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The Effect of Split-Ticket Voting Cost on Electoral Enfranchisement

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The features of electoral systems can affect electoral outcomes even for fixed societal preferences. We analyze a quasi-experiment around a staggered change from a paper ballot to an electronic ballot system, which reduces the cost of split-ticket voting. A high cost to split the ticket favors straight-ticket voting, i.e., choosing the same party in all electoral races. If voters care the most about a single-seat race and if they are voting straight-tickets, then the single-seat race drives the decision about which party to vote on all races. Therefore, strategic voting considerations on the single-seat race have spillovers to other races, negatively affecting small parties even in races with a proportional representation system. We show how the reduction in the cost to split the ticket increases the number of split-ticket votes and improves the performance of small parties in multiple-seat races. This results in higher political competition.

KEYWORDS

electoral system, elections, electronic voting, strategic voting, split-ticket, political competition, enfranchisement

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El efecto del costo del corte de boleta en la representación del electorado

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Las características de los sistemas electorales pueden afectar los resultados incluso para preferencias sociales fijas. Se analiza un cuasi-experimento en torno a la adopción escalonada de un sistema de boleta electoral de papel a uno de boleta electrónica que reduce el costo del corte de boleta. Un alto costo de cortar boleta favorece la votación por lista completa, es decir, elegir el mismo partido en todas las contiendas electorales. Si a una votante le importa más la contienda de nivel superior, de un solo escaño, y si decide votar la lista completa, entonces la contienda de un solo escaño domina la decisión en las contiendas de todos los niveles de gobierno. Por lo tanto, las consideraciones estratégicas de votación en la contienda de un solo escaño tienen efectos indirectos en las otras, lo que afecta negativamente a los partidos pequeños incluso en contiendas de múltiples escaños con representación proporcional. Se muestra cómo la reducción en el costo de cortar la boleta aumenta la incidencia boletas divididas y mejora el desempeño de los partidos pequeños en contiendas de múltiples escaños. Esto resulta en una mayor competencia política.

KEYWORDS
sistema electoral, elecciones, voto electrónico, voto estratégico, corte de boleta, competencia política, representación del electorado

1 | INTRODUCTION

Electoral systems are a fundamental pillar of democratic societies. Their characteristics influence electoral results, even for fixed societal preferences. In turn, they affect policy decisions and economic outcomes, ultimately affecting societies' welfare. Even as the stakes of electoral outcomes are high, with the potential to alter the allocation of key resources across groups, the private return on an individual vote is small: the probability that any voter is pivotal is negligible due to electorate size, even for local elections.[1] Thus, minor changes in electoral rules that affect perceived costs and benefits can have profound implications on voters' choices. A deeper understanding of these implications can help design electoral systems that allow voters to better express their preferences.

In this study, we examine the effect of the adoption of a new electoral technology on voters' expressed preferences. We exploit a quasi-experiment around the staggered change from a paper French ballot-and-envelope to an electronic ballot system in the province of Salta, Argentina. The change reduced the cost of split-ticket voting, i.e., choosing different political parties across races. Under the ballot-and-envelope system, each party had its own partisan paper ballot listing candidates for all the electoral races. If the voter wanted to split the ticket, she had to physically cut the ballots of the different parties and combine her desired choices for each race. The process imposed a cost both in terms of time and in the perceived risk of making a mistake and getting the vote nullified. The cost was largely reduced under the new electronic ballot system.

We build a model to analyze the implications of an electoral technology reform that reduces the cost of splitting the ticket. The model comprises voters' uncertainty regarding societal preferences and strategic voting, i.e., the act of not voting the preferred party with the aim of affecting the outcome of the election. The model has a continuum of voters, four political parties, and two electoral races: a single-seat race (e.g., governor) and a multiple-seat race (e.g., city council). Voters have lexicographic preferences with respect to the outcomes across races, and thus they first decide who to vote on the single-seat race and, with that taken as given, they choose their vote on the multiple-seat race. Voters have to pay a fixed cost to split the ticket, that is, to vote a different party on each race. Due to strategic considerations, voters only vote large parties on the single-seat race, and if the cost of splitting the ticket is large enough, many of them refrain from splitting the vote and choose the same large party on the multiple-seat race.

