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Schneider, Rodrigo; Athias, Diloá; Bugarin, Mauricio Soares

# Article

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# Electronic voting and public spending: the impact of *de facto* enfranchisement on federal budget amendments in Brazil

Rodrigo Schneider<sup>a</sup>, Diloá Athias<sup>b</sup> and Mauricio Bugarin <sup>o</sup>

<sup>a</sup>Department of Economics, Skidmore College, Saratoga Springs, NY, USA; <sup>b</sup>Development Pathways Ltd, United Kingdom; <sup>c</sup>Department of Economics, University of Brasilia, Brasilia, Brazil

#### ABSTRACT

This article examines whether an increase in political participation biased toward low-income voters - and concentrated in legislative elections - impacts federal representatives' allocation of resources from the federal budget to Brazilian municipalities. We use a regression discontinuity design that exploits the assignment of electronic voting to municipalities based on population size to identify the causal effect of enfranchisement on the allocation of federal public spending. We find that an increase of 1 percentage point in the valid-vote-to-turnout ratio for federal representatives in a municipality increases the allocation of funds from the federal budget by 3.3%, and that experienced politicians are more responsive to the enfranchisement of low-income voters.

#### **ARTICLE HISTORY**

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#### **KEYWORDS**

Electronic voting; political participation; politically motivated transfers

### 1. Introduction

The discussion associating public spending to voters' income has an old tradition. As early as 1835, Alexis de Tocqueville in his seminal book "Democracy in America" (De Tocqueville, 1835/2003) argued that allowing those who do not own property to vote would increase the proportion of voters who are in favor of larger public spending and income redistribution. Theoretical models also predict that an increase in voting participation of low-income voters increases public spending (Meltzer & Richard, 1981). Many empirical studies test this hypothesis; however, it has remained a challenge to solve the problem of simultaneity between voting turnout and public spending.<sup>1</sup>

This work uses the phased-in introduction to electronic voting (EV) in Brazil – which enfranchised low-income voters without directly affecting public spending - to identify the impact of enfranchisement on the allocation of funds from the federal budget. We show that voting enfranchisement biased toward low-income voters, and concentrated in municipalities using EV, increases funds from the federal budget allocated to these localities. Our main contribution to the literature is understanding whether federal representatives, when deciding where to allocate their discretionary funds, respond to the enfranchisement of low-income voters. We acknowledge the contribution of Fujiwara

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CONTACT Mauricio Bugarin 🖾 bugarin.mauricio@gmail.com 🖃 Department of Economics, University of Brasilia, Predio da FACE, Asa Norte, CEP 70910-900, Brasilia, DF, Brazil

<sup>&</sup>lt;sup>1</sup>See, for instance, Meltzer and Richard (1983); Lindert (2004), Mueller and Stratmann (2003), and Alesina and Giuliano (2009).

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(2015) that also examined the impact of enfranchisement in Brazil on public spending in healthcare. However, we add to the literature by examining the decision of each representative individually and, therefore, we provide a potential mechanism to explain the relationship found in Fujiwara (2015) between enfranchisement caused by EV and healthcare spending *aggregated* at the state level.<sup>2</sup> Furthermore, the present paper focusses on voluntary transfers, rather than on public health expenditure, which allows for a clearer direct relation between congress representatives and federal transfers to municipalities.

Electronic voting (EV) increased political participation in the Brazilian legislative elections. Even though Brazil has a voting turnout of around 80%, before EV, only 58% of votes for federal representatives were valid (*Tribunal Superior Eleitoral*, TSE).<sup>3</sup> Therefore, federal representatives could ignore the voice of voters that were not able to cast a valid vote, which, as the previous literature argues were mostly low-income citizens.<sup>4</sup> After the use of EV, valid-votes-to-turnout ratio for federal representatives increased to impressive 90% in 2002.<sup>5</sup> The main purpose of this work is to measure the impact of this *de facto* enfranchisement on federal representatives' individual allocation of discretionary funds from the federal budget, which impacts local governments' public spending.

We measure the impact of enfranchisement on allocation of funds from the federal budget using a regression discontinuity design. We use the number of registered voters, at the municipality level, as our running variable and exploit the deterministic rule that assigned EV to municipalities with more than 40,500 registered voters. First, we establish that municipalities with lower income per capita had larger enfranchisement caused by EV.<sup>6</sup> We then show that, on average and during the congressional four-year term analyzed, municipalities that used EV received 9 USD,600 (in 2000 value) more discretionary funds from federal representatives.<sup>7</sup> Next, we report findings suggesting that our estimation is robust across different bandwidths and to polynomial functions of the running variable. In addition, we mitigate concerns of selection bias by running a falsification test considering elections in which EV was already being used across the country. We keep the same running variable and cutoff (40,500) but find no significant results.

Besides the introduction, this work contains five other sections. Section 2 first presents a literature review on the connection between voting participation and public spending; then, it discusses the EV implementation and allocation of funds from the federal budget. Section 3 discusses the empirical model and the data used. Section 4 presents the results followed by a discussion of alternative explanations to our findings, while Section 5 provides a discussion of the findings. A conclusion is provided in Section 6.

