, Husted & Kenny (1997) analyze 46 American states between 1950 and 1988. During this period, restrictions to vote focused mainly on the poor, such as poll taxes payments and literacy tests, were banned in the country, thereby increasing voting participation and, at the same time, decreasing the income of the median voter. Therefore, it should come as no surprise the result found on their study showing that a reduction of 0.2 on the median voter income to the total population income ratio caused an increase of 5 to 12% on public social spending.

Nonetheless, it should be pointed out that Meltzer & Richard's (1981) argument is not consensual. Alesina & Giuliano (2009), for instance, argue that the empirical studies are limited and other aspects such as the median voter's perspective on social mobility and strength of lobbying groups could reinforce the limits imposed on government intervention in the economy. A possible way to explain the difficulty to find empirical evidence on the relationship between the median's voter income and public spending is given by the fact that the median income of the citizen may not be the same as the median income of those who actually show up to vote and cast valid votes. That is, even if democracy allows all eligible voters to cast their votes, those who do not vote may have their preferences completely ignored by politicians. Mueller & Stratmann (2003), for example, find that there is a positive relationship between turnout and public spending.

Therefore, democracy by itself is not enough to guarantee larger public spending. According to UNDP (2005), between 1990 and 2002, less than 55% of all eligible voters living in a democracy showed up to cast a vote to a candidate (or party). More importantly, those abstaining to vote are more likely to represent the poor (and illiterates). Frey (1971) shows a positive

relationship between income and electoral participation in the United States. Weeks (2014) finds that "According to U.S. Census, 47 percent of eligible adults with family incomes of less than $20,000 a year voted in 2012 […] By contrast, those with annual earnings of $100,000 or more turned out at rates of around 80 percent". Greene & Nikolaev (1999) using electoral polls between 1972 and 1993 concluded that electoral participation monotonically increases with income. Borgonivi et al. (2010) show a positive relationship between education and electoral participation in 15 European countries. In Brazil, Elkins (2000) finds a positive relationship between political concern and education.

Consequently, a lower political participation concentrated on the poor makes the median voter income to be larger than the median citizen income reducing the preferences for public goods given by the electoral equilibrium as argued by Bugarin & Portugal (2015). A solution pointed by these authors is to use mandatory voting.[8] Jackman (2001) uses the Australia elections to show how mandatory voting increase voting participation (the turnout has increased from 65% to 95% after mandatory voting was imposed in this country). However, mandatory voting by itself cannot guarantee voting participation. As aforementioned, Brazil's case is illustrative. Although the constitution makes it mandatory for all literate citizens between 18 and 70 years old to vote,[9] in 1994 for instance, less than 60% of those who showed up to vote (turnout close to 80%) could actually cast a valid vote for a candidate or party to the legislative seats.

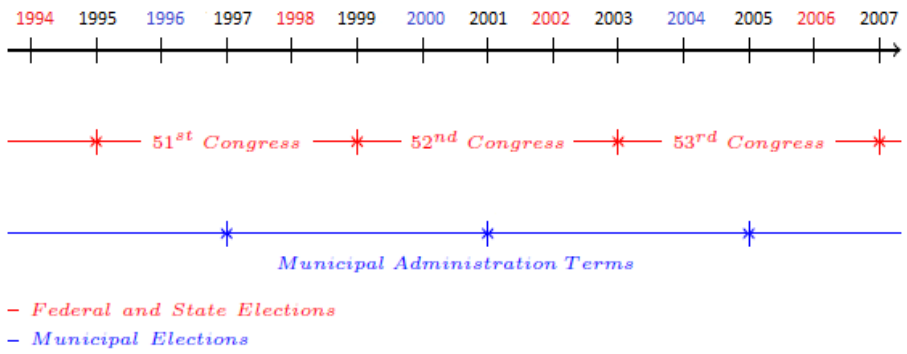
2.2 Electronic voting and political participation in Brazil

In Brazil, there are elections every other year as Figure 1 shows. For instance, in 1994, the federal elections elected the Federal and State Representatives; senators; governors and

[8] According to The Economist (2015), 38 countries use or has used mandatory voting in their elections.
[9] All Brazilian citizens, age 16 and older have the right to vote. Illiterate citizens are not mandated to vote.

president. Two years later, the municipal elections elected the municipal representatives and mayors.[10] EV was first implemented in the 1996 municipal level elections. All municipalities with more than 200,000 eligible voters and the states' capitals used the new technology.[11] In the 1998 federal elections all Brazilian municipalities with more than 40,500 eligible voters[12] used the electronic voting system. Finally, in the municipal elections of 2000 and all the following ones every Brazilian voter was able to electronically vote.

Figure 1: Timeline



As showed in the literature (Hidalgo, 2010; Moraes, 2012; Fujiwara, 2015), EV usage is responsible for an increase of 20 p.p. in the valid votes (correctly cast votes) to turnout ratio for federal and state representatives. In order to cast a vote for Representative before EV, one should clearly write the name or number of the candidate in the ballot. It could also be possible to write the name or number of the party, had the voter decided to vote directly to the party instead of one of its candidates. Therefore, knowing how to read in order to understand the instruction on how to

[10] Both municipal and federal elections grant a four years term to the ones elected (except senator that get an 8 year term). In addition, a two years distance separates these two elections.
[11] Only 57 municipalities used EV in 1996.
[12] Four states used EV in all their territories independent of the number of eligible voters (Rio de Janeiro, Amapá, Alagoas and Roraima).

cast a vote and where one should specifically write the name of the candidate in the ballot would be essential to correctly vote in Brazil.

The EV introduction made it easier for voters to cast a ballot. In the new system, the voter would only need to press the candidate's number on a numerical keyboard[13] and after verifying the picture of the candidate one was willing to vote for, it would be enough to press a green button to confirm the vote.[14] The only way one could not cast a vote, without being on purpose,[15] would be to type a candidate's number with no correspondence to any candidate and after reading in the screen warning "this number is wrong", the voter would have to press the green button anyway. As Hidalgo (2010) points out, the EV was considered a democratic progress since even the illiterates could press a number followed by the green button after seeing their preferred candidates' face on the screen.

The main four works on EV in Brazil are Hidalgo (2010), Moraes (2012), Fujiwara (2015) and Schneider (2016). All these works converge to the fact that EV has increased political participation.[16] The last three works also show, although in different ways, that EV had a larger impact on enfranchisement in municipalities with a larger rate of illiteracy.[17] Hidalgo (2010), focusing on federal representatives elections, shows that the party ideological choice (from left to right) suffered only a small effect due to EV that benefitted the right wing parties the most.

[13] Similar to a regular phone keypad commonly used in Brazil at the time according to Hidalgo (2010). Note that Brazilians are intensive users of cellular phones; by the end of November 2016 there were 248.4 million active cellular lines in Brazil, which corresponds to 1.2 cellular phone line per citizen in Brazil (http://www.teleco.com.br/ncel.asp).
[14] Fujiwara (2015) shows illustrations of the old ballot comparing it to the electronic one. It is also important to notice that the government had made TV advertisement teaching how to vote in the new system and trained people to help voters if something went wrong during the voting process in the Election Day.
[15] The voter could not cast a vote on purpose by pressing a white button (blank vote) followed by the green one to confirm it.
[16] By increasing the valid votes to turnout ratio close to 22%.
[17] Schneider (2016) also shows that EV had a larger impact on enfranchisement in municipalities with lower GDP per capita.

Schneider (2016) showed that places where clientelism have stronger ties in Brazil had a decrease in turnout due to EV, which benefitted the left wing parties because clientelism is strongly related to the right wing parties. Therefore, disenfranchisement helped the left wing parties. Moraes (2012) studies the increase in electoral competition resulted by the EV usage and Fujiwara (2015) focuses on the public health spending at the state level in Brazil showing that the larger the percentage of voters using EV within a state, the larger the amount of health spending and consequently the better the health outcomes in these places.

