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Does Enfranchisement Affect Fiscal Policy?

Theory and Empirical Evidence on Brazil

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Abstract This paper studies the effect of political participation on public spending at the local level in Brazil. In particular, we look at the phased-in implementation of electronic voting in the late 1990s—which enfranchised poorer voters by decreasing the number of invalid votes—to identify the causal effect of political participation on public spending. We build a theoretical political economy model which allows voters to cast, not purposefully, an invalid vote, and show that when poorer voters' likelihood of casting a valid vote increases, public social spending increases as well. We test this prediction empirically using a difference-in-differences model where municipalities using electronic voting constitute our treatment group. We find that an increase of 1 percentage point in the valid vote to turnout ratio for state representatives increases health spending by 1.8%; education by 1.4%; public employment by 1.25%; intergovernmental transfers by 1%; and local taxes by 2.6%.

Keywords Electronic voting · Political participation · Social public spending · Difference-in-differences

JEL Classification: H21 · H4 · H5 · H7

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1 Introduction

If all citizens can freely enjoy publicly provided goods the same way, then enfranchisement of poorer voters decreases the income of the median voter and increases public spending. This result follows from the fact that richer voters disproportionately finance publicly provided goods. Meltzer and Richard (1981) exposed this argument theoretically using a political economy model of tax redistribution. Although the theory is intuitive, it is not trivial to empirically test it. The main challenge is to identify the direction of causality, since an increase in public spending could incentivize low income voters to turnout and support incumbent politicians that better represent their fiscal policy preferences.

There is evidence both in favor and against the prediction that enfranchising poorer voters increases public spending. Hodler, Luechinger and Stutzer (2015) finds that enfranchisement of less educated voters decreased government welfare spending and business taxation in Switzerland. The authors argue that this is because less educated voters are more impressionable by political campaigns, which are financed by interest groups demanding lower taxation. Hoffman, León and Lombardi (2017) show that, in Austria, making voting compulsory increased turnout but not government spending. They explain this result by showing that newly enfranchised voters had low-interest in politics. In the other direction, several authors show empirical evidence corroborating Meltzer and Richard's (1981) model (see Lindert 2004; Brown and Hunter 1999; Husted and Kenny 1997). However, as Alesina and Giuliano (2011) argue, all these empirical works may suffer from endogeneity as public spending may cause voting turnout. Cascio and Washington (2013) and Fujiwara (2015) solve this issue using shocks of poorer voters' enfranchisement (i.e., enfranchisement of black voters in the U.S. in the former and introduction to electronic voting in Brazil in the latter) to show empirical evidence that confirms the argument in Meltzer and Richard (1981).

In this work, we take advantage of the introduction of electronic voting (EV) in Brazil—which made casting a valid vote easier, especially among low income voters—as an exogenous shock to identify the impact of enfranchisement biased toward poorer voters on public spending. Differently from Fujiwara (2015) who also uses electronic voting in Brazil to study the impact of enfranchisement on public spending, this work contributes to the literature in at least three ways. First, we present a theoretical model showing that voting turnout only influences policy makers' choice of redistributive taxation when voters are able to cast a valid vote. Second, we estimate the magnitude of an increase in voting turnout on fiscal policy by expanding Fujiwara's (2015) analysis to local governments and to other public spending outcomes.[1] Third, we use a difference-in-differences (DID) setup analyzing fiscal policies at the

[1] In Fujiwara (2015), the Brazilian states are the unit of analysis and the impact of poor citizens' enfranchisement is measured against health spending and health outcomes only.

municipality level in a context where voting is mandatory, and a specific group was disproportionately affected by EV. Hodler et al. (2015) and Hoffman et al. (2017) also use a DID setup to deal with endogeneity, however, their data examine state level expenditures and focus on a policy that did not target a group with specific policy preferences as the case we analyze. Moreover, the fact that voting in Brazil is mandatory makes voting turnout high and mitigates attrition bias. Finally, as electronic voting disproportionately enfranchised poor and less educated voters, we can also explore heterogeneous effects of the new technology across socio-economic groups.

In addition to contributing to the literature on voting and redistribution, our paper also speaks to the literature on voting costs. In his seminal work, Downs (1957) explains the decision to vote through a cost-benefit analysis, whereby a citizen balances the benefits of having her candidate win, weighted by the probability of being a pivotal voter, and the cost of turning out to vote. As the probability that an individual vote matters is extremely low, the level of turnout should be smaller than it is in most democracies. Riker and Ordeshook (1968) explain this paradox by including a variable into the model that captures the sense of civic duty. If this variable is large enough, then the benefit to vote can offset the cost. A more recent literature explaining the decision to vote includes psychological attitudes such as social norms (Blais and Young 1999; Schram and Winden 1991; Schram and Sonnemans 1996; Edlin, Gelman and Kaplan 2007; Feddersen and Sandroni 2006). The main prediction of these theoretical models is that decreasing the cost of voting increases turnout.

There is also a growing empirical literature measuring the effect of voting costs on turnout. Fujiwara, Meng, and Vogl (2016), for example, find empirical evidence that rainfall on current election days, as well as on past election days through habit formation, reduces voter turnout. Hassell and Settle (2017) find that life stress reduces turnout for those individuals who are not routinely involved in the electoral process. Bhatt, Dechter, and Holden (2019) find statistical evidence that reducing registration costs increases both voter registration and voter turnout. Furthermore, the paper "highlights the importance of voter registration costs for electoral participation, especially for citizens from lower socioeconomic backgrounds." Braconnier, Dormagen, and Pons (2017) conduct a large-scale experiment in the 2012 French presidential and parliamentary elections and find a similar result. They assign 20,500 households to one control group or six treatment groups. The latter groups received canvassing visits providing either information on voting registration or assistance to register, which increased their registration level. The paper concludes that "easing registration requirements could substantially enhance political participation and interest".[2]

[2] For empirical research measuring the effect of voting costs on electoral outcomes, see, for instance, Lott (2009) and Schneider and Senters (2018).