There are three main implications of this model. First, a cost reduction in split-ticket voting increases the amount of split-ticket votes. Second, it improves the performance of small parties in multiple-seat races. Third, this improved electoral performance results in increased political competition. We empirically test and verify these implications and thus show how strategic considerations in one race, combined with high costs to split the ticket, can affect party performance even in races where strategic considerations do not intrinsically hold. Interventions that facilitate ballot splitting can increase political competition.

Our paper directly contributes to the literature on enfranchisement and on strategic voting. Both in advanced (e.g., Valelly, 2004; Miller, 2008; Naidu, 2012; Fresh, 2018) and developing economies, key suffrage laws have had large effects on enfranchisement levels and on electoral results across political parties. Ferreira de Moraes (2012), Fujiwara (2015), and Schneider et al. (2020) analyze the introduction of electronic voting in Brazil, which increased de facto enfranchisement of mainly lower educated citizens, increasing political competition. Higher political competition brought about a reallocation of public expenditure towards services most needed by the poor. This underscores the importance of

[1] Subjective elements of voting, such as moral reward, have been regarded by the literature as a necessary element to justify observed turnout (Jones and Hudson, 2000).

understanding which types electoral reforms raise political competition; a goal to which we contribute on our paper. In Brazil, the complexity of the previous voting technology manifested in a high incidence of nullified votes, particularly among illiterate voters. On our paper, we find that the complexity of the multiple paper-ballot system results in a bias against ballot splitting. We show how even minor complexities and their associated costs can preclude voters from fully expressing their preferences in elections, negatively affecting enfranchisement.

The literature has also established the incidence of voting errors that reduce effective enfranchisement for the US, as voters that make mistakes are not able to express their preferences. Analyzing the 2004 California recall election, Dee (2007) and Shue and Luttmer (2009) quantify the vote share-premium that accrues to less known candidates when placed besides one of the two major candidates. These mistaken votes are more prevalent when punch-card systems are in place and are positively related to the proportion of less educated and poorer households. Ansolabehere and Stewart III (2005) examine the relative performance of voting technologies in the United States from 1988 to 2000, finding that traditional single paper ballots produce the lowest rates of uncounted votes, followed by optically scanned ballots, mechanical lever machines, direct register electronic machines (DREs), and punch cards. In our study, voters' fear under the paper ballot system of making a mistake and of getting their vote nullified, combined with the time cost to split the ticket, biases them away from ballot splitting. Analyzing the determinants of turnout across US states in the 2008 election, Cebula et al. (2016) find that the presence of a presidential candidate of the same ethnic group increases turnout of African-American voters. The enfranchisement effect in this case responds to the added benefit brought about by a candidate menu that represents voters preferences more closely. Our findings provide similar evidence from the cost side: for a fixed candidate menu, the policy implemented reduced the cost of choosing the most desired option for each race in the presence of strategic considerations, increasing enfranchisement.

In turn, strategic voting refers to casting a vote that does not sincerely reflect the voter's preference ordering. In its most common form, a voter chooses her most preferred option only amongst candidates with significant chances of securing a seat. Analyzing the merger of Finnish municipalities, Saarimaa and Tukiainen (2016) show that the reform led to higher vote concentration within the previous municipal boundaries. This was caused by voters trying to make sure that candidates from their city, which are more likely to defend their interests, made it to the municipal legislature. That is, even within the set of candidates from their city, voters adjusted their voting decisions depending on the chances of each political party of winning a seat. The reform led to higher vote concentration, while the opposite is the case for the reform analyzed in our study. This underscores the importance of taking into account voters' strategic behavior when analyzing the implications of potential electoral reforms.

A large group of papers has attempted to identify and measure the amount of strategic voting, as well as its determinants (e.g., Blais and Nadeau, 1996; Cox and Soberg Shugart, 1996; Alvarez and Nagler, 2000; Duch and Palmer, 2002; Alvarez et al., 2006; Endersby and Shaw, 2009; Blais et al., 2010; Fujiwara, 2011; Plutowski et al., 2020). Blais et al. (2001) propose a methodology to examine different forms of strategic voting. Kawai and Watanabe (2013) use a model to measure strategic versus misaligned voting, that is, whether the voter is strategic vs whether because of being strategic she votes a party that is not her preferred one. Abramson et al. (2009) compare, across countries, the incentives to vote strategically on first-past-the-post versus proportional representation systems. Cox (1997), Bawn (1999), Reed (1999), Moser and Sheiner (2005), Gschwend (2007), Moser and Sheiner (2009), and Spenkuch (2018) investigate the incentives to split the ticket to vote strategically on mixed-

member electoral systems where voters cast multiple ballots simultaneously. Moser and Sheiner (2009) presents evidence on how the incentives to split the ticket to vote strategically depend upon a variety of institutional and contextual factors. We show how a small cost to split the ticket that reduces the amount of split-ticket voting, can, combined with voter preferences and strategic behavior, have diverse implications for different electoral races and parties.