This article brings new results and intuition on how enfranchisement affects public spending. Differently from Fujiwara (2015), our work relies on municipal level data[18] and shows that not only health, but also public employment, education and the overall municipalities' public expenditures increase due to EV usage. Also, this work shows that the municipal revenue, mostly composed by federal and state transfers, of places that used EV in 1998 disproportionately increased explaining how these municipalities were able to spend more on public goods. Therefore, this work uses a larger sample and explains the connection between federal representatives and mayors. Finally, it also adds to the literature by testing empirically the predictions of the model presented in the following section and by incorporating the findings that EV decreased turnout in places where clientelism is stronger.

[18] Fujiwara (2015) analyses state level data (27 observations).

3 – The effect of electronic vote on the electoral outcome: A political economy model

3.1 Introduction

Section 3 builds a voting model aimed at better understanding the effect of EV on the electoral equilibrium. The model distinguishes to different stages of voters' decision; first, a voter decides whether to vote. Next, if the voter decides to vote, then she will decide to which party to vote for.

A voter's decision to vote is one of the most discussed issues both in Political Sciences and in Economics as well. Indeed, considering that there is a cost associated to voting, a rational agent will choose to vote only if she believes it is reasonably likely that her vote will change the electoral outcome. Chamberlain & Rothschild (1981) prove that under rather general conditions, the probability that a voter will cast the decisive vote in an election between two alternatives (parties) in which there are 2N+1 voters is of order N^{-1}. Therefore, in large elections the probability of a voter being pivotal is negligible.[19] But then, electoral participation should be reduced, as also suggested in Downs (1957, p. 260-276).

However, actual electoral data show a much higher level of electoral participation, even in countries where voting is not mandatory. For instance, the 2012 US presidential elections showed a record low participation level of 57.4%, which is much higher than social choice theories would predict.

[19] According to John Longredan, "[…]the chances of actually influencing an election are about the same as getting hit by lightning" (in Carey, 2008).

Both experimental and theoretic studies aim at understanding why people vote. Blais & Young (1999) conclude that a feeling of civic duty is a strong factor that makes people vote, based on an experiment conducted by the Canadian Electoral Commission. Schram & Winden (1991) present a theoretic model that also assumes the civic duty motive but adds the issue of group identification and the fact that the larger the number of votes a group obtains, the more it is able to affect public policy as well; it concludes that members of a group will pressure the other members to vote. This second theoretic motive for voting is supported by Schram & Sonnemans' (1996) experimental study. Edlin, Gelman & Kaplan (2007) present a model in which a citizen's utility has a social component, i.e., she cares about the other citizens' welfare; the model shows that there will be higher voting participation than when a citizen has the typical selfish utility. Harder & Kronick (2008) stresses that the social environment and the difficulties a citizen faces to vote (due to lack of literacy, for example) affect the willingness to vote. Finally, Feddersen & Sandroni's (2006) model assumes that citizens care about the aggregate social cost of voting and introduces the concept of "ethical rules" that determine which citizens will vote in equilibrium; the model endogenizes a concept similar to the exogenous concept of civic duty as part of the equilibrium solution.

In the present paper we use the concept of "willingness to vote" as a proxy for all the motives for voting described above. In our model each citizen i has a willingness to vote $v_i \in V \subset \mathbb{R}_+$. The willingness $v_i \geq 0$ represents the utility gain agent i receives when she votes, regardless of the final result of the election. Note that, since the citizen understands that her vote is insignificant, her decision on whether or not to vote depends on the comparison between the cost of voting and her willingness to vote. If the cost is lower than the willingness to vote, the agent

will then decide to participate and will vote sincerely, for the party that better represents her preferences.

Hence, our electoral analysis will be divided in two steps. In the first step, each citizen decides whether to vote, based on her cost to vote and on her willingness to vote. In the second step, those who decided to vote cast their ballots.

3.2. First step: The decision to vote

Primitives of the model

There is a continuum of agents of mass 1, $W = [0,1]$. Each agent $i \in W$ has a type $v_i \in V \subset \mathbb{R}_+$ – her willingness to vote. In particular, if $v_i = 0$, then agent i sees no value in voting. The willingness to vote v_i is a continuous random variable distributed in a non-negative set V according to the distribution $F(v_i)$.

If she decides to vote, citizen i will incur a cost $\kappa_i \in \mathbb{R}_+$. The cost reflects a number of components. Directly, it reflects the displacement costs, the opportunity cost of time, etc. Most importantly, it reflects the cost of gathering the information she needs in order to decide who to vote for, as well as preparing for filling properly the complex voting cell. This is the component that will matter in the present model as it may change according to the voting technology (discussed previously).

General electoral participation

An agent of type v_i and cost κ_i will decide to vote if and only if:

$$v_i - \kappa_i \geq 0. \qquad (1)$$

Let $E = \{i \in W | \, v_i - \kappa_i \geq 0\}$ be the set of voting citizens. Then the cardinality of E, $|E|$, corresponds to the proportion of voting citizens. Note that the higher the expected value of the willingness to vote, the higher the overall electoral participation, ceteris paribus. More importantly for the present study, the lower the voting costs, the higher the proportion of voting citizens, ceteris paribus.

An illustration of the voting costs associated to legal requirements can be found in Brazilian institutions. Before the 1988 Brazilian Constitution voters were required to be literate in order to vote; therefore, an illiterate citizen would have to first learn how to read and write in order to have access to voting. Similarly, before the 1960s several American States required citizens to pass literacy tests in order to vote; that, in practice, reduced the vote of the black citizens for whom these tests were typically difficult (Husted & Kenny, 1997).

These examples suggest that poorer citizens tend to have lower electoral participation. Indeed, several empirical studies suggest that this is the case, as reviewed in Bugarin & Portugal (2015). In what follows we include such a friction in the original model.

Different electoral participation by social classes

Suppose now that society is divided in three income classes. The low-income class *P* is formed of poorer citizens with income y^P. The middle-income class *M* congregates the middle class with income y^M and the high-income class *R* is composed of richer citizens with income y^R, where $y^P < y^M < y^R$. A class $J = P, M, R$ has mas $\alpha^J \in [0,1]$ where $\alpha^P + \alpha^M + \alpha^R = 1$.

Suppose now that there is total orthogonality between income and willingness to vote, so that the willingness to vote is distributed in each class according to the same distribution function $F(v_i)$. Furthermore, suppose for simplicity that all citizens sharing the same income class share

the same voting cost, i.e., $\kappa_i = \kappa^J$ for every citizen i class $J, J = P, M, R$. Finally, as discussed before, suppose that the cost of voting is higher for the low-income class, i.e., $\kappa^P > \kappa^M, \kappa^R$.

Therefore, $F(\kappa^J)$ corresponds to the percentage of citizens from class $J = P, M, R$ that gives up voting. Hence, $\alpha'^J = [1 - F(\kappa^J)]\alpha^J$ is the percentage of citizens that belong to class J and vote, $\eta^J = F(\kappa^J)\alpha^J$ is the percentage of citizens that belong to class J and do not vote, and $\alpha^J = \alpha'^J + \eta^J$.

The effect of the electronic vote on each class' electoral participation

Our model allows us to investigate the effect of EV on each income class. Suppose that class *P*, besides being the poorer class, is also the class with lowest literacy levels, so that, it is also the class with highest voting costs with the older voting technology, because it requires memorizing and writing down the candidates' names, as discussed earlier. Then, the percentage of electoral participation will be lower in class P $\left(\kappa^P > \kappa^M, \kappa^R \rightarrow 1 - F(\kappa^P) < 1 - F(\kappa^M), 1 - F(\kappa^R)\right)$.