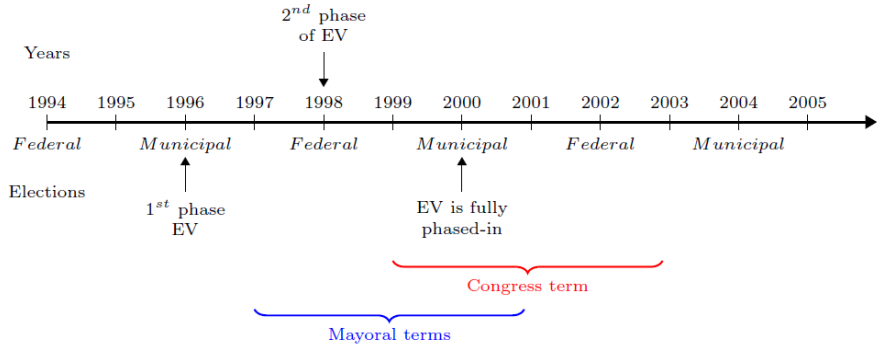

Fig. 1 Federal and local elections in Brazil

Consequently, institutions and rules are often devised to encourage civic involvement in politics by decreasing the cost of vote. For instance, democracies promote participation by holding elections on holidays or weekends, allowing postal or proxy voting, and creating initiatives such as the prominent Get-Out-The-Vote (GOTV) campaign (Berinsky, Burns and Traugott 2001; Berinsky 2005). Nonetheless, campaigns to increase voting participation such as GOTV, mostly increases the participation of the rich and the impact of enfranchising poor voters is still unknown. Our paper shows that de facto enfranchisement of poor and less educated voters through a reduction of their voting costs impacted fiscal policies.

In Brazil, there are elections every two years. For instance, in 1994, federal elections elected federal and state representatives, senators, governors and the president. Two years later, municipal elections elected municipal representatives and mayors.[3] This pattern is illustrated in Figure 1. EV was first implemented in the 1996 municipal level elections, but only 57 municipalities used it.[4] Nonetheless, in the 1998 federal elections, all Brazilian municipalities with more than 40,500 eligible voters, and all the ones belonging to four selected states (Rio de Janeiro, Amapá, Alagoas and Roraima), used the electronic voting system (i.e., close to 500 municipalities). Beginning in 2000, all voters used EV in Brazil.

The large impact EV had on voting enfranchisement biased toward the poor—exclusively in legislative elections—is well documented in the literature (Hidalgo 2012; Fujiwara 2015). For instance, before EV, only 58% of voters cast a valid vote (correctly cast votes) to federal representatives and in 2002, when

[3] Both municipal and federal elections grant a four-years terms to the ones elected (except senators that get eight-year terms). In addition, a two years distance separates these two elections.

[4] These 57 municipalities had more than 200,000 voters, which is significantly more than the municipal average number of voters in Brazil at the time—just over 16,000 voters—, and are therefore excluded from our analysis.

EV was a feature across the country, this number increased to 92% (*Tribunal Superior Eleitoral*, TSE). Using rigorous empirical analysis, Hidalgo (2012) and Fujiwara (2015) show that EV increased the valid votes to turnout ratio for federal and state representatives by 23 and 12 percentage points, respectively (i.e., close to a 33% increase). Also, this effect was larger in municipalities that had less educated and poorer voters.

This large impact of EV on enfranchisement concentrated on low income voters can be explained by how the new voting system facilitated the requirements to cast a vote for representatives in Brazil. Figure 2 shows the paper ballot system on the left-hand side and the electronic voting machine on the right-hand side. The paper ballot system required one to clearly write the name or number of the candidate in the ballot. Therefore, it was essential to be literate to understand the ballot instructions and cast a valid vote in Brazil. The new voting system, only required voters to press the candidate's number on a standard numerical keyboard and after verifying the picture of the candidate, press a green button to confirm their vote.[5] By removing these two requirements, namely, the need to read the ballot instructions, and the need to write one's candidate's name, the new EV technology enfranchised many voters, especially poorer and less educated ones.

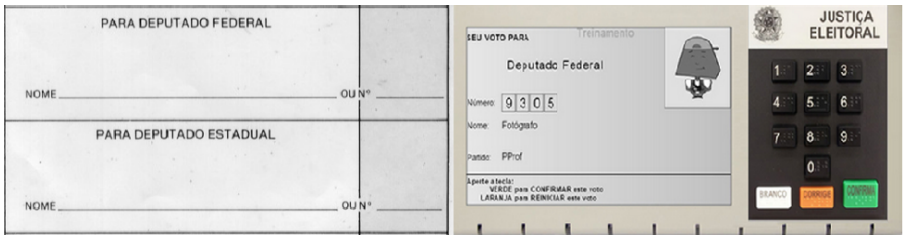

Fig. 2 Paper ballot (left) and electronic voting machine (right)

We follow two steps in our study investigating the impact of enfranchisement of low-income voters on public spending. First, we build a theoretical model allowing voters to cast, not purposefully, an invalid vote, and show that when poorer voters' likelihood of casting a valid vote increases, social spending increases as well. Second, we present a difference-in-differences (DID) model, where municipalities using EV comprise our treatment group, to empirically test our theoretical model prediction. We focus our empirical analysis on states that had electronic voting across their territories and use them as the treatment group.

Our decision to use within state variation is based on two arguments. First, as Schneider, Athias and Bugarin (2018) show, representatives elected in 1998

[5] It is also important to note that the government, at the time, produced TV ads that taught voters how to vote using the new system and trained people to help voters if something went wrong during the voting process in the election day.

sent more discretionary intergovernmental transfers to municipalities using EV. Second, as intergovernmental transfers comprise a mechanism to explain any observed increase in public spending caused by EV, we needed to segregate representatives elected by the new technology from the remaining ones. To do so, as states in Brazil act as a multi-member districts in congressional elections, we wanted to make sure that all representatives elected in the treatment group were elected solely by voters using electronic voting. Thus, we restrict our sample to municipalities with less than 40,500 voters, which allows us to compare municipalities with similar size, while at the same time guarantees that the treatment group is composed by municipalities that only had representatives elected by EV representing them in congress.