Our paper builds on Barnes et al. (2017), a previous causal assessment of the adoption of electronic ballots in Salta. They show how a reduction in the cost of splitting the ticket increases split-ticket voting. They argue that voters' decisions regarding whether to split the ticket are only affected by the ballot change if the benefit of splitting is unclear, given that voters already split if the benefit is clear. On the empirical analysis they show which parties received more or less votes for governor than for the legislature in precincts using electoral ballots first relative to other precincts, looking at each electoral episode separately. In our view, this approach has two main limitations. First, it does not allow for an analysis of party performance as it does not show, for instance, if the increase in the relative performance on the executive race relative to the legislative race is due to an improvement in electoral performance in the former or a deterioration in the latter. Evaluating parties' performances provides important insights into voters' preferences and strategic decisions. Second, the reliance on the cross sectional estimation of each electoral episode may not allow for an adequate correction of selection bias.

We expand their analysis in multiple ways. First, we rely on party groupings that remain stable over time, which allows us to perform a difference-in-difference identification strategy to estimate the effects of the ballot change on parties' performance. Second, we provide a model to formalize our assumptions, which has testable empirical implications on the expected impacts on ballot splitting, party performance across races, and political competition. The model provides important insights on voters' preferences across races and their strategic voting behavior. In particular, that voters' prioritize the executive race in their voting decisions. Our empirical results provide support to this implication. Third, we further expand the empirical analysis by including the mayor and city council races, and by incorporating data on two additional elections to allow for the evaluation of pre- and post-trends of the dependent variables, providing further support for a causal interpretation of the results.

Our analysis does not take a stand on the desirability of one ballot technology over the other. First, such conclusions warrant a careful consideration of the multiple dimensions affected by the policy change, such as the pecuniary costs of each technology for electoral institutions and for political parties, the ease of use of each technology across socioeconomic and demographic groups, and the transition learning costs for voters, among others. Second, the societal welfare implications of the ballot change through the dimensions analyzed in this article are not established. In particular, both political competition and legislative fragmentation may have important trade-offs. For instance, while the reduction in the cost to split the ticket allowed voters to better express their preferences, the increased political competition/fragmentation may lead to higher political gridlock.[2]

The remainder of this paper is organized as follows. Section 2 describes the context and the characteristics of the voting technologies. In section 3 we propose a model of strategic voters voting on multiple races under the presence of split-ticket costs, and derive its predictions. In section 4 we describe the data and our empirical strategy to test the model's predictions. In section 5 we show our results, and in section 6 we perform our main

[2]For more on the trade-offs of increasing political competition see, for instance, Alfano and Beraldi (2015). Additionally, the ease of split-ticket voting may induce an increase of the electoral options and a corresponding increase in cognitive and information costs for voters.

robustness checks. Section 7 concludes.

2 | CHARACTERISTICS OF EACH ELECTORAL SYSTEM

2.1 | Old Electoral System: French Ballot-and-Envelope

The Argentinian traditional system is based on the French ballot-and-envelope model, in which each political party has its own paper ballot which lists all the party's nominees for each race. Figure 1 shows a ballot from the 2007 provincial-level elections. The left part shows the candidates for the governor race, the middle part for the congress race, the top right part for the mayor race, and the bottom right for the city council race.

FIGURE 1 Paper ballot under the traditional electoral system. *Source:* Electoral Tribunal of Salta Province.