<sup>&</sup>lt;sup>2</sup>Our study differentiates from Fujiwara (2015) as we examine data at the representative x municipality level, which allows us to use the population discontinuity caused by EV and construct an RDD model to examine the allocation of public spending. Fujiwara (2015), on the other hand, constructs a DID containing data on healthcare expenditure aggregated at the state level and, therefore, with only 27 observations.

<sup>&</sup>lt;sup>3</sup>In the United States, for instance, voting turnout is close to 60%.

<sup>&</sup>lt;sup>4</sup>The valid vote for executive elections was almost not affected by EV (Fujiwara, 2015).

<sup>&</sup>lt;sup>5</sup>See Brasil. Tribunal Superior Eleitoral, (2003).

<sup>&</sup>lt;sup>6</sup>Following the approach in Calonico, Cattaneo, Farrell, and Titiunik (2017) to estimate optimal bandwidth, we use a bandwidth of 8,700 registered voters.

<sup>&</sup>lt;sup>7</sup>This is equivalent to 17,714 Brazilian *reais*. We used the annual average exchange rate in 2000 which was 1.83 BRL/USD.

#### 2. Background

#### 2.1. Voters' enfranchisement and public spending

Meltzer and Richard (1981) show that voting enfranchisement biased toward poor voters increases public spending. Using a model of electoral competition, they argue that the median voter is the one imposing her preferences on public spending. Therefore, the poorer the median voter is, the larger will be her optimum public spending provision demanded. This result derives from the assumption that all citizens enjoy public goods the same way; however, poorer citizens will contribute less (lower tax) to finance the public provision.

Several empirical studies have attempted to test Meltzer and Richard's theoretical prediction. Lindert (2004), using decennial data from OECD countries between 1880 and 1930, find a positive relationship between government size and voter participation. In Latin America, Brown and Hunter (1999) find that democracies spend more on social programs than dictatorships. Husted and Kenny (1997) analyze 46 U.S. states between 1950 and 1988 and find that a reduction of 0.2 on the ratio of median voter's income to the total population income caused an increase of 5% to 12% on public social spending.

Nonetheless, corroborating Meltzer and Richard (1981) argument is not trivial. As Alesina and Giuliano (2009) argue, empirical studies attempting to achieve this goal may suffer from endogeneity as public spending may increase voting turnout. Additionally, other aspects such as the median voter's perspective on social mobility (Benabou & Ok, 2001; Piketty, 1995) and the strength of lobbying groups (Karabarbounis, 2011) could reinforce the limits imposed on government intervention in the economy. Another difficulty to establish a causal relationship between the median voter's income and public spending is given by the fact that the median income of the population may not be the same as the median income of those who 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.

As Bugarin and Portugal (2015) argue, when there is a lower political participation concentrated on the poor, the income of the median voter is larger than the income of the median citizen creating a Nash equilibrium with lower amount of public goods than the situation in which all voters show up to vote. A solution pointed by these authors is to use mandatory voting. Jackman (2001) uses the Australian 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,<sup>8</sup> in 1994 for instance, less than 60% of those who showed up to vote (turnout close to 80%) cast a valid vote for a candidate or party to the legislative seats.

#### 2.2. Electronic voting and political participation in Brazil

In Brazil, federal and municipal elections happen every four years. The two forms of elections, however, are not concurrent and alternate such that there are elections every

<sup>&</sup>lt;sup>8</sup>While Brazilian citizens aged 16 years and over have the right to vote: citizens aged between 16 and 18 years, citizens aged 70 years and over, or illiterate citizens are not obliged to vote.



Figure 1. Brazilian elections' timeline.

other year, as shown in Figure 1. For instance, while there were federal elections in 1994, which elected federal and state representatives, senators, governors and a president; two years later, in 1996, municipal elections in all municipalities elected municipal councilors and mayors. Both municipal and federal elections grant a four-year term to the ones elected (except senators that get an eight-year term). The electoral system used to elect federal and state representatives and municipal councilors follows an open list proportional representation.

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.<sup>9</sup> In the 1998 federal elections, all Brazilian municipalities with more than 40,500 eligible voters used the electronic voting system.<sup>10</sup> Finally, in the municipal elections of 2000, and all the subsequent elections, every Brazilian voter used EV. As we use a Regression Discontinuity Design (RDD) taking advantage of the 40,500 eligible voters' cutoff implemented in 1998 to determine which municipalities were going to use EV, we may be concerned with a potential manipulation of the running variable. As the Brazilian Electoral Court decided to use the number of eligible voters in 1996 to determine this cutoff, our concern is mitigated (one could not manipulate the number of voters in the past). For the sake of completeness, we also show a McCrary test<sup>11</sup> in appendix (Figure A1) that attenuate even further any concerns with manipulation of the running variable.