Our empirical model finds a positive impact of EV usage on social spending. To preview our findings, our DID model estimations report that an increase of 1 percentage point in the valid vote to turnout ratio for state representatives increases health spending by 1.8%; education spending by 1.4%; and public employment spending by 1.25%. We also find that the revenue collected at the local administration level increases, which provides a mechanism explaining our findings. Our results show that an increase of 1 percentage point in the valid vote to turnout ratio for state representatives increases intergovernmental transfers by 1% and local taxes by 2.6%.

Besides the introduction, this work is divided as follows. Section 2 presents a model that motivates the empirical analysis. Section 3 briefly discusses the data. Section 4 presents the difference-in-differences model and results. Section 5 presents an heterogenous effects analysis. Finally, section 6 concludes the work.

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

This section builds a voting model aimed at better understanding the effect of electronic voting (EV) on the electoral equilibrium. The model distinguishes two 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.

2.1 Foundations

A voter's decision to vote is one of the most discussed issues both in political science 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. 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.

In the present paper we use the concept of "willingness to vote" as a proxy for all the motives for voting.[6] In our model each citizen i has a willingness to vote $\nu_i \in V \subset \mathbb{R}_+$. The willingness $\nu_i \geq 0$ 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.

It is noteworthy that the concept of "decision to vote" must be seen in a more comprehensive way if one wishes to include in the same theoretic model a wide range of countries, some of which have mandatory voting. Indeed, if voting is voluntary, as it is the case in the US and most European countries, then deciding "not to vote" means simply not going to the polls. However, if voting is mandatory, as it is the case in Australia and Brazil, and if it is enforced, then what voters need to decide is how much effort to put into the electoral process, in terms of preparedness for voting, rather than the decision to actually go to the polls. In other words, under mandatory voting, voters decide whether to take the cost of making a valid vote, which means, first, taking the time to decide who to vote for, then preparing for casting a valid vote, which requires training especially if the voter is illiterate and he/she needs to write a name or a number in a ballot.

For the case of Brazil, we focus on that latter interpretation. Therefore, hereafter we use the term "decision to cast a valid vote" rather than "decision to vote". Furthermore, we will also use the term "valid-voting" for casting a valid vote and the term "valid electoral participation" for the electoral participation of those who cast a valid vote. However, the reader should keep in mind that the term would be replaced by "decision to vote" if one applies the model to a country under voluntary voting.

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

[6] There is a large literature that explains people's decision to vote. The motives include a sense of civic duty (Blais and Young 1999), group peer presure (Schram and Winden 1991; Schram and Sonnemans 1996), altruism (Edlin, Gelman and Kaplan 2007), and ethics rules (Feddersen and Sandroni 2006).

2.2 First step: The decision to cast a valid 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 $\nu_i \in V \subset \mathbb{R}_+$—her willingness to vote. In particular, if $\nu_i = 0$, then agent i sees no value in voting. The willingness to vote ν_i is a continuous random variable distributed in a non-negative set V according to the distribution $F(\nu_i)$.

If she decides to cast a valid 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). For the sake of simplicity, we assume that the citizen bears no cost if she decides not to cast a valid vote.[7]

General electoral participation

An agent of type ν_i and cost κ_i will decide to cast a valid vote if and only if:

$$\nu_i - \kappa_i \geq 0. \tag{1}$$

Let $E = \{i \in W | \nu_i - \kappa_i \geq 0\}$ be the set of citizens casting valid votes. Then the cardinality of E, $|E|$, corresponds to the proportion of valid-voting citizens. Note that the higher the expected value of the willingness to vote, the higher the overall valid electoral participation, ceteris paribus. More importantly for the present study, the lower the voting costs, the higher the proportion of voting citizens casting valid votes, 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 and Kenny, 1997).

[7] Alternatively, and more precisely, we could consider κ_i to be an *additional* cost the citizen has to incur in order to cast a valid vote, in a mandatory voting regime.

These examples suggest that poorer citizens tend to have lower valid electoral participation. 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 mass $\alpha^J \in [0, 1]$ where $\alpha^P + \alpha^M + \alpha^R = 1$.

Suppose further 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 $F(\nu_i)$. Furthermore, suppose for simplicity that all citizens sharing the same income class share the same cost to cast a valid vote, 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 valid-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 valid-voting. Hence, $\alpha'^J = [1 - F(\kappa^J)]\alpha^J$ is the percentage of citizens that belong to class J and cast valid votes; $\eta^J = F(\kappa^J)\alpha^J$ is the percentage of citizens that belong to class J and do not cast valid votes;[8] and $\alpha^J = \alpha'^J + \eta^J$. Therefore, $= \alpha' = \sum_J \alpha'^J$ is the total percentage of citizens that cast valid votes.

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 costs for casting a valid vote with the older voting technology, because it requires memorizing and writing down the candidates' names, as discussed earlier. Then, the percentage of valid electoral participation will be lower in class $P(\kappa^P > \kappa^M, \kappa^R \to 1 - F(\kappa^P) < 1 - F(\kappa^M), 1 - F(\kappa^R))$.

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 valid-voting costs, from κ^P to $\tilde{\kappa}^P < \kappa^P$. As for the other classes, including citizens better able to read and write and with higher education levels, the effect of EV

[8] For the sake of simplicity, we rule away the possibility of a purposeful blank vote as a political statement, i.e., in the present model, a citizen will cast an invalid vote only if she/he decides not to incur the cost of preparing for voting.

will be less significant. Hence, for simplicity we assume that EV does not affect the valid-voting costs for the other two classes. Therefore, EV will allow higher valid electoral participation rates for the poor class without significantly changing the participation rates in the remaining classes.

2.3 Second step: Electoral equilibrium with heterogeneous participation

The basic ideas of the model

The electoral competition model presented here follows Bugarin and 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 cast valid votes. Those who do will vote sincerely, for the party that better represents their 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 valid 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 3 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.