What would be the effect of implementing EV? We expect that the EV will create the highest changes precisely in class *P* that has the highest rate of illiteracy. In that class, the easier voting technology will reduce voting costs, from κ^P to $\widetilde{\kappa}^P < \kappa^P$. As for the other classes, including citizens better able to read and write and with higher education levels, the effect of EV will be less significant. Hence, for simplicity we assume that EV does not affect the voting costs for the other two classes. Therefore, EV will allow higher participation rates for the poor class without significantly changing the participation rates in the remaining classes.

3.3. Second step: Electoral equilibrium with heterogeneous participation

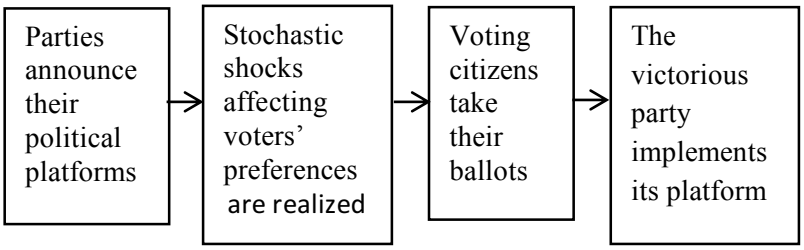
The basic ideas of the model

The electoral competition model presented here follows Bugarin & Portugal (2015). Two parties simultaneously announce political platforms. A platform consists of a provision of a public good that will be produced if the party wins the election. Production of the public good is totally funded by taxes to be collected from every citizen according to a single tax rate. Since society is composed of three income classes, all citizens from the same class will have the same preferences for public good provision. Furthermore, since all citizens benefit the same way from public good consumption but the poorer ones pay fewer taxes for its production, typically the poorer classes prefer more public goods than the rich ones.

A percentage of citizens in each class does not vote. Those who vote will vote sincerely, for the party that better represents his preferences. Citizens' preferences take into consideration parties' platforms but are also influenced by unpredicted stochastic factors that are orthogonal to the announced platforms. Examples of such factors are sexual scandals or a terrorist attack, among others.

Elections are held in one national electoral district in which each voter has one vote. After the elections, each party is assigned a quantity of seats in the Legislature that corresponds to the percentage of votes it received. After the new Legislature is formed, the party that has a majority of seats (we assume an odd number of seats) implements its campaign platform: taxes are collected and the public good is provided. Figure 1 presents the general form of the game. Note that only the first and the third boxes correspond to agents' decisions. Furthermore, decisions in the third box are straightforward since voting citizens vote sincerely. The details of the electoral competition game and its solution are presented next.

Figure 2 - The electoral competition game



The electoral completion game with heterogeneous participation[20]

Society is composed of three income classes, as previously described. Two parties $P=A$, B announce simultaneously a per capita level of provision of a public good, $g_J, J = A, B$, to be implemented by the winning party. Public good production is financed by an income tax collected according to the tax rate τ, common to all agents. All tax-collected resources are used for the public good's provision. Then the government budget constraint is given by the equation below, where $\sum_J (\eta^J + \alpha'^J)\, y^J = \sum_J \alpha^J\, y^J = y$ represents the average income of all citizens.

$$\tau \sum_J (\eta^J + \alpha'^J)\, y^J = \tau y = g. \qquad (2)$$

A voter's utility has two components: a pragmatic component and an ideological one. This is the most general way of characterizing an economic agent who also has political concerns; for more on this topic, see Ferejohn (1986), Bugarin (1999) and Bugarin (2003). The pragmatic or *economic* part of the utility represents the voter's decisions as a *homo œconomicus* and depends on the consumption of a private good, as well as the consumption of the public good. Thus, if a citizen of class J has private consumption c^J and public good consumption g, its utility is $c^J +$

[20] This section and the following section as well draw heavily on Bugarin & Portugal (2015).

$H(g)$ where H is a twice differentiable, strictly increasing, and strictly concave function. In the present model public good provision and the corresponding income tax rate are the result of the electoral process; therefore, the *homo œconomicus* will choose the highest possible private consumption, i.e., $c^J = (1-\tau)y^J$, and the resulting pragmatic component of his utility is:

$$(1-\tau)y^J + H(g). \qquad (3)$$

Hence, we can write that agent's pragmatic utility as $W^J(g) = (y-g)\frac{y^J}{y} + H(g)$. Therefore, her preferred public policy is:

$$g^{*J} = (H')^{-1}\left(\frac{y^J}{y}\right),\ J = P, M, R. \qquad (4)$$

Note that $g^{*P} > g^{*M} > g^{*R}$, i.e., the poorer a citizen is, the more favorable she is to public expenditure, as discussed before. This result is well known in the literature and has been carefully formalized in Meltzer & Richard (1981). It explains the increase in the size of governments throughout the 19th and 20th centuries as a consequence of the expansion of suffrage in the consolidating western democracies.

The ideological component of a voter's utility function reflects her concerns as a *homo politicus* and depends on two random variables corresponding to the voter's bias towards party *B*, or equivalently, party *B*'s popularity at the time the election is held.[21] The first random variable is common to all voters and relates to the realization of a state of nature that affects the entire population. A war, an abrupt change in international oil prices and a countrywide energy crisis are examples of such phenomena. A clear example is the popularity of the U.S. president after the

[21] Analogous results would obtain if we had set the bias with respect to party *A* due to the symmetry of the bias.

terrorist attack on September 11th, 2001, which increased from 57% in February to 90% in September.[22] We model that process with a random variable δ uniformly distributed on $\left[-\frac{1}{2\psi}, \frac{1}{2\psi}\right]$. The parameter ψ>0 measures the level of society's sensibility to these shocks: the lower the value of ψ, the more those shocks may affect society. To illustrate, price changes in oil may strongly affect the political equilibrium in a country that depends strongly on that product, such as Venezuela, and have much less effect in countries that produce near their internal demand levels, such as Brazil.

The second random variable is particular to each voter *i* in group *J* and reflects her personal bias towards party B. It relates to information about relevant politicians on issues that are not consensual in society, such as information that a candidate used drugs in his youth; some voters may believe that this fact makes the candidate unsuitable to a political leadership career, others may find no relation whatsoever with political career, others may even sympathize with the candidate. We model that bias as a random variable σ^{iJ} uniformly distributed on $\left[-\frac{1}{2\phi}, \frac{1}{2\phi}\right]$. Hence, the greater the parameter ϕ, the more homogeneous class J is.

Therefore, if party *B* wins a majority of seats in the Legislature with platform g^B, voter *i* in the social class J derives utility:

$$W^J(g^B) + \sigma^{iJ} + \delta. \qquad (5)$$

Note that it may be the case that the realization of δ is positive, whereas the realized value of σ^{iJ} is negative. Suppose, for example, that the GDP of a country increases above expectations,

[22] See "Poll Analyses", Section "Gallup Poll News Service", The Gallup Organization, http:/www.gallup.com, 09/24/2001.

which brings about overall support for the incumbent president's party, but the media releases the news of a sexual scandal in the presidential office, which may affect different voters in different ways.

The solution to the electoral competition game

We solve the game by backwards induction. Suppose party *P* announces policy g^P, *P* = *A*, *B*. Then, voter i in class *J* prefers party *A* to party *B* if and only if:

$$W^J(g^A) > W^J(g^B) + \sigma^{iJ} + \delta. \quad (6)$$

Then, the voter that is exactly indifferent between the two parties in class J corresponds to the realization σ^J of the random variable σ^{iJ} given by the following equation $\sigma^J = W^J(g^A) - W^J(g^B) - \delta$.