Hidalgo (2012) shows that EV usage is responsible for an increase of close to 23 percentage points in the valid votes to turnout ratio for federal representatives. This number represents an increase of *de facto* enfranchisement in Brazilian legislative elections close to 33% and can be explained by the complexity to cast a paper ballot in these elections. Before EV, to cast a vote for representatives, voters should clearly write the name or number of the candidate in the ballot. Therefore, it was essential to know how to read to understand the ballot instructions and to correctly vote in Brazil. Moraes (2012) also finds that EV usage caused an increase in *de facto* enfranchisement and, furthermore, finds evidence that the new technology induced a higher level of political competition and that this increased political competition tended to induce a relocation in municipal expenditure towards healthcare. Fujiwara (2015) confirms the evidence of an increase in healthcare expenditure in states that had a larger share of their voters using EV.

<sup>&</sup>lt;sup>9</sup>Only 57 municipalities used EV in 1996.

<sup>&</sup>lt;sup>10</sup>In addition, four states used EV in all their territories independent of the number of eligible voters (Rio de Janeiro, Amapá, Alagoas and Roraima).

<sup>&</sup>lt;sup>11</sup>We are grateful to an anonymous referee for suggesting this supporting test.

The EV introduction made it easier, especially for less-educated voters, to cast a ballot. In the new voting system, voters need to press the candidate's number on a numerical keypad and after verifying the picture of the candidate, press a green button to confirm their vote.<sup>12</sup> The only way to cast an *invalid* vote, accidentally, is to type a candidate's number with no correspondence and press the green button after seeing the screen warning "this number is wrong".<sup>13</sup> As Hidalgo (2012) points out, the EV was considered a democratic progress since even illiterates could press a number followed by the green button after seeing a picture of their preferred candidates' faces on the screen. Fujiwara (2015) corroborates this insight by showing that municipalities with above median illiteracy rate had larger increase in valid votes to turnout ratio. The present paper also suggests that EV had larger enfranchisement impact in low-income municipalities. We split our sample into quintiles according to income per capita and find that EV caused a larger increase in valid votes to turnout in poorer municipalities (Table 1).

Not all research investigating the introduction of EV in Brazil share the same optimistic views about the new technology. Zucco and Nicolau (2016) suggest that EV "caused a sharp rise in party label votes (votos de legenda), that can only be explained by voting error", because of the counter-intuitive logic of ballot order on electronic machines in which legislative candidates appear first in the machine and only after casting a vote for them that voters are presented with candidates for the executive positions. They argue that these errors could offset a large portion of the gains in enfranchisement. Schneider and Senters (2018) also present a less optimistic view of EV as they show that the new technology concentrated vote shares among viable candidates and thus exhibited electoral bias. It remains a stylized fact; however, that the percentage of valid votes has increased sharply with the introduction of EV in Brazil, which, as suggested by Bugarin and Portugal (2015), induces politicians to take into more careful consideration the interests of these newly *de facto* enfranchised voters, as a reelection strategy.

Establishing whether EV was beneficial or harmful to the Brazilian democracy is beyond the scope of this work. Our goal is to understand whether EV, through its positive impact on the enfranchisement of low-income voters, affected federal representatives' allocation of discretionary funds. Next, we discuss how federal representatives allocate funds from the federal budget in Brazil.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile
EV -1998	0.261***	0.309***	0.226***	0.173***	0.143***
	(0.040)	(0.072)	(0.038)	(0.057)	(0.052)
Observations	38	37	37	37	37

Table 1. Heterogeneous	effects of EV	usage on	enfranchisement
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This table presents, in each column, a coefficient showing the impact of EV usage on valid votes to turnout ratio for each quintile based on municipalities income per capita. The quintiles were calculated using the sample restricted to the municipalities belonging to the optimal bandwidth. \* Statistically significant at 10%.\*\* Statistically significant at 5%. \*\*\* Statistically significant at 1%.

<sup>12</sup>Fujiwara (2015) shows illustrations of the old ballot comparing it to the electronic one. It is also important to note that the government 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.

<sup>13</sup>Voters could cast a blank vote by pressing a white button followed by the green one to confirm it.

#### 2.3. Understanding federal representatives' allocation of funds

In very rough terms, the Brazilian Annual Federal Budget is designed in two main steps. First, the Executive estimates revenue and drafts the Annual Federal Budget proposal (*Proposta de Lei Orçamentária Anual*), which is, then, sent to Congress for amendments and final approval, the second main step. All amendments in Congress must not alter the total level of expenditure proposed by the Executive.

During the amendment period, federal representatives can allocate part of the federal budget in a discretionary manner and frequently do so motivated by political reasons (Ames, 1995). Budgetary amendments are one way of connecting federal representatives to local municipalities. To access these discretionary funds, local governments will often approach federal representatives (this is especially the case for smaller municipalities). Alternatively, federal representatives aiming to obtain electoral support in a given municipality will propose budget amendments that benefit that given municipality.