The electoral competition game with heterogeneous participation

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

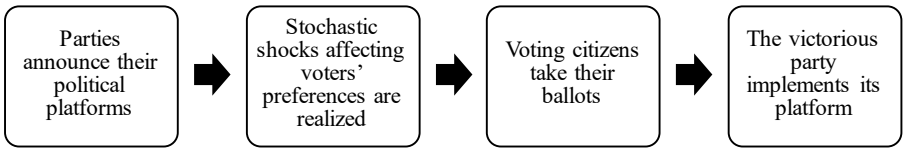

Fig. 3 The electoral competition game

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.

$$\tau \sum_J (\eta^J + \alpha'^J) y^J = \tau y = g. \tag{2}$$

A voter's utility has two components: a pragmatic component and an ideological one.[9] 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 $c^J + H(g)$ 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:

$$(1-\tau)y^J + H(g). \tag{3}$$

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:

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

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.

The ideological component of a voter's utility function reflects her concerns as a *homo politicus* and depends on two orthogonal variables that affect a voter's bias towards party B, or equivalently, party B's popularity at the time

[9] See Ferejohn (1986), Bugarin (1999) or Bugarin (2003) for a discussion on the "sociotropic" (economic) versus "ideological" components of a voter's utility function.

the election is held.[10] The first is a random variable 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 terrorist attack on September 11th, 2001, which increased from 57% in February to 90% in September.[11] We model that process with a random variable δ uniformly distributed on $[\frac{-1}{2\psi}, \frac{1}{2\psi}]$. The parameter $\psi > 0$ 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 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. Alternatively, it may simply reflect voter i's ex ante ideological preference for party B (if negative, for party A). Each voter knows her own ideological bias, σ^{iJ}; however, parties only know the distribution of σ^{iJ}. For the sake of simplicity, we assume that σ^{iJ} uniformly distributed on $[\frac{-1}{2\phi}, \frac{1}{2\phi}]$.

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:

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

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

[10] Analogous results would be obtained if we had set the bias with respect to party A due to the symmetry of the bias.

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

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

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 valid votes party A receives is:

$$\pi^A = \sum_J \alpha'^J . Prob[\sigma^{iJ} \leq \sigma^J] = \sum_J \alpha'^J [\sigma^J + \frac{1}{2\phi}]\phi = \sum_J \alpha'^J \sigma^J \phi + \frac{\alpha'}{2}. \tag{7}$$

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:

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

The above expression can be rewritten as:

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

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

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

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:

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

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

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 $y' = \frac{\sum_J \alpha'^J y^J}{\sum_J \alpha'^J} = \frac{\sum_J \alpha'^J y^J}{\sum_J \alpha'}$

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

Note that income $y' = \frac{\sum_J \alpha'^J y^J}{\sum_J \alpha'^J} = \frac{\sum_J \alpha'^J y^J}{\sum_J \alpha'}$ 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 cast valid votes. Then, $\alpha' = \alpha'^R$, $y' = y'^R$ and $g^E = (H')^{-1}(\frac{y^R}{y}) = g^{*R}$, 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.

2.4 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:

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

Since $\alpha'^P < \alpha'^M < \alpha'^R$, then it follows that $g_b^E = (H')^{-1}\frac{y'_b}{y} < (H')^{-1}(1)$, 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 valid-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:

$$\begin{aligned} y'_a = \frac{[1 - F(\tilde{\kappa}^P)]\alpha^P y^P + [1 - F(\kappa^M)]\alpha^M y^M] + [1 - F(\kappa^R)]\alpha^R y^R]}{[1 - F(\tilde{\kappa}^P)]\alpha^P + [1 - F(\kappa^M)]\alpha^M] + [1 - F(\kappa^R)]\alpha^R]} < \\ \frac{[1 - F(\kappa^P)]\alpha^P y^P + [1 - F(\kappa^M)]\alpha^M y^M] + [1 - F(\kappa^R)]\alpha^R y^R]}{[1 - F(\kappa^P)]\alpha^P + [1 - F(\kappa^M)]\alpha^M] + [1 - F(\kappa^R)]\alpha^R]} = y'_b. \end{aligned} \tag{14}$$

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

In other words, the new voting technology brings about a reduction in the cost of voting to the poor, which increases their valid electoral 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 casting valid votes, will public policy reflect their preferences.

The main point of the present work is that, due to the high cost of casting a valid vote 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, after the implementation of EV in Brazil we should have observed, on one hand, a significant increase in the proportion of valid votes, which has been widely documented in the literature[12] and, on the other hand, a significant increase in the provision of public goods. More specifically, since poorer citizens care more about social policy (health, education, etc.) we should have observed a clear increase in public spending in these areas.

The following sections test the latter hypotheses confirming that there was indeed a robust increase in social expenditure in Brazil after the advent of EV.

3 Data and descriptive statistics

We first collect data at the municipality level on public spending. We focus on social expenses—health, education and public employment—, as well as intergovernmental transfers and local taxes.[13] Total expenditure on health, education and public employment shows the overall increase in social spending in response to enfranchisement. Intergovernmental transfers and local taxes, on the other hand, may provide us a mechanism explaining this increase for the following reasons. First, federal and state representatives have discretionary power over intergovernmental transfers and use them to improve their electoral success.[14] Second, as discussed in Novaes (2018), mayors act as vote brokers for representatives by campaigning for them in exchange for these discretionary intergovernmental transfers. Therefore, representatives would be interested in transferring money to the municipalities with more valid votes to turnout ratio (affected by EV usage), since the mayor can deliver a larger number of votes in exchange for these transfers. Third, mayors, together with municipal councils,

[12] See Fujiwara (2015) or Hidalgo (2012), for example, or the data available at the Brazilian High Electoral Court (http://www.tse.jus.br).

[13] 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).

[14] See Ferreira and Bugarin (2007), Brollo and Nannicini (2012), and Bugarin and Marciniuk (2017).

can increase local taxes to finance social spending that the newly enfranchised low-income voters are likely to support because rich voters pay a larger share for their provision.[15]

We then obtain data on socio-economic and political outcomes at the municpality level. *Instituto Brasileiro de Geografia e Estatística* (IBGE) provides socio-economic data, while *Tribunal Superior Eleitoral* (TSE) provides electoral data. From IBGE, we collected data from the 1991 and 2000 Brazilian Census on income, population (total, rural, illiterates) and human development index (HDI). From TSE, we obtained data for the federal elections of 1994, 1998 and 2002 at the municipality level on voting turnout, electorate, blank votes (*voto em branco*), null votes (*voto em nulo*), and valid votes. Valid votes are those which are assigned to candidates excluding blank and null votes.[16]

Table 1 shows summary statistics of voting turnout, blank votes to turnout ratio, null votes to turnout ratio and valid votes to turnout ratio in the elections for federal representatives of 1994, 1998 and 2002. As one can notice, in 1998, municipalities using EV had a sharp increase in valid votes to turnout ratio as well as a decrease in blank votes and null votes. In 2002 when all Brazilian municipalities adopted EV, valid votes to turnout ratio got close to 100% across control and treatment groups, while blank votes and null votes dramatically decreased supporting our hypothesis that EV *de facto* enfranchised voters.