Since citizens vote sincerely, the number of votes party *A* receives is:

$$\pi^A = \sum_J \alpha'^J \cdot \text{Prob}\left[\sigma^{iJ} \leq \sigma^J\right] = \sum_J \alpha'^J \left[\sigma^J + \frac{1}{2\phi}\right]\phi = \sum_J \alpha'^J \sigma^J \phi + \frac{\alpha'}{2}. \quad (7)$$

Define $W'(g^A) = \sum_J \alpha'^J W^J(g^A)$ and $W'(g^B) = \sum_J \alpha'^J W^J(g^B)$. Then the probability of victory of party *A* is:

$$p^A = \text{Prob}\left[\pi^A \geq \frac{\alpha'}{2}\right] = \text{Prob}\left[\delta \leq \frac{1}{\alpha'}[W'(g^A) - W'(g^B)]\right]. \quad (8)$$

The above expression can be rewritten as:

$$p^A = \frac{1}{2} + \frac{\psi}{\alpha'}[W'(g^A) - W'(g^B)]. \quad (9)$$

By symmetry, the probability of victory of party *B* is:

$$p^B = \frac{1}{2} - \frac{\psi}{\alpha'}[W'(g^A) - W'(g^B)]. \quad (10)$$

Parties choose their announced platforms in order to maximize their probability of winning the election given by (9) and (10). Therefore, party *A* solves the following problem:

$$\max_{g^A} p^A(g^A, g^B) = \frac{1}{2} + \frac{\psi}{\alpha'}[W'(g^A) - W'(g^B)] \qquad (11)$$

$$\text{Subject to: } 0 \leq g^A \leq y.$$

Moreover, party *B* solves a completely similar problem. The solution to this platform announcement simultaneous game yields the same dominant strategy to both parties, given below, where $y' = \frac{\sum_J \alpha'^J y^J}{\sum_J \alpha'^J} = \frac{\sum_J \alpha'^J y^J}{\alpha'}$.

$$g^A = g^B = g^E = (H')^{-1}\left(\frac{y'}{y}\right). \qquad (12)$$

Note that income $y' = \frac{\sum_J \alpha'^J y^J}{\sum_J \alpha'^J} = \frac{\sum_J \alpha'^J y^J}{\alpha'}$ is a convex combination of each income class' income, in which the weights are the percentage of citizens in each class that really vote. Therefore, the higher the political participation in one class, the higher the weight parties give to that class' income and, thereby, the closer the equilibrium policy will be to that class' preferred policy.

For the sake of illustration, suppose that $\alpha'^P = \alpha'^M = 0$ and $\alpha'^R > 0$, i.e., only the rich citizens vote. Then, $\alpha' = \alpha'^R$, $y' = y^R$ and $g^E = (H')^{-1}\left(\frac{y^R}{y}\right) = g^{*R}$, so that the platform announced by each party is precisely the one preferred by the rich citizens. This explains again why there was so little redistribution in the past when voting rights were restricted to land owners.

3.4. The effect of electronic voting on the electoral equilibrium

Consider first the electoral equilibrium prior to EV. Recall that $\alpha'^J = [1 - F(\kappa^J)]\alpha^J,\ J = P, M, R$ and $\kappa^P > \kappa^M, \kappa^R$. Then we can write (with the subscript *b* for "before") as:

$$y'_b = \frac{\sum_J \alpha'^J y^J}{\alpha'} = \frac{\sum_J [1-F(\kappa^J)]\alpha^J y^J}{\alpha'} > \sum_J \alpha^J\, y^J = y. \quad (13)$$

Since $\alpha'^P < \alpha'^M, \alpha'^R$, then it follows that $g_a^E = (H')^{-1}\left(\frac{y'_a}{y}\right) < (H')^{-1}(1)$, i.e., public goods provision before EV is below what it would be if all citizens were voting. This is a direct consequence of the fact that precisely the poor citizens, who prefer more public goods provision, are the ones to present the lowest electoral participation.

Consider now the situation posterior to the introduction of EV. According to our model's assumption, κ^M and κ^R remain unchanged, whereas the cost parameter κ^P decreases to $\tilde{\kappa}^P < \kappa^P$. Then, using the subscript *a* for "after", we can write:

$$y'_a = \frac{[1-F(\tilde{\kappa}^P)]\alpha^P y^P + [1-F(\kappa^M)]\alpha^M y^M + [1-F(\kappa^R)]\alpha^R y^R}{[1-F(\tilde{\kappa}^P)]\alpha^P + [1-F(\kappa^M)]\alpha^M + [1-F(\kappa^R)]\alpha^R} <$$

$$\frac{[1-F(\kappa^P)]\alpha^P y^P + [1-F(\kappa^M)]\alpha^M y^M + [1-F(\kappa^R)]\alpha^R y^R}{[1-F(\kappa^P)]\alpha^P + [1-F(\kappa^M)]\alpha^M + [1-F(\kappa^R)]\alpha^R} = y'_b\,. \quad (14)$$

But then: $g_a^E = (H')^{-1}\left(\frac{y'_a}{y}\right) > (H')^{-1}\left(\frac{y'_b}{y}\right) = g_b^E$.

In other words, the new voting technology brings about a reduction in the cost of voting to the poor, which increases their participation and, thereby, increases the weight of their preferences in parties' calculations, thereby increasing the equilibrium provision of public goods.

This is the main conclusion of the present theoretic model. The main theoretic insight is that increasing *de jure* access to voting, by legally extending the suffrage to poorer citizens, is not

enough to ensure that the political parties will take these citizens' preferences into account. It is necessary that, in addition to having the right to vote, these citizens really exert that right. Only in the case where poorer citizens do participate strongly in the political arena by voting, will public policy reflect their preferences.

The main point of the present work is that, due to the high cost of voting to poorer, illiterate citizens in Brazil, their preferences were not fully considered until EV technology strongly increased their participation, changing the electoral equilibrium.

The empirical implication of the model and its testable hypotheses are straightforward: if the model does rightfully reflect the real situation, then, we should have observed a significant increase in the provision of public goods in Brazil after the implementation of EV. More specifically, since poorer citizens care more about social policy (health, education, cash transfers, etc.) we should have observed a clear increase in public spending in these areas.

The following sections test these hypotheses confirming that there was indeed a robust increase in social expenditure in Brazil after the advent of EV and that this increase is particularly strong in municipalities with higher numbers of illiterate citizens.

4- Data

We exploit publicly available data on local government spending.[23] Our main focus is on social expenses related to health and education services, and public employment. However, we also look at receipt of intergovernmental transfers, total budget, and total expenses. Intergovernmental transfers are selected because the Federal and State Representatives have

[23] The Brazilian National Treasury publishes detailed annual municipal expenditures. All variables on spending are in per capita values and have been deflated using the IGPM index (1994 is the base year).

connections with municipalities and disproportionately benefit the ones that are more likely to vote for them by sending these transfers (see Brollo & Nannicini, 2012 for a discussion on politically motivated transfers in Brazil). In addition, as discussed in Novaes (2015), mayors act as brokers for Representatives campaigning for them in exchange for financial support. Therefore, Representatives would be interested in transferring money to the municipalities with more valid votes to turnout ratio (positively related to EV usage), since the mayor will be able to deliver a larger amount of votes in exchange for these transfers. Finally, total budget and expenses shows the overall increase in social spending in response to enfranchisement.

As argued before, we are assuming that the mayor responds to the federal elections. To capture this, the present work uses the average spending in the two years after the federal elections, which are also the two years before the municipal elections. For instance, the 1998 federal elections' impact is measured by the average of the municipal public spending between 1999 and 2000. Places that used EV in 1998, and that therefore have extra political participation biased toward the poor, are expected to spend more on public goods provision between 1999 and 2000.