Budget amendments are proposed in Congress in the year prior to their execution and each federal representative is entitled to make a specific maximum number of amendments, with an upper bound on the total amount of resources these amendments require. According to Firpo, Ponczek, and Sanfelice (2015), both the maximum number of amendments and the total value of all amendments per representative have increased since 1995. While in 1995 each representative had R\$1.5 million per year to allocate across 20 federal budget amendments, in 2010, the maximum value was raised to R\$12.5 million, and the number of amendments was increased to 25 per deputy per annual budget (this number was, at the time, close to 7 million USD as the annual average exchange rate in 2010 was 1.76 BRL/USD). Currently, in 2018, it was established that each representative had R\$ 14.8 million to allocate across 25 budget amendments.

These individual representatives' budget amendments fall into the category of voluntary transfers, which has been widely studied in Brazil with a focus on its possible partisan bias. Bugarin and Marciniuk (2017), for example, find evidence that overall federal voluntary transfers to municipalities tend to be higher when the President and the municipality's Mayor both belong to the same party, as long as the governor of the state which the municipality is part does not belong to that same party, himself or herself. This phenomenon is called "strategic partisan transfer hypothesis". The present paper differentiates itself from that literature in two aspects. First, it focusses on voluntary transfers on the part of the Legislature. Second, rather than focusing on the party identification motive, it stresses the electoral connection and the role of *de facto* enfranchisement of low-income voters.

As each representative is limited to a number of budget amendments and to a maximum annual expenditure, representatives' budget amendments are usually allocated strategically in an attempt to maximize prospects of reelection. That is, each federal representative allocates his/her budget amendments to municipalities in which he/she had larger political support (Ames, 2001; Firpo et al., 2015). Furthermore, in 2015 the Brazilian Congress passed Constitutional Amendment Proposal (PEC) N. 86 of 2015 that rules mandatory the implementation of the representatives' amendments. This special treatment reserved specifically to the individual representatives, amendments shows how important and sensitive this issue is for the National Congress.

One of the threats to our analysis is that political support, at the municipality level, can vary across EV usage. If EV caused an increase in political support, then a potential increase in discretionary funds to municipalities using EV could be reflecting this increase in political support rather than a response to enfranchisement of low-income voters. We address this concern controlling for political support, for each representative, at the municipality level. We follow Firpo et al. (2015) and construct a dummy variable indicating whether elected federal representatives are associated to municipalities. We explain next how this variable can capture political support for each federal representative.

In Brazil, federal representatives are elected in large multi-member electoral districts, where the states are the districts themselves. Therefore, campaigning across the entire district can be too costly and often candidates concentrate their efforts in a few selected municipalities of their district. Each representative has his or her own set of selected municipalities, which are often called their "reduto eleitoral" – or *de facto* district. In other words, these groups of municipalities characterize the areas chosen by representatives to obtain their share of discretionary funds from the federal budget (Ames, 1995). This characteristic of Brazilian elections can be a threat to our empirical analysis if the level of importance of municipalities to federal representatives varies across EV usage. Following Firpo et al. (2015) we construct a variable that "associates" each candidate to the municipalities that they *de facto* represent. This variable enables us to capture municipalities' level of importance to federal representatives.<sup>14</sup>

Formally, candidate *i* is considered associated to municipality *m* if, taking the number of votes received in municipality *m* and term *t*, he or she is ranked as one of the effective candidates a municipality has. Put differently, candidate *i* is municipality *m*'s "associate" candidate for the term *t* if  $A_{imt} = 1\{r_{imt} \le E_{mt}\}$ , where  $E_{mt}$  is the number of effective candidates a municipality *m* had in term *t* and  $r_{imt}$  is the ranking of candidate *i* according to all candidate votes in municipality *m* in term *t*.<sup>15</sup>

#### 3. Empirical strategy and data

#### 3.1. Regression discontinuity design

We use a regression discontinuity design to identify the impact of enfranchisement on the allocation of funds from the federal budget. In this design, the number of registered voters is the running variable and the cutoff point determining whether a municipality used EV is defined as 40,500.<sup>16</sup> That is, all municipalities with more than 40,500 registered voters used EV.<sup>17</sup>

More specifically, our model is constructed as the following:

<sup>&</sup>lt;sup>14</sup>We also show that our estimates are robust to controlling for alternative measures of the level of importance.

 $<sup>{}^{15}</sup>E_{mt} = \left(\sum_{i=1}^{I_{st}} \left(\frac{v_{imt}}{\sum_{i=1}^{I_{st}} v_{imt}}\right)^2\right)^{-1}$ , where  $I_{st}$  represents the number of candidates in the state (district) *s* and term *t* and  $v_{imt}$ 

is the total vote count of candidate i in municipality m and term t (i.e. the right-hand side term is the inverse of the Herfindahl–Hirschman Index).

<sup>&</sup>lt;sup>16</sup>We remove from our sample the four Brazilian states that used EV across their territories in 1998 (i.e. Alagoas, Rio de Janeiro, Amapá and Roraima).

<sup>&</sup>lt;sup>17</sup>The requirement to use EV in 1998 was announced in 1997 and defined based on the number of registered voters in 1996, which mitigates concerns of selection bias (i.e. municipalities manipulating the number of registered voters).