Table 1 Voting turnout, blank votes to turnout ratio, null votes to turnout ratio and valid votes to turnout ratio in the elections for federal representatives of 1994, 1998 and 2002 across control and treatment groups

	$\frac{\text{Turnout}}{\text{Electorate}}$		$\frac{\text{Blank Votes}}{\text{Turnout}}$		$\frac{\text{Null Votes}}{\text{Turnout}}$		$\frac{\text{Valid Votes}}{\text{Turnout}}$	
	Control	Treat.	Control	Treat.	Control	Treat.	Control	Treat.
1994	78%	83%	20%	17%	21%	24%	58%	57%
1998	76%	77%	15%	6%	16%	4%	69%	90%
2002	80%	82%	4%	4%	3%	3%	92%	93%

Note: Authors' construction based on information collected at TSE.

[15] As we show in the appendix, Table A2, valid votes to turnout ratio for municipal councils were also positively affected by EV usage.

[16] Blank votes are votes cast on purpose for no candidates by pressing a white button on the electronic voting machine. Null votes are votes that are cast to a candidate that does not exist (i.e., to cast a null vote, one should type a number that represents no candidate and press the green button to confirm).

4 Empirical Strategy and results

4.1 Estimation Strategy

We test our theoretical model prediction using the difference-in-differences (DID) methodology. We compare public spending of the municipalities that used EV (treatment group) to the ones that did not (control group). This is doned by comparing the differences in public spending between two periods, before and after EV usage, within these two groups. Formally, we regress the following model:

$$ln(y_{it}) = \beta_0 + \beta_1(post_t * EV_i) + \gamma_i + \delta_t + \epsilon_{it}, \tag{15}$$

where y_{it} is the total per capita spending (health, education, or public employment) and total per capita revenue from intergovernmental transfers in municipality i and year t. $post_t$ is a dummy variable equal to 1 if $t > 1999$ and EV_i is a dummy variable equal to 1 for municipalities that used EV in 1998. For this estimation, we restrict the EV usage to municipalities with less than 40,500 eligible voters to avoid heterogeneity and to guarantee that all representatives elected by the treatment group were solely elected via EV.[17] γ_i and δ_t captures municipality and year fixed effects respectively 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.

Our estimations rely on the following assumptions. First, we assume that non-observed variables that vary across time are orthogonal to the variable of interest.[18] Second, the selection of the four states which used EV in all their territories was not driven by political interests. As Fujiwara (2015) argue, there are no political motivation behind the EV usage selection.[19] Third, the control and treatment groups are comparable, that is, there are no significant differences between them, except in variables that are likely to be affected by EV usage.

To support our assumption that treated and control municipalities are comparable, we assess balance on independetn observable variables before treatment. Specifically, we regress separately observable covariates on the EV dummy. Figure 4 reports the results of this exercise. The findings corroborate

[17] If we were to consider all municipalities that used EV in 1998, our treatment group would have municipalities where the number of eligible voters would vary from 947 to 7,131,342. On the other hand, the control group would have, at most, 40,499 eligible voters.

[18] See Angrist and Krueger (1999) for a complete discussion on the DID methodology.

[19] Fujiwara (2015) explains the selection of the four states as follows: "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 the logistics of distributing the electronic devices jointly with the military" (p.431).

with our assumption that both control and treatment groups behaved similarly before treatment. In the appendix, Table A1 reports underlying descriptive statistics for treated and control municipalities for the sample analyzed in Figure 4.

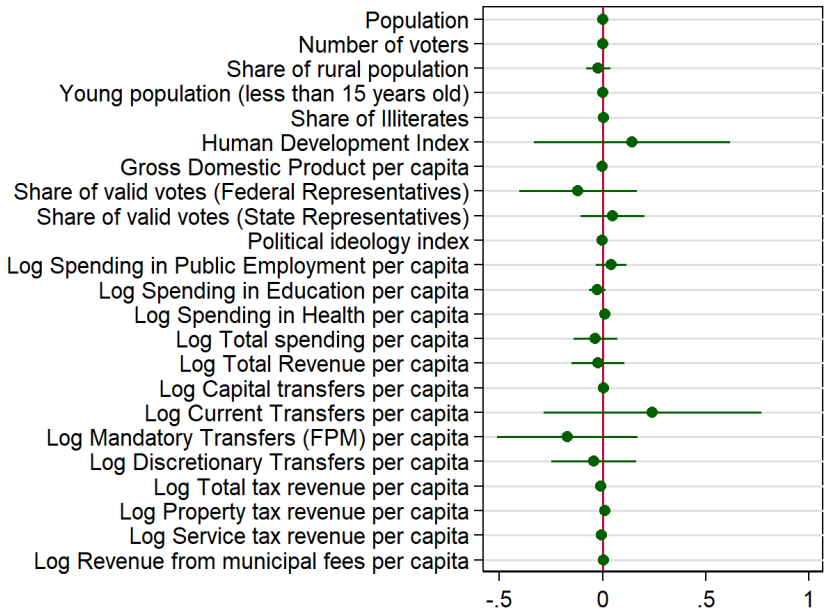

Fig. 4 Balance test. This graphical representation shows point estimates and 95% confidence intervals of regressing each observable variable on the *EV* dummy which is equal to 1 for municipalities that used EV in 1998. All points are not distinguishible from zero. Political outcomes refer to the 1994 federal elections, socio-economic outcomes refer to the 1991 census, budgetary outcomes refer to 1998 but are all robust to using 1997.