Usage of EV is identified by the municipalities' total registered electorate in 1996. Information on electorate in each municipality was obtained from the Supreme Electoral Court (TSE). In addition to the dummy used to identify EV usage, we control for a number of confounding factors: the percentage of votes for the incumbent mayor in the 1996 municipal elections; a dummy showing if the mayor's party is the same as the president or governor's coalitions at the time (for each respective state); the number of eligible voters; the average household monthly income per capita; the percentage of people living in rural areas; and the

illiteracy rate.[24] Lastly, we use a municipality ideological index, which is composed by a number ranging from 0 to 10 (where 0 is extreme left wing and 10 extreme right wing)[25] and is helpful to explain differences in municipal level spending.

5 - Two Stage Least Square Regression

5.1 Estimation Strategy

The natural regression to test the model presented above, would be the following one:

$$ln\, Y_m = \alpha + \beta_1 V_m + \beta_2 X_m + \epsilon_m \qquad (15)$$

where $ln\, Y_m$ is the logarithm of the average social spending between 1999 and 2000 in municipality m, V_m is the valid votes to turnout ratio for State Representatives in 1998, X_m contains the control variables and ϵ_m is the error term. However, two problems may arise with this model. First, the social spending between 1999 and 2000 may be correlated to past social spending which in turn increased V_m. For instance, suppose the spending in education between 1999 and 2000 is correlated to the spending in education in the past 10 years. If this is true, then previous spending on education would benefit the poor by giving them access to schooling and also help them to be enfranchised as they could cast a vote. The estimated return to enfranchisement would then be biased due to this reverse causality – bringing an overestimated β_1. Secondly, omitted variables such as the measurement of the median voter income may also bias the results. Valid votes by itself may not show poor voter enfranchisement. It could be the case that the municipality has a

[24] Data on electoral outcomes and mayor's party affiliation were obtained from the TSE. The demographic data were made available by Ipeadata, and are based on the decennial data collected in 1991 and 2000. Therefore, 1991 and 2000 has become a proxy for 1994 and 1998 respectively.
[25] The construction of this index can be found at Schneider (2016)

large valid vote to turnout ratio because most citizens are rich and can therefore cast a vote. This could underestimate our results since large number of valid votes would show smaller preferences for redistribution.

To solve these problems, we estimate the following 2SLS model:

$$V_m = \mu + \pi_1 D_m + \pi_2 X_m + u_m \qquad (16)$$

$$ln\, Y_m = \delta + \lambda V_m + \Lambda X_m + \varepsilon_m \qquad (17)$$

where D_m is a dummy variable indicating if municipality m used EV. The difference between equations (15) and (17) is that λ measures the impact of the estimated valid votes to turnout ratio captured by equation (16). Therefore, the instrumented valid votes to turnout ratio in equation (17) impacts social spending only through the enfranchisement brought by EV that is biased toward the poor voters. Since the number of eligible voters is by definition related to EV usage, there are no controls for number of voters. To compensate for this fact, the regressions are restrained to a small interval close to the cutoff for EV usage (40,500 voters) so the municipalities can be comparable.[26] The results are presented next.

5.2 Results

Table 1 shows the estimations for a closed interval of municipalities containing between 35,500 and 45,500 voters.[27] An increase of 10 p.p. in the valid votes to turnout ratio increases

[26] Note that municipalities belonging to the four states mentioned earlier (Rio de Janeiro, Amapá, Roraima and Alagoas), used EV even if they had less 40,500 voters.
[27] Increasing the interval to a bandwidth of 15,000 voters increases the significances of the results.

health spending by 16.5%; public employment by 7.1%; total spending by 9.9%; total revenue by 9.5% and intergovernmental transfer by 14.5%.

Table 1 – Enfranchisement of the poor and local government finances, 2SLS estimates

	Health	Education	Public Employment	Total Spending	Total Budget	Intergovernmental Transfers
V_m	1.657**	0.319	0.714*	0.992**	0.951**	1.449***
	(0.672)	(0.519)	(0.392)	(0.437)	(0.426)	(0.375)
Observations	116	116	115	116	116	116
R-squared	0.56	0.57	0.65	0.61	0.58	0.50

Notes: Robust standard errors clustered at the Brazilian state level are reported in parenthesis. All regressions control for average household monthly income per capita and use state fixed effects. All regressions use a bandwidth of 5,000 voters. *** p<0,01, ** p<0,05, * p<0,1.

Although the municipalities are likely to be similar, one can still argue that the results are driven by the lack of control for population. The next section presents a robustness check to increase the confidence in the presented results.

5.3 Robustness Checks

The robustness check for this section comes from a falsification test that does a series of similar regressions as the ones mentioned above, but using the municipal social spending variables after the 1994 and 2002 elections as dependent variables. As presented in Table 2 (in Panels A and B), these two sets of regressions show no significant effect on social spending due to the EV usage, with the exception of public employment and intergovernmental transfers in 2002. This is expected given that there were no differences on voting systems adopted between the municipalities in the considered years (either no one used EV or every municipality used it).

Table 2 – Falsification tests:

	Health	Education	Public Employment	Total Spending	Total Budget	Intergovernmental Transfers
Panel (A): 1994 elections and municipal spending between 1995 and 1996						

V_m	25.25	18.24	9.38	13.29	14.16	18.88
	(33.43)	(22.51)	(13.02)	(15.82)	(16.50)	(26.40)
Observations	116	117	116	116	116	115
Panel (B): 2002 elections and municipal spending between 1995 and 1996						
V_m	12.31	9.938	14.84*	11.89	10.02	14.09*
	(10.38)	(8.548)	(8.470)	(7.995)	(7.587)	(7.782)
Observations	117	117	117	117	117	117

Notes: Robust standard errors clustered at the Brazilian state level are reported in parenthesis. Regressions for the Placebo 1994 control for average household monthly income per capita (for the year of 1991) and regressions for the Placebo 2002 control for the 2002 GDP per capita. All regressions use state fixed effects. Wald Chi-Square test for all Placebo 1994 regressions do not allow one to reject the hypothesis that at least one of the predictors' regression coefficient is not equal to zero. All regressions use a bandwidth of 5,000 voters. *** p<0,01, ** p<0,05, * p<0,1.

The 2SLS estimates presented above empirically confirms the prediction of the model presented in section 3. However, it has some limitations. First, it has a small sample. Second, although the difference between the number of eligible voters is small across municipalities close to the cutoff, the regressions do not control for it due to the high correlation between the number of eligible voters and the instrument EV usage (correlation close to .70 for the 5,000 bandwidth considered). The differences-in-differences methodology is used next to check the robustness of the results by introducing a larger sample analysis.

6 - Differences-in-Differences

6.1 Estimation Strategy

An alternative way to test our hypothesis is to use the differences-in-difference (DID) methodology. As mentioned before, this method compares municipalities that used EV (the treatment group) to the ones that did not (the control group). It then presents the differences in public spending between two periods, before and after the EV usage, within these two groups as

the following regression shows:

$$ln(y_{it}) = \beta_0 X_{it} + \beta_1 (Year_t * EV_i) + \beta_3 \text{Year} + \beta_4 EV_i + \epsilon_{it}, \quad (18)$$

where $Year_t$ is a dummy variable equal to 1 when $t = 1998$ and EV_i is a dummy variable equal to 1 for municipalities that have used EV. For this estimation we restrict the EV usage to the four states that had electronic voting is all its territory. Therefore, we can have a sample that covers most Brazilian municipalities and that at the same time have on average the same number of voters than the control group has.[28] The vector X_{it} includes all control variables that vary across time and municipalities (such as average income and number of eligible voters). The dependent variable y_{it} corresponds to the *per capita* social public spending (such as health and education) and ϵ_{it} represents the error term. The coefficient β_1 is the parameter of interest that captures the effect of EV on municipal public spending.