306 👄 R. SCHNEIDER ET AL.

$$Y_{rmt} = \alpha + \lambda D_m + \beta_1 (N_m - c) + \beta_2 (N_m - c) * D_m + X_{mt} + Assoc_{rmt} + \Lambda_r + \epsilon_{rmt}$$
(1)

such that:  $(c - h) \leq N_m \leq (c + h)$ , where  $Y_{rmt}$  is the value of total funds, per number of eligible voters, sent by federal representativer to municipality m in budget cycle t. c represents the cutoff (40,500),  $N_m$  indicates the number of registered voters in 1996 for each municipality surrounding the cutoff,  $D_m$  is a dummy variable indicating EV usage in 1998, and h represents the selected bandwidth.  $\lambda$  captures the enfranchisement effect on federal budget allocation.  $X_{mt}$  contains population and income per capita for each municipality m at budget cycle t. Note that we run regressions for each budget cycle separately and only capture variation in EV usage in the 2000-2003 budget cycle. Assoc<sub>rmt</sub> is a dummy variable indicating whether the federal representative r is associated to municipality m at the budget cycle t. This variable captures the level of importance of each municipality m to federal representative r.  $\Lambda_r$  adds federal representatives fixed effects to capture time-invariant unobservable characteristics of these politicians. Finally,  $\epsilon_{rmt}$  contains the error term for each observation.

In an ideal experiment, we would have, during the same budget cycle, two data points for each municipality containing information on the amount of discretionary funds received by them when they used EV (i.e. received the treatment) and when they did not. As each municipality either used EV or did not, we cannot analyze this ideal experiment. Therefore, we rely on the assumption that all confounding variables that could explain federal representatives' allocation of funds change continuously across the threshold (i.e. municipalities are comparable), with exception of the enfranchisement of low-income voters. Two features make us confident that our assumption holds. First, as we have shown below, socio-economic observed characteristics of municipalities as well as voting outcomes, such as income, education, geographic coordinates and turnout, change smoothly across the cutoff point. Second, in our falsification test examining discretionary funds allocation *after* EV became a feature across Brazil, we find that federal representatives' allocation of funds changes continuously across the cutoff point.

#### 3.2. Data

For this research, we construct a panel data where the unit of observation is the intersection representative x municipality x budget cycle. The dataset is constructed using different sources. Data on the electoral results of each representative in each municipality of their district were collected from the Superior Electoral Court's website (*Tribunal Superior Eleitoral*, TSE). Municipal socio-economic data were obtained from the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatísticas*, IBGE), this includes income per capita, population size and longitude and latitude coordinates. Finally, we collected data on approved budget amendments from the Brazilian Chamber of Deputies' website.

For each budget cycle, we aggregate the total funds each federal representative allocated to each municipality. The budget cycles considered in this analysis are 2000–2003, 2004–2007 and 2008–2011. We considered all federal budget amendments proposed by each representative, independent of it being *de facto* implemented. Note that, as federal budgets are determined in the year preceding its implementation, federal representatives elected in 1998 and whose term starts in 1999, can only start allocating

discretionary funds from the 2000 federal budget. In addition, since all municipalities used EV in the 2002 and 2006 federal elections, the budget cycle between 2000 and 2003 is the only one that allows us to measure how variation in EV usage impacts the allocation of federal funds. The remaining ones will be used in our falsification tests.

Table A1 in the appendix provides descriptive statistics of the municipalities in the sample. We divided Table A1 in two Panels, A and B, considering respectively all Brazilian municipalities and only the ones within the optimal bandwidth (8,688). As can be seen in this table, turnout in Brazil is close to 80% and is stable across elections and samples. Population, GDP per capita and the number of associate candidates all present a positive time trend and are, on average, larger among municipalities in the restricted sample. Budget amendments per voter also present an upward time trend; however, they are, on average, larger among the unrestricted sample.

#### 4. Findings

#### 4.1. Does EV affect federal representatives' allocation of funds?

We start this subsection showing that low-income voters were disproportionately benefitted by EV usage, subsequently, we show that our sample is balanced and provides evidence of the positive impact of EV on the total amount of discretionary funds.<sup>18</sup> We use a regression discontinuity as the ones proposed in equation 1; however, we use data at the municipality level (i.e. it does not vary at the federal representative level). Table 1 considers the sample of municipalities within the optimal bandwidth and splits this sample into quintiles using municipalities' income per capita. As one can notice, the bottom two quintiles had the largest impact of EV usage on valid votes to turnout ratio while the top two quintiles had the lowest impact. This corroborates our hypothesis that EV disproportionately enfranchised low-income voters. Next, we show in Figure 2, Panel A, that our sample is balanced. Using the same RDD model (i.e. varying at the municipality level only), we show that the number of associate candidates as well as the income per capita, voting turnout, longitude and latitude do not change discontinuously across the threshold in 1998 suggesting that there are no confounding variables explaining our results. The only significant result we find is that the total funds per voter received by municipalities using EV during the 2000-2003 budget cycle increased by 18 Brazilian reais (in 2000 value). We corroborate our hypothesis that EV usage caused this increase by showing in Figure 2, panel B, that there are no discontinuities in the total funds per voter received by municipalities during the next two budget cycles (i.e. 2004-2007 and 2008-2011) when all municipalities used EV.