To test whether treatment and control groups have a common-trend prior to EV usage, we construct a generalized DID, using all years, and year dummies interacted with the treatment prior to 1999. More specifically, we use the following model:

$$ln(y_{it}) = EV_i \cdot \sum_{i=1993, i\neq 1999}^{2004} \beta_{i-1999}(i) + \gamma_i + \delta_t + \epsilon_{it}. \quad (16)$$

A visual representation of the results is presented in Figure 5, where it shows the coefficient estimate for each year (using 1999 as the year base) interacted with the EV usage dummy. Spending on education, health and public employment, as well as revenue from intergovernmental transfers and local taxes, increased significantly more in municipalities using EV after 1999 in accordance with our hypothesis. However, the main *automatic* intergovernmental

transfer, the so-called *Fundo de Participação dos Municípios* (FPM), was no affected by EV usage. Although there is evidence of a positive pre-trend, our results are robust to the pre-trend adjustment proposed by Kleven, Landais, Saez and Schultz (2014) as we show in the next subsection.

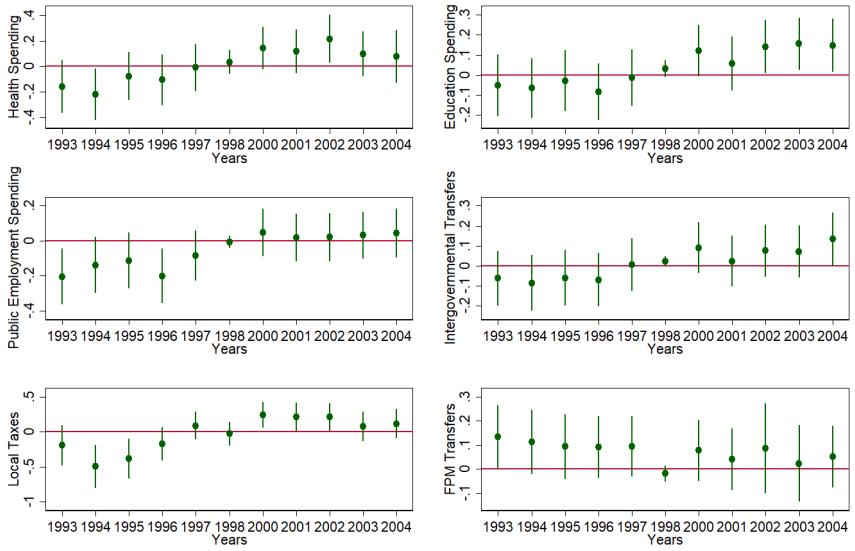

Fig. 5 All graphs show the interaction of a dummy for EV usage with each year considered in our sample (1999 is the year base). The analysis is restricted to municipalities with less than 40,500 voters. 5,166 municipalities out of 5,596 are covered in this representation.

4.2 The impact of EV on public spending

The DID estimates for the model presented in equation (15) are reported in Panel A1 of Table 2. Columns (1), (2) and (3) show, respectively, the impact of EV on public spending in the areas of health, education and public employment. Columns (4) and (5) consider, respectively, intergovernmental transfers and tax revenue received by municipalities. EV usage increases total spending on health, education and public employment by 25, 20, and 18% respectively. EV usage also increases intergovernmental transfers by 14 percent and local taxes by 37%. Mandatory transfers (FPM) was not affected by EV usage (Column 6).

The results in Table 2 suggest that not only increase in tax revenue, but also increase in discretionary intergovernmental transfers, are mechanisms to explain how public spending increased after EV. Indeed, as Brollo and Nannicini (2012) argue, intergovernmental 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), main source of revenue for small municipalities.[20] The results in Table 2, as expected, indicate that EV had no positive impact in FPM transfers after 1999.[21] This further corroborates our argument that EV caused a larger increase of discretionary intergovernmental transfers from central and state to local authorities allowing the latter to expand their social spending.

Table 2 DID estimates of the impact of EV usage on public spending

Variables	Health	Education	Pub. emp.	Transfers	Total tax	FPM
			Panel A1. Baseline			
EV	0.252***	0.196***	0.176***	0.140***	0.372***	-0.008
	(0.055)	(0.032)	(0.037)	(0.023)	(0.082)	(0.027)
			Panel A2. Control for preexisting trends			
EV	0.287***	0.163***	0.256***	0.138***	0.446***	-0.046
	(0.053)	(0.030)	(0.035)	(0.022)	(0.080)	(0.049)
Obs.	54,517	54,695	55,222	55,107	54,912	55,037

Notes: All regressions use municipalities fixed effects. Standard errors, clustered by municipalities, are presented in parenthesis. 1st, 2nd, 3rd, 4th, 5th and 6th columns consider, respectively, the logarithm of per capita total municipal spending on health; spending on education; spending on public employment; revenue from intergovernmental transfers; revenue from local taxes; and revenue from FPM. The DID regressions comparing outcomes between 1994-1999 (before EV) and 2000-2004 (post EV). The sample considers municipalities with less than 40,500 voters. *** $p < 0,01$, ** $p < 0,05$, * $p < 0,1$.

Following Kleven et al. (2014), we propose a detrend exercise to control for a potential diference in preexisting trends between the control and treatment groups. Explicitly, we first regress on a linear trend each one of the dependent variables analyzed in Panel A1 of Table 2. We conduct this exercise separately for each group (i.e., treatment and control) and considering only the sample prior to the treatment. Then, we predict the outcome variables out of sample for the entire period. Finally, we collect the part of this analysis that cannot be explained by the pre-trend and use as our dependent variable (i.e., we remove the previous trend from the analysis). We report, both in Panel A2 of Table 2 and in Figure 6, the results obtained when we conducted this exercise. As Figure 6 shows, the pre-trends are mostly eliminated from our sample. Panel A2 of Table 2 shows the estimated coeficients. The magnitudes of the results are similar to the one estimated in Panel A1 of Table 2 mitigating concerns that our results are driven by pre-trends in the data.

[20] 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.

[21] Bugarin and Marciniuk (2017) also conclude for the neutrality of the FPM in their study of partisan transfers in Brazil.