The following assumptions are made about the estimations. First, as the EV was implemented partly in the 1998 federal elections, we assume that the local administrations observe the change in the political participation for these elections and answer to it based on the median voter's choice. Second, we assume that non-observed variables that vary across time are orthogonal to the variable of interest.[29] Third, the selection of the four states which used EV in all its territory was not driven by political interests. As Fujiwara (2015) points out: "Two remote states largely covered by the Amazon forest (Amapá and Roraima) were chosen to check the electoral authority's ability to distribute EV in isolated areas, while the states of Rio de Janeiro and Alagoas had areas where the army provided security to election officials, allowing an opportunity to check

[28] If we were to consider all municipalities that used EV in 1998, our treatment group would have municipalities where the number of eligible voters will vary from 947 to 7,131,342. On the other hand, the control group will have less than 40,500 eligible voters in all its municipalities.
[29] See Angrist & Krueger (1999) for a complete discussion on the DID methodology.

the logistics of distributing the electronic devices jointly with the military" (p.431). Therefore, there seems to be no political motivation behind the EV usage selection. Fourth, the control and treatment group do not present significant differences due to the EV usage on variables that are not likely to be affected by it. Table 3 presents a balance check to support the argument.

Table 3 shows that the EV usage affected the valid votes to turnout ratio for federal and state representatives increasing it by 22 and 14 percentage points respectively. This should be expected based on the previously mentioned literature on EV in Brazil.[30] Before testing whether the EV usage is affecting the municipal level of public spending, Figure 4 (below) motivates the DID methodology to be applied.

As it can be observed, between 1999 and 2000 (year of the municipal election) there is a clear increase on public spending (for all variables considered) disproportionately larger on municipalities that used EV in 1998. It is interesting to notice that not only the electoral spending cycle on municipal elections exist (1996, 2000 and 2004), but also that in 1996 it was disproportionately larger on municipalities that did not use EV (public employment spending is the only exception) making it stronger the argument that the EV has changed the municipal social spending. In 2004, there is a clear pattern in public spending that is similar for both groups, which can be explained by the leveling on political participation in all municipalities brought by the general usage of EV since 2000.

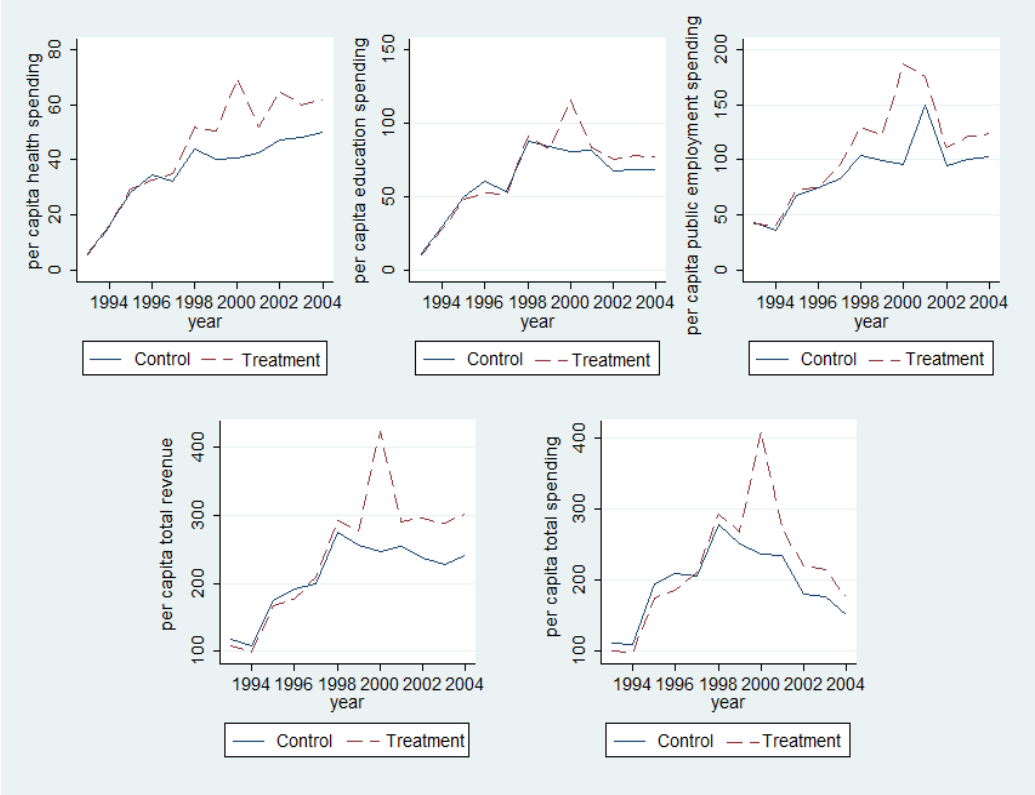
[30] However, EV usage also decreased turnout as showed in Schneider (2016) work. This should be a concern to our measurement because the turnout was reduced especially in places where clientelism is stronger (Schneider 2016), which are poorer places. Therefore, our estimations could be underestimated as the impact of EV on social spending would be even larger had those poorer voters participated in the election. This will be further discussed in this section.

Table 3 – DID estimation showing that the treatment and control group have not changed across periods

	Valid Votes Fed	Valid Votes ST	Rural	Income	Voters	HDI	Illiterates	Turnout
EV*Year=1998	0.227***	0.141***	0.025	-14.8	571.1	0.005	-1.72	-0.064***
	(0.025)	(0.02)	(0.024)	(11.91)	(369.4)	(0.006)	(1.15)	(0.023)
Observations	9,760	9,760	10,222	10,222	9,761	10,222	10,222	9,761
R-squared	0.48	0.52	0.25	0.61	0.09	0.79	0.75	.48

Notes: All regressions use state fixed effects. Standard errors, clustered by mesoregion, are presented in parenthesis. All regressions are controlled for a dummy identifying EV usage (collinear to the state fixed effects) and a dummy identifying the year of EV usage. Regression (1), (2), (3), (4), (5), (6) and (7) consider the valid votes to turnout ratio for federal representatives; state representatives; percentage of people in the municipality living on rural areas; average income; number of voters; human development index and percentage of illiterate adults. The sample considers municipalities with more than 1245 and less than 40500 voters. *** p<0,01, ** p<0,05, * p<0,1.

Figure 4 – Per capita average spending on health; education; public employment, total revenue and total spending (all values are deflated) between 1993 and 2004 comparing the municipalities that used EV in 1998 (treatment) and the ones that did not (control).



The smallest 10% municipalities were dropped to attenuate the per capita spending on the smallest municipalities. The analysis is restricted to municipalities with less than 40,500 voters. 4577 municipalities (82% of the total Brazilian municipalities) are covered in this representation.

6.2 Results

The DID estimation results are presented in Table 4, Panel A. Columns (1), (2) and (3) show respectively, the results obtained for social spending on health, education and public employment. Columns (4) and (5) take into account, respectively, municipal total spending and budget. Finally, Column (6) shows the intergovernmental transfers, both national and subnational (state), received by municipalities. EV usage, therefore, is responsible for an increase in the total spending on health, education and public employment respectively by approximately 28, 20 and 22 percent.[31] Total spending, revenue and intergovernmental transfers have also increased respectively by approximately 22, 20 and 17 percent.

The intergovernmental transfer variable helps to explain how municipalities can get more revenue in order to spend on social expenditures. As Brollo & Nannicini (2012) argue, these transfers are extremely relevant since it accounts, on average, for 65% of the municipal budget. However, parts of these transfers are constitutional automatic transfers such as the Fundo de Participação dos Municípios - FPM. Therefore, it could be the case that the municipalities that used EV in 1998 were disproportionately favored by the FPM, main source of revenue for small municipalities[32] and this could be driving our obtained results. The estimates presented in Table 4 control for the amount of money received by the FPM in each municipality which makes the coefficients to be even larger showing evidence that not taking this transfer into account was actually downward biasing the results.