Next, we estimate the regression proposed in Equation 1 using our data at the federal representative level. This granular analysis helps us understand how representatives behave at the individual level and whether they respond to the enfranchisement of low-income voters. We first analyze row 1, which restricts our regressions to the 2000–2003 budget cycle (after the 1998 elections). We first notice that not adding controls nor federal representative fixed effects decreases the magnitude and significance of our estimate (significant at the 12% level). However, once fixed effects are added controlling

<sup>&</sup>lt;sup>18</sup>We thank an anonymous referee that suggested adding these analyses to the paper.





₽-30000 35000 40000 45000 Number of Voters

20



Figure 2 shows an electorate size-varying function using an 8,688 number of registered voters' bandwidth and a vertical red line representing the cutoff point (40,500). The solid line is fitted separately on each side of the threshold, and the dashed line represents the 95% confidence interval. The scatter plots show averages for intervals of 1,000 voters. Panel A shows estimates for 1998 and Panel B shows estimates for 2002 and 2006.

50000

30000

35000

45000

40000 Number of Voters 50000

for time-invariant characteristics of each representative, our estimate increases by close to 1.7 times and becomes highly significant. It also improves the fit of our model (based on a larger F-statistic). We increase even more the precision of our estimates; the fit of our model; and the magnitude of the results once we add controls for income, population and political relevance of each municipality to each representative. By controlling for representatives' fixed effects we can capture all the variation within each representative's

decision of allocating funds to the municipalities considered in our sample. This allows us to understand whether representatives respond, at the individual level, to the enfranchisement of low-income voters. Our preferred estimation in Table 2 shows that EV increased the amount of federal funds per voter sent by a representative to a municipality by 0.43 Brazilian *reais* (in 2000 value). This result is not only statistically significant but is also relevant in terms of magnitude. The average of funds per capita sent by a representative to municipalities within the optimal bandwidth in the 2000–2003 budget cycle was 0.56 Brazilian *reais* (in 2000 value). Therefore, EV caused an increase of 76% from the mean in the funds per capita allocated by each representative at the municipality level.

Finally, we propose a falsification test that once again estimates the regression presented in Equation 1, but that analyzes different budget cycles – where there was no variation in EV usage – to examine whether our sample suffers from selection bias. In Table 2, rows 2 and 3, we find – consistent across all specifications – that funds per voter vary smoothly across the cutoff point. When we analyze the budget cycles following the 2002 and 2006 elections, where all municipalities used EV, there are no statistically significant results. This falsification test improves the strength of our estimation reported in row 1 indicating that it is likely driven by the enfranchisement of low-income voters caused by EV.

#### 4.2. Heterogeneous effects of EV

Next, we examine whether the impact of EV usage on the allocation of discretionary funds varies across federal representatives' level of experience. We expect that experienced candidates will be more responsive to voters' demands as they are familiarized with the process of strategically allocating discretionary funds to maximize their chances of staying in office. We use two variables as proxies for experience: candidates' reelection status and age. We first examine whether candidates that were reelected were also more responsive to EV usage. In Table 3, Columns 1 and 2 split candidates within reelection status. The results suggest that candidates reelected are more responsive to enfranchisement of low-income voters. Columns 3 and 4 split the sample between below and above

	(1)	(2)	(3)
VARIABLES	Funds per voter	Funds per voter	Funds per voter
EV – 1998	0.199	0.334***	0.431***
	(0.128)	(0.119)	(0.113)
EV – 2002	-0.168	0.054	0.163
	(0.188)	(0.174)	(0.169)
EV – 2006	-0.098	0.055	0.157
	(0.358)	(0.265)	(0.260)
Federal representatives Fixed Effects	No	Yes	Yes
Controls	No	No	Yes

Table 2. Measuring the EV impact on the allocation of funds from the federal budy	budge
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Standard errors are reported in parentheses. Controls include population, income and association to the municipality. All regressions consider the optimal bandwidth of 8,688 registered voters. Each row runs a separate regression, for each budget cycle, measuring the impact of being assigned to use EV in 1998 on funds per voter. EV – 1998, EV – 2002 and EV – 2006 consider, respectively, the 2000–2003 (539 representatives and 7,882 observations), 2004–2007 (523 representatives and 7,630 observations) and 2008–2011 (535 representatives and 7,786 observations) budget cycles. \* Statistically significant at 10%.\*\* Statistically significant at 5%. \*\*\* Statistically significant at 1%.