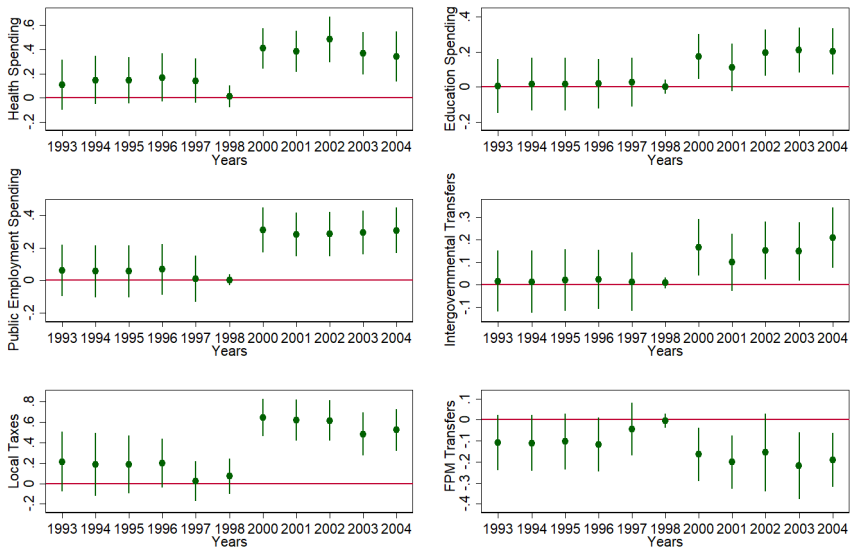

Fig. 6 All graphs show the interaction of a dummy for EV usage with each year considered in our sample (1999 is the year base). We adjust the outcome variables for pre-trend following Kleven et al. (2014). The analysis is restricted to municipalities with less than 40,500 voters. 5,166 municipalities out of 5,596 are covered in this representation.

Finally, we conduct a falsification test analyzing changes across periods using data at the municipality level and following the empirical strategy proposed in equation (15). We use as dependent variables socio-economic outcomes (i.e. per capita GDP, share of people living in rural areas, share of illiterates and HDI) as well as political outcomes (i.e. valid votes to turnout ratio and number of voters). As we do not have yearly data for the dependent variables used in this analysis, we compare the 1994 to the 1998 federal elections for political outcomes and the 1991 to the 2000 census for socio-economic outcomes.

Table 3 shows our results and report that EV impacted only valid votes to turnout ratio as expected. EV increased valid votes to turnout ratio for federal and state representatives by 23 and 14 percentage points respectively. This result is close to the ones reported in the literature (Fujiwara 2015, Hidalgo 2012). Nonetheless, the DID results examining socio-economic variables suggest that there was no differential change across periods within treatment and control groups.

The results presented in Table 3 allow for an interpretation of public spending in terms of valid votes to turnout ratio. Using Table 3 estimation showing that EV increased the valid votes to turnout ratio for state representatives by 14 percentage points and connecting this value to Table 2, one can find that an increase of 1 percentage point in the valid vote to turnout ratio for state representatives increases health spending by 1.8%; education by 1.4%; public

employment by 1.25%; intergovernmental transfer by 1%; and local taxes by 2.6%.[22]

Table 3 DID estimates of EV on electoral and socio-economic outcomes across different periods

Variables	Fed. (94-98)	St. (94-98)	Rural (91-00)	Income (91-00)	Voters (91-00)	HDI (91-00)	Illit. (91-00)
EV	0.228***	0.143***	0.035	-15.1	347.5	0.005	-1.851
	(0.036)	(0.029)	(0.04)	(16.6)	(424.9)	(0.009)	(1.590)
Obs.	9,841	9,841	10,332	10,332	9,842	10,332	10,332

Notes: All regressions use municipalities fixed effects. Standard errors, clustered by mesoregions, are presented in parenthesis. All regressions are controlled for a dummy identifying EV usage and a dummy identifying the year of EV usage. 1st, 2nd, 3rd, 4th, 5th, 6th and 7th columns contain, respectively and as dependent variable, valid votes to turnout ratio for federal representatives; valid votes to turnout ratio for 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 less than 40500 voters. *** $p < 0,01$, ** $p < 0,05$, * $p < 0,1$.

5 Heterogeneous Effects

In this section we look at heterogenous effects across population groups to check whether enfranchisement of less educated and poorer voters is the mechanism explaining our results. If our theory is correct, then we should see stronger effects of EV usage in poorer places and with higher illiteracy rate. In Table 4, Panel A, we split our sample within above- and below-median illiteracy rate and run the same specification as the one reported in Table 2, however, for each sample separately. In Table 4, Panel B, we use a similar approach but split the sample between below- and above-median GDP per capita. As Table 4 shows, poorer places as well as places with higher illiteracy rate experienced stronger EV effects on social spending and fiscal revenue. This is consistent with our theory that enfranchisement of less educated and low-income voters is the mechanism explaining our findings.

We also find that EV usage had a negative and significant effect on FPM across more developed municipalities (i.e. above-median GDP and below-median illiteracy rate). This unexpected result can be explained by the way

[22] This assumes that the increase in public spending caused by EV is solely driven by enfrnachisement in legislative elections. If one considers the federal representatives' elections instead, then the conclusion would be that an increase of 1 percentage point in the valid vote to turnout ratio for federal representatives increases health spending by 1.13%; education by 0.9%; public employment by 0.81%; intergovernmental transfer by 0.63%; and local taxes by 1.63%.

FPM is distributed. As Mendes, Miranda and Blanco (2008) explain, FPM in non-capital municipalities, which are the ones analyzed in our sample, is allocated based on population size. However, municipalities belonging to Brazilian states that allowed new municipalities to be formed by emancipating from larger municipalities receive a lower amount of money from FPM than municipalities of similar sizes in states that did not allow for emancipation. Therefore, to control for heterogeneity across these two dimensions, we re-run all estimations in Table 4 but adding population size and controlling for state fixed effects and find that all significant coefficients remain except the ones that have FPM as dependent variables.[23] This mitigates concerns that a change in FPM caused by EV is driving our results.