[31] A 28% increase on health spending, for instance, would be equivalent to an increase of 33R$ (or 16$) per capita.
[32] According to IBGE (the Brazilian institute of geography and statistics), municipalities with less than 5,000 citizens, between 1998 and 2000, got on average 57.3% of their revenue from FPM.

Table 4 - Panel B shows the result for a similar exercise, however, instead of comparing the public spending after the 1994 and 1998 elections, this DID analysis takes into account the elections of 1998 and 2002. For this counter factual analysis one should expect the sign of the coefficient (β_1) to be negative since the municipalities that did not use EV in 1998 are presumably going to catch up after using the new system. Nonetheless, as EV was used by all Brazilian municipalities in 2000, one cannot isolate its impact on public spending as clear as before. After all, one cannot argue that the 2002 elections have enfranchised voters through EV introduction. The result shows that public spending on health was the only variable to get a negative and significant sign. The remaining coefficients that presented significant results were positive, but their magnitudes are much smaller than before.

Table 4 - Estimating the relationship between the logarithm of the municipal spending on public goods (such as health and education) and the EV usage using the DID methodology.

VARIABLES	(1) Health	(2) Education	(3) Public employment	(4) Total spending	(5) Total revenue	(6) Intergovernmental transfers
Panel A: 1995-1996 vs. 1999-2000						
EV*Year=1998	0.288***	0.200***	0.229**	0.228***	0.202***	0.178***
	(0.086)	(0.048)	(0.103)	(0.035)	(0.032)	(0.033)
Observations	8,102	8,124	9,386	9,051	9,053	9,393
R-squared	0.39	0.53	0.62	0.62	0.66	0.75
Panel B: 1999-2000 vs. 2003-2004						
EV*Year=2002	-0.101**	0.078*	-0.034	0.010	0.036**	0.017
	(0.042)	(0.042)	(0.056)	(0.022)	(0.016)	(0.016)
Observations	8,086	8,095	9,887	9,989	9,993	9,895
R-squared	0.41	0.47	0.60	0.72	0.70	0.77

Notes: All regressions use state fixed effects. Standard errors, clustered by mesoregion, are presented in parenthesis. All regressions are controlled for income, number of voters, FPM transfers and a dummy identifying EV usage (collinear to the state fixed effects). Regression (1), (2), (3), (4), (5), and (6) consider the logarithm of per capita municipal spending on health; education; public employment, total spending, total revenue and total intergovernmental current transfers. The sample considers municipalities with more than 1245 and less than 40500 voters. *** p<0,01, ** p<0,05, * p<0,1.

Table 4 - Panel A results are close to the one presented in section 5. An interesting exercise can be done by considering Table 3 estimations showing an increase of 14 p.p. in the valid votes to turnout ratio for State Representatives. Plugging this value on Table 1 gives the following result: An increase of 14 p.p. in the valid votes to turnout ratio increases health spending by 23.1%; public employment by 10%; total spending by 13.9%; total revenue by 13.3% and intergovernmental transfer by 20.3%. This exercise brings confidence in the results presented in section 5 and also provides external validity to those estimations.

Finally, we address the problem of a lower turnout caused by EV usage. As argued by Schneider (2016), EV caused lower turnout specially on places where clientelism is strong, which are the poorer municipalities. In order to test if this is also the case for our restricted sample, we measure whether turnout had a larger decrease on places with below median income. Table 5 present the results and as column 1 shows, there was no change in turnout in municipalities with above-median income although they had a large increase in enfranchisement (close to 20 p.p. increase in valid votes to turnout ratio). However, places with below median income had a large decrease in turnout due to EV (close to 10 p.p.) together with a considerable increase in valid votes to turnout ratio (25 p.p.). Therefore, Schneider (2016) argument holds in our restricted sample and allow us to isolate the impact of enfranchisement on social spending if we consider only the above median income municipalities, which had no change in turnout.

Table 5 - Estimating the impact of EV on turnout and valid votes to turnout ratio

	Turnout		Valid votes to turnout ratio	
VARIABLES	Above-median Income	Below-median Income	Above-median Income	Below-median Income
EV*Year=1998	0.003	-0.102***	0.199***	0.253***
	(0.023)	(0.014)	(0.021)	(0.036)
Observations	5,021	4,740	5,021	4,739

R-squared	0.527	0.413	0.549	0.456

Notes: All regressions use state fixed effects. Standard errors, clustered by mesoregion, are presented in parenthesis. All regressions are controlled for income, number of voters and a dummy identifying EV usage (collinear to the state fixed effects). Regression (1) and (2) consider the different impact of EV on turnout between above and below-median income. Regression (3) and (4) consider the different impact of EV on valid votes to turnout ratio between above and below-median income. The sample considers municipalities with more than 1245 and less than 40500 voters. *** p<0,01, ** p<0,05, * p<0,1.

By splitting the sample between above and below median income we are able to test the impact of EV on social spending in these two different samples. Table 6 presents the results and as it can be noticed, the impact of EV on social spending was much larger in places with above-median income (Panel A) than in municipalities with below-median income (Panel B). This important finding corroborates our hypothesis that our previous estimations (on Table 4 – Panel A) could be underestimated because the lower turnout biased toward poor voters would decrease the total amount of social spending as our model predicts. Therefore, had the turnout not changed due to EV, the increase in social spending would have been much larger. Finally, we next present robustness checks to give more confidence in our results.

Table 6 - Estimating the relationship between the logarithm of the municipal spending on public goods and the EV usage (splitting the sample between above and below-median income).

VARIABLES	(1) Health	(2) Education	(3) Public employment	(4) Total spending	(5) Total revenue	(6) Intergovernmental transfers
Panel A: Above-median income						
EV*Year=1998	0.338**	0.206***	0.197**	0.330***	0.330***	0.283***
	(0.157)	(0.060)	(0.096)	(0.061)	(0.062)	(0.061)
Observations	4,497	4,508	4,946	4,893	4,894	4,949
R-squared	0.357	0.460	0.465	0.503	0.538	0.649
Panel B: Below-median income						
EV*Year=1998	0.182**	0.118**	0.185*	0.117***	0.076**	0.077***
	(0.076)	(0.054)	(0.098)	(0.031)	(0.031)	(0.023)

Observations	3,605	3,616	4,440	4,158	4,159	4,444
R-squared	0.341	0.551	0.618	0.631	0.707	0.830

Notes: All regressions use state fixed effects. Standard errors, clustered by mesoregion, are presented in parenthesis. All regressions are controlled for income, number of voters, FPM transfers and a dummy identifying EV usage (collinear to the state fixed effects). Regression (1), (2), (3), (4), (5), and (6) consider the logarithm of per capita municipal spending on health; education; public employment, total spending, total revenue and total intergovernmental current transfers. The sample considers municipalities with more than 1245 and less than 40500 voters. *** p<0,01, ** p<0,05, * p<0,1.

6.3 Robustness Check

The next analysis shows how intergovernmental transfers are politically motivated. This can help us understand how municipalities that used EV were able to afford spending more on social policies. Even if the mayor had decided to increase social public spending he (or she) would need to get more revenue. If the intergovernmental transfers in Brazil are politically motivated, as argued by Brollo & Nannicini (2012), then places that used EV should have access to larger transfers. As argued before, the mayors act as brokers for the federal (and state) representatives, which are the ones that have access to these transfers and benefit mayors that can help them to get reelected.