	(1)	(2)	(3)	(4)
VARIABLES	Reelected	Not-reelected	Below median age	Above median age
EV	0.468***	0.370*	0.391**	0.490***
	(0.131)	(0.201)	(0.168)	(0.149)
Observations	4,719	3,163	4,168	3,714

Table 3. H	eterogeneous	effects of EV	usage on t	the allocation	of funds	from the	federal I	budget

Standard errors clustered at the federal representative level are reported in parentheses. Controls include population, income, association to the municipality and federal representatives fixed effects. All regressions consider the optimal bandwidth of 8,688 registered voters. Columns 1, 2, 3 and 4 consider, respectively, 307, 232, 316 and 223 federal representatives. \* Statistically significant at 10%.\*\* Statistically significant at 5%. \*\*\* Statistically significant at 1%.

median age candidates. Older candidates are also more responsive to enfranchisement. Combined, these results indicate that more experienced candidates responded better to the enfranchisement of low-income voters.

#### 4.3. Alternative interpretations

The last part of our empirical analysis discusses threats to the interpretation of our findings and implement additional robustness checks. So far, we have interpreted our findings as a consequence of enfranchisement biased toward poor voters. However, we acknowledge that the main threat to our interpretation is that municipalities that use EV will automatically provide a disproportionately larger share of votes to elected representatives because voters are more likely to cast valid votes in these localities. Therefore, we cannot disentangle the effect of larger political support from enfranchisement of low-income voters.

We attempt to solve the aforementioned issue by investigating whether our results are driven by increase in political support. First, we regress the total funds per voter on the share of each representative's total vote coming from the municipality, and the share of the municipality's total vote for each candidate.<sup>19</sup> We then use the residuals of this estimation, which captures the part of the total funds per voter that cannot be explained by our measure of political support and use it as our dependent variable following Equation 1. Table 4, Column 1, reports our estimation, where we find that EV increased total funds per voter by 0.34. The results suggest that only a small fraction of our main estimate could be driven by the effect of EV on the share of political support obtained by representatives. In Columns 2–4, we show that our results are not sensitive to allowing the running variable to vary quadratically and cubically, nor to using the rdrobust package.<sup>20</sup> Finally, following Fujiwara (2015), we set 20,000 and 5,000 registered voters as maximum and minimum bandwidths for our sample, respectively, and show (columns 5 and 6) that our results are robust to these bandwidths' selection.

<sup>&</sup>lt;sup>19</sup>We also include population, income and federal representative fixed effects as additional control.

<sup>&</sup>lt;sup>20</sup>To this end, we utilize the Stata package rdrobust, which uses a triangular kernel to estimate our regression model instead of the uniform kernel we used throughout our empirical analysis.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Residuals	Quadratically	Cubically	Rdrobust	Larger bandwidth	Smaller bandwidth
EV	0.339***	0.430***	0.291**	0.446***	0.281***	0.274*
	(0.097)	(0.113)	(0.148)	(0.123)	(0.082)	(0.144)
Observations	7,882	7,882	7,882	7,882	23,596	4,989

 Table 4. Robustness analysis examining the impact of EV usage on the allocation of funds from federal budget.

Standard error clusters at the federal representative level are reported in parentheses. All regressions consider 539 representatives and are controlled by population, income, association to the municipality and federal representatives fixed effects. In addition, columns 1–4 consider the optimal bandwidth of 8,688 registered voters, while column 5 and 6 contain, respectively, 20,000 and 5,000 registered voters. EV is a dummy variable indicating EV usage in 1998. Column 1 is an estimation of the impact of EV on funds from the federal budget after removing the part of these funds that are explained by socio-economic variables and political support. Columns 2 and 3 allow the running variable to vary quadratically and cubically, respectively. Column 4 uses the rdrobust package and triangular kernel. Columns 5 and 6 estimates the baseline model but considering a 20,000 and 5,000 bandwidth, respectively. \* Statistically significant at 10%.\*\* Statistically significant at 5%. \*\*\* Statistically significant at 1%.

### 5. Discussion

Our estimates presented in Section 4 indicate that federal representatives sent, on average and during the 2000–2003 budget cycle, 0.43 more Brazilian *reais* (in 2000 value) per eligible voter to municipalities using electronic voting (EV). As the average of voters in our sample is 41,196, we find that federal representatives sent, on average and during the 2000–2003 budget cycle, 17,714 more Brazilian *reais* (in 2000 value)<sup>21</sup> to municipalities using EV. Using figures from Hidalgo (2012), where EV is reported to have increased the valid-votes-to-turnout ratio for federal representative by 23 percentage points, we apply a back-of-the-envelope calculation to estimate the direct impact of increasing valid votes on discretionary transfers. Our results indicate that an increase of one percentage point in the valid-votes-to-turnout ratio increases the total discretionary funds per voter by 0.018 Brazilian *reais*. This is equivalent to a 3.3% increase from the mean baseline amount of funds per voter (0.56 Brazilian *reais*) considering our restricted sample.

The connection between democracy and representation lies at the foundation of political participation and liberties. If participation is widespread and voters are free to express their choices, then elected policymakers will act in the best interest of the people. Consequently, institutions and rules are often devised to encourage civic involvement in politics and to promote freely contested elections. For instance, democracies promote participation by holding elections on holidays or weekends, permitting absentee and early voting, and creating initiatives such as the prominent Get-Out-The-Vote (GOTV) campaign (see Berinsky, 2005; Berinsky, Burns, & Traugott, 2001).