Voters form a line in order to receive an empty envelope. Then, they enter the "dark room" one at a time, where they make their choices in private, choosing among all of the ballots that are displayed on a table. If the voter wants to vote the same political party across all the races, she introduces the desired ballot into the envelope. If she wants to vote different political parties for different races, she has to manually cut each part of the corresponding ballot and place the desired parts into the envelope.[3] If she mistakenly includes more than one political party for the same race, or if when cutting the ballots relevant parts are cut away, then the vote is nullified. It is important to point out that voters cannot choose which candidate within a party to vote, they can only choose across parties for each race.[4]

When the voter leaves the room, she deposits the envelope into a ballot box within sight of the voting room authorities and other people waiting to vote. Each political party is responsible for printing and supplying its own paper ballots to the voting rooms. The government transfers funds to the parties for them to perform such activities.

[3]There are scissors in the voting rooms.

[4]For the multiple-seat races, where multiple candidates from the same party can get elected, the party has a fixed pre-established ordering.

2.2 | New Electoral System: Electronic Voting

Under the electronic ballot system, when the voter arrives to the voting room, she receives a blank ballot which she has to introduce into a voting touch-screen machine. On the screen she has to choose how the candidates for each race will be displayed.

One option is to choose that the candidates are displayed by political party, in which case the device will first display all gubernatorial candidates. After she chooses the gubernatorial candidate, the other lists and candidates associated with the chosen prospective governor will be displayed. The reason is that in Argentina gubernatorial candidates usually have the support of multiple smaller political parties that do not file gubernatorial candidates of their own. In the second screen there will be many lists, all with the same prospective governor, but each with a different set of candidates for the other electoral races. By selecting and confirming, the voter is casting a straight-ticket ballot. Another initial option is to choose to display the candidates by electoral race, in which case the voter sees all the candidates for a race at once, selecting across parties for each race independently. The candidates on the screen appear in random order to avoid having an effect on the results, as investigated by Dee (2007). Figure 2 shows a display of candidates of all political parties competing for a senator race.

FIGURE 2 Screen view when voting on the Senator race under the new electronic electoral system. *Source:* Electoral Tribunal of Salta Province.

After selecting the desired candidates on the touch screen, the machine prints them on the ballot and saves the information on a radio-frequency identification chip contained inside it, information that is not stored in the voting machine. The machine guides the voter while choosing the candidates, and only prints valid combinations, which prevents the vote from getting nullified. Lastly, the voter has to fold the ballot in half and introduce it into the ballot box.[5] The new ballot system reduces the cost of splitting the ticket in terms of

[5]The electronic ballot includes two easy-cut-through stubs, one at each end of the ballot, containing a ballot number. Precinct authorities preserve the first stub while the voter is casting the vote and verifies that it coincides with the second stub before allowing the voter to insert the printed ballot in the ballot-box and discarding both stubs. The main body of the ballot does not contain any identification number, so that it cannot be traced back to any voter.

required time and chances of nullification.

3 | MODEL

We build a model to obtain predictions about how strategic voters' behavior changes in response to reductions in the cost of splitting the ticket in elections with two races that differ in number of seats.

In the model there are two races. Race 1 (governor) offers only one seat and is the one that voters care about the most (see lexicographic preferences on next paragraph), and race 2 (city council) offers multiple seats. There is a continuous variable p that captures parties' characteristics. Voters have preferences over p. There are four parties, each located at a different value within the support of p. We denote as C^L, C^{ML}, C^{MH}, and C^H the relative (to each other) low, medium-low, medium-high, and high values of the p variable that the different parties posses, respectively. The parties located at C^{ML} and C^{MH} are closer to the preferences of the median voter, and in some instances will be denoted as "large parties", while the parties located at C^L and C^H will be denoted as "small parties".

Voters choose candidates (parties) for both races, choices that we denote by (c_1, c_2), where the sub-indices indicate the race.[6] c_1 is the value of the variable p of the party chosen for race 1, and similarly for c_2. This means that the choice set for both c_1 and c_2 is $\{C^L, C^{ML}, C^{MH}, C^H\}$. Let u_1 and u_2 be the utility that voters obtain from each realized race outcome. We assume that preferences between the two races are lexicographic, which means that for two bundles $(\tilde{c}_1, \tilde{c}_2)$ and $(\hat{c}_1, \hat{c}_2)$, the former is strictly preferred to the latter, $(\tilde{c}_1, \tilde{c}_2) \succ (\hat{c}_1, \hat{c}_2)$, if either of the following two conditions is satisfied:

- $u_1(\tilde{c}_1) > u_1(\hat{c}_1)$
- $u_1(\tilde{c}_1) = u_1(\hat{c}_1)$ & $u