Table 7 shows the negative relationship between voting more for the right wing parties' candidates and social spending. The interaction variable between municipal ideology and EV usage has no significant effect. The variable called "share" shows how much of the total vote was given to the current mayor, so this variable does not change across time. As one can notice, the interaction between this variable and EV usage is positive and significant for education, total revenue and intergovernmental transfer. Interestingly, this interaction squared is negative for these variables showing negative marginal returns to share of votes. This can be an indication that places where the elections are more contested are the ones where the mayor needs to make a larger effort

to be reelected.[33] Finally, a dummy indicating if the mayor represents the same party of the governor or the president and his coalition formed after the 1998 elections shows a positive and significant increase in public employment, total spending, total revenue and intergovernmental transfers only for municipalities that used EV.

Table 7 - **Estimating how the logarithm of the municipal spending on public goods (such as health and education) and transfers are politically motivated**.

VARIABLES	(1) Health	(2) Education	(3) Public employment	(4) Total spending	(5) Total revenue	(6) Intergovernmental transfers
EV*Year=1998	0.269***	0.179***	0.205**	0.213***	0.192***	0.172***
	(0.080)	(0.048)	(0.097)	(0.032)	(0.030)	(0.031)
Ideology	-0.038**	-0.030**	-0.061***	-0.029**	-0.025**	-0.026**
	(0.017)	(0.014)	(0.016)	(0.012)	(0.011)	(0.011)
EV*ideol.	0.005	-0.02738	-0.03912	-0.03034	-0.01505	-0.00762
	(0.056)	(0.02677)	(0.03970)	(0.02805)	(0.02454)	(0.02115)
Share	-0.0001	0.0001	-0.0001	0.0002***	0.0002***	0.0002**
	(0.0002)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0001)
EV*Share	0.001	0.019***	-0.007	0.005	0.010*	0.008*
	(0.016)	(0.007)	(0.010)	(0.005)	(0.005)	(0.004)
$(EV*Share)^2$	0.0000	-0.0001***	0.0001	-0.00004	-0.0001	-0.0001
	(0.0002)	(0.00005)	(0.0001)	(0.00005)	(0.00005)	(0.00004)
Coalition	0.004	0.012	0.010	-0.001	0.005	0.008
	(0.017)	(0.010)	(0.011)	(0.008)	(0.008)	(0.007)
EV*coalit.	0.149	0.077	0.130***	0.095**	0.073*	0.059*
	(0.111)	(0.048)	(0.048)	(0.040)	(0.039)	(0.035)
Observations	8,024	8,045	9,234	8,925	8,927	9,241
R-squared	0.39	0.53	0.62	0.62	0.66	0.75

Notes: All regressions use state fixed effects. Standard errors, clustered by mesoregion, are presented in parenthesis. All regressions are controlled for income, number of voters, FPM transfers and a dummy identifying EV usage (collinear to the state fixed effects). Regression (1), (2), (3), (4), (5), and (6) consider the logarithm of per capita municipal spending on health; education; public employment, total spending, total revenue and total intergovernmental current transfers. The sample considers municipalities with more than 1245 and less than 40500 voters. *** p<0,01, ** p<0,05, * p<0,1.

Next we focus on two additional robustness checks: One to show that the municipal representatives were also affected by EV usage and another to show that the previous findings are

[33] Federal or state representatives would be interested in helping the mayor by sending intergovernmental transfers so he (or she) can campaign for them in the federal elections two years later.

robust to different timing selection. The first robustness check, therefore, argues that the municipal elections were also affected by the EV usage. This is pertinent because it brings support to another mechanism on how the mayors increased social spending. Municipal representatives, interested on poor voters that are now enfranchised, would support the mayor's decision of increasing social spending. Since there is no study showing that the vote for municipal representatives were also impacted by the EV usage, this work used a regression discontinuity design (RDD), as in the previous literature (Fujiwara 2015; Schneider 2016), to show that the valid vote to turnout ratio for municipal representatives also increased due to EV.

The sample selected takes into account the 1996 elections where State Capitals and municipalities that had more than 200,000 voters were able to use EV. As most states, 17 out of 26, used EV only in one municipality and there were State Capitals with less than 200,000 voters (e.g. Palmas-TO with only 42,313 voters), this work selected the São Paulo state to do the RDD analysis. Almost 23% (13 out of 57) of the municipalities that used EV in 1996 belonged to São Paulo state and there were enough number of municipalities close to the cutoff to be considered[34] (not the case for the remaining states). Table 8 shows that there was an increase close to 10 percentage points in the number of valid votes to turnout ratio for municipal representatives due to the EV usage.

[34] The balance check considering number of voters and average income shows that the cutoff by itself does not bring differences between the municipalities that used EV and the remaining ones.

Table 8 - Estimating the impact of EV usage on valid votes to turnout ratio for municipal representatives on the municipal elections of 1996.

VARIABLES	Valid Votes to turnout ratio (1)	Valid Votes to turnout ratio (2)	Valid Votes to turnout ratio (3)
EV	0.090***	0.101***	0.095***
Observations	24	22	20
R-squared	0.65	0.78	0.78

Notes: Robust standard errors presented in parenthesis. All regressions are controlled for income, number of voters, number of voters minus the cutoff and an interaction between the former variable and EV usage. Regression (1), (2) and (3) consider respectively municipalities with more than 120,000; 130,000 and 140,000 voters. *** p<0,01, ** p<0,05, * p<0,1.

Finally, Table 9 shows that the timing chosen for our estimations does not change the significance or sign of our results. This table presents a DID that compares the average of municipalities social spending between 1999 and 2000 (after federal elections) and compare it to the average on social spending between 1997 and 1998 in order to guarantee that the mayor is the same between these two periods. As one can notice, although the coefficients are attenuated, they remain being positive and significant.

Table 9 - Estimating the relationship between the logarithm of the municipal spending on public goods (such as health and education) and the EV usage using the DID methodology, but changing the time framing.

VARIABLES	(1) Health	(2) Education	(3) Public employment	(4) Total spending	(5) Total revenue	(6) Intergovernmental transfers
EV* Year = 2000	0.220**	0.111**	0.120**	0.135***	0.118***	0.088***
	(0.093)	(0.046)	(0.048)	(0.024)	(0.026)	(0.028)
Observations	9,829	9,853	9,878	9,884	9,886	9,886
R-squared	0.45	0.60	0.67	0.73	0.75	0.78

Notes: All regressions use state fixed effects. Standard errors, clustered by mesoregion, are presented in parenthesis. All regressions are controlled for income, number of voters, FPM transfers and a dummy identifying EV usage (collinear to the state fixed effects). Regression (1), (2), (3), (4), (5), and (6) consider the logarithm of per capita municipal spending on health; education; public employment, total spending, total revenue and total intergovernmental current transfers. The sample considers municipalities with more than 1245 and less than 40500 voters. *** p<0,01, ** p<0,05, * p<0,1

7 - Conclusion

This paper has shown that voters' enfranchisement in Brazil, concentrated on the poor and illiterates, which were less likely to correctly cast a ballot before the electronic voting (EV) introduction, increased the amount of social public spending on health, education and public employment by 28, 20 and 22% respectively. In addition, municipalities total spending, total revenue and total intergovernmental current transfers also disproportionately increased in municipalities using EV by 22, 20 and 17% respectively. This empirical result corroborates our model prediction that suggests larger public provision in municipalities using EV. This paper also considered Schneider's (2016) finding that EV reduced turnout in areas where clientelism is stronger (poorer places), which according to our investigation made our estimations underestimated. Therefore, had EV not changed turnout, the impact of EV on social spending would be even larger than the number we found on our main estimation. The main contribution of the present work is therefore to show the consequences of enfranchisement on public spending and shed a light on the impact of a larger turnout in democracies where the vote is not mandatory. When electoral participation in a country is low, the level of public spending might not represent the choice of the majority of its citizens diminishing the strength of the democracy. Finally, this work has also brought additional evidence on politically motivated intergovernmental transfer and social public spending.

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