Nonetheless, campaigns to increase voting participation as absentee and early voting as well as GOTV mostly increases the participation of the rich and the impact of enfranchising low-income voters is unclear. This paper shows that enfranchisement of low-income voters, concentrated among municipalities using EV, increased the amount of discretionary funds from the federal budget allocated to these localities. The main contribution of the present work is, therefore, to show the consequences of *de facto* 

<sup>&</sup>lt;sup>21</sup>This value corresponded to approximately 9.6 thousand USD as the annual average exchange rate in 2000 was 1.83 BRL/USD.

enfranchisement on the allocation of 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.

# 6. Conclusion

This article examines whether an increase in political participation biased toward low-income voters - and concentrated in legislative elections - impacts federal representatives' allocation of resources from the federal budget to Brazilian municipalities. Our findings suggest that federal legislative representatives responded to the enfranchisement of low-income voters, concentrated in municipalities using EV, by allocating more federal funds to these localities. To attenuate concerns that our findings may be capturing confounding variables that vary across EV usage, and to provide results consistent with our interpretation that representatives are responding to a shift in the income of the median voter, we use two strategies. First, we control for federal representatives' fixed effects. Second, in a residual analysis, we only examine the variation in the decision to allocate federal funds that are unexplained by variations in political support. In both analyses, we find support for the conclusion that EV usage per se explains the allocation of funds from the federal budget, which we interpret as suggestive evidence that enfranchisement of poor voters is driving our results. Finally, we find support for the hypothesis that experienced politicians are more responsive to the enfranchisement of low-income voters as they are familiarized with the process of strategically allocating discretionary funds to increase the chances of reelection.

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#### Notes on contributors

*Rodrigo Schneider* is an Assistant Professor of Economics at Skidmore College. He received his bachelor's degree in economics from Insper in 2010; his master's degree in economics from the University of Brasília in 2012; and his Ph.D. in economics from the University of Illinois at Urbana-Champaign in 2018. Dr. Schneider specializes in public policy, political economy, applied econometrics, and development.

*Diloá Athias* is an economist with research interests in the field of public policy, especially in social policy and social protection. Diloá holds a Ph.D. in economics from the University of Illinois and is currently an Economist at Development Pathways, United Kingdom.

*Mauricio Bugarin* is a Professor of Economics at the University of Brasilia, Brazil and is the Leader of the Economics and Politics Research Group. He received his B.A. and M.A. degrees in Mathematics from the University of Brasilia and his M.Sc. and Ph.D. degrees in Economics from the University of Illinois. He is presently visiting the Political Science Department at Vanderbilt University. Prof. Bugarin's main interests encompass institutions and their role in promoting democracy, economic efficiency and the rule of law; applied mechanism design; public economics and economic models of political processes; and Brazil-Japan comparative studies.

#### ORCID

Mauricio Bugarin (b) http://orcid.org/0000-0003-1177-7344

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- 314 👄 R. SCHNEIDER ET AL.
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# Appendix



#### Figure A1. Density function of observations.

The running variable in the horizontal axis is equal to the number of registered voters in 1996 minus 40,500. The vertical line indicates the cutoff (i.e. number of registered voters in 1996 = 40,500). The McCrary density test fails to reject the null hypothesis of no discontinuity in the density at conventional levels of significance at the cutoff (*p*-value is 0.23). The bin size is 686 and the bandwidth is 17,200.

	Periods						
	Election year: 1998		Election year: 2002		Election year: 2006		
	Budget Cycles: 2000-03		Budget Cycle: 2004-07		Budget Cycle: 2008-11		
	(1) (2)		(3)	(4)	(5)	(6)	
VARIABLES	Mean	SD	Mean	SD	Mean	SD	
Panel A: All municipalities							
Turnout	0.764	0.091	0.804	0.070	0.819	0.054	
Number of associate deputies	3.77	2.78	4.30	2.88	4.62	3.18	
Budget amendments per voter	47.11	99.00	47.69	314.65	68.93	669.06	
Population	29,771	178,831	31,409	189,548	33,568	199,101	
GDP per capita	3.748	3.980	5.357	5.961	8.189	9.557	
Observations	5,506		5,556		5,557		
Panel B: Municipalities within the c	ptimal band	lwidth (8,688)					
Turnout	0.782	0.075	0.818	0.052	0.823	0.039	
Number of associate deputies	4.96	3.78	5.54	4.05	5.61	4.07	
Budget amendments per voter	26.26	25.57	32.94	36.36	55.69	92.50	
Population	64,720	13,594	69,359	16,591	75,221	22,386	
GDP per capita	5.090	4.552	6.830	5.724	10.082	8.216	
Observations		195		195		195	

Budget amendments per voter are in Brazilian *reais* in 2000 prices. Population and GDP per capita for each municipality are measured as budget cycle means. See text for how the optimal bandwidth is calculated and data sources.