Table 4 DID estimates of EV on public spending after splitting the sample by illiteracy rate and income

Variables	Health	Educ.	Pub. emp.	Transfers	Total tax	FPM
			Panel A - Illiteracy rate			
Below-median	0.150	0.137**	-0.001	0.119***	-0.066	-0.117*
	(0.124)	(0.058)	(0.048)	(0.035)	(0.066)	(0.061)
Above-median	0.252***	0.125***	0.146***	0.100***	0.368***	0.036
	(0.058)	(0.036)	(0.041)	(0.029)	(0.100)	(0.028)
Obs.	27,378	27,413	27,877	27,817	27,779	27,892
			Panel B - GDP per capita			
Below-median	0.298***	0.174***	0.207***	0.115***	0.465***	0.047*
	(0.052)	(0.037)	(0.041)	(0.031)	(0.105)	(0.028)
Above-median	0.120	0.117**	-0.008	0.120***	-0.036	-0.114**
	(0.118)	(0.050)	(0.043)	(0.031)	(0.057)	(0.054)
Obs.	27,287	27,337	27,830	27,773	27,736	27,841

Notes: All regressions use municipalities fixed effects. Standard errors, clustered by municipalities, are presented in parenthesis. The first and second rows of Panel A restrict the sample to, respectively, below- and above-median illiteracy rate. The first and second rows of Panel B restrict the sample to, respectively, below- and above-median GDP per capita. 1st, 2nd, 3rd, 4th, 5th and 6th columns consider, respectively, the logarithm of per capita total municipal spending on health; spending on education; spending on public employment, revenue from intergovernmental transfers; total revenue; revenue from FPM and revenue from local taxes. The DID regressions comparing outcomes between 1994-1999 (before EV) and 2000-2004 (post EV). The sample considers municipalities with less than 40,500 voters. $p < 0,01$, ** $p < 0,05$, * $p < 0,1$.

[23] This table is available upon request.

6 Conclusion

This paper shows that voters' enfranchisement in Brazil, concentrated among poorer and less educated populations, who were no longer required to write on the ballot after the electronic voting (EV) introduction, increased social spending. Our results indicate that public spending on health, education and public employment increased by 25, 20, and 18 percent respectively. In addition, municipalities total intergovernmental transfers and local taxes also disproportionately increased in municipalities using EV by, respectively, 14 and 37 percent. This empirical result corroborates our model prediction suggesting larger public provision in municipalities using EV.

The main contribution of the present work is, therefore, to show the consequences of a *de facto* enfranchisement on public spending and shed a light on the impact of larger turnout in democracies where 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 diminishing the strength of the democracy.

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7 Appendix

7.1 Descriptive statistics of Figure 4

We start the appendix by showing descriptive statistics of all variables used in Figure 4. We provide, in Table A1, the mean and standard deviation, across control and treatment groups for each of the variables we used in Figure 4 to establish that our groups are comparable.

7.2 Were municipal representatives also affected by EV?

In this subsection of our appendix, we show that the municipal representatives were also affected by EV. 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), to show that the valid vote to turnout ratio for municipal representatives also increased due to EV.

The sample selected considers 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 (not the case for the remaining states).[24] Table A2 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. Therefore, municipal representatives would also be inclined to help the mayors to increase social spending as the enfranchisement biased toward poor voters potentially affected their reelection's chances.

[24] A parametric fuzzy RDD estimation, which considers the entire sample of municipalities, reports an increase close to 11 percentage points in the number of valid votes to turnout ratio for municipal representatives due to the EV usage. This estimation is similar to the one reported in Table A2 considering only the State of São Paulo.

Table A1 Mean and standard deviation for both control and treatment groups using the variables in Figure 4

Variables	Control		Treated	
	Mean	SD	Mean	SD
Population	13653	13246	17745	13898
Number of Voters	8860	7683	10439	8027
Share of Rural Population	0.5	0.2	0.5	0.2
Young Population (less than 15 years old)	4783	4478	6284	4892
Share of Illiterate	31.8	16.6	41.7	18.3
Human Development Index	0.6	0.1	0.6	0.1
Gross Domestic Product per capita	116.4	65.4	103.4	57.8
Share of valid votes (Federal Representatives)	0.6	0.1	0.6	0.1
Share of valid votes (State Representatives)	0.7	0.1	0.7	0.1
Political Ideology Index	5.4	0.7	5.4	0.6
Logarithm of Spending in Public Employment per capita	4.6	0.6	4.6	0.8
Logarithm of Spending in Education per capita	4.4	0.6	4.3	0.7
Logarithm of Spending in Health per capita	3.6	0.8	3.7	0.9
Logarithm of Total Spending per capita	5.6	0.6	5.5	0.8
Logarithm of Total Revenue per capita	5.6	0.6	5.5	0.7
Logarithm of Capital Transfers per capita	2.6	1.6	2.2	1.9
Logarithm of Current Transfers per capita	5.4	0.5	5.3	0.7
Logarithm of FPM per capita	4.7	0.6	4.2	0.8
Logarithm of Discretionary Transfers per capita	4.6	0.6	4.9	0.8
Logarithm of Total Tax Revenue per capita	1.9	1.3	1.4	1.8
Logarithm of Property Tax Revenue per capita	0.3	1.9	0.2	2.3
Logarithm of Service Tax Revenue per capita	0.2	1.6	0.1	2.4
Logarithm of Revenue from Local Fees per capita	0.2	1.9	0	1.8
Obs.	4,976		190	

Notes: Political outcomes refer to the 1994 federal elections, socio-economic outcomes refer to the 1991 census, budgetary outcomes refer to 1998 but are all robust to using 1997.

Table A2 Estimating the impact of EV usage on valid votes to turnout ratio for municipal representatives in 1996

Variables	Valid votes to turnout ratio	Valid votes to turnout ratio	Valid votes to turnout ratio
EV	0.097***	0.111***	0.104***
	(0.018)	(0.017)	(0.019)
Obs.	24	22	20

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. 1st, 2nd and 3rd regressions consider, respectively, municipalities with more than 120,000; 130,000 and 140,000 voters. São Paulo, the State capital was excluded from the sample. *** $p < 0,01$, ** $p < 0,05$, * $p < 0,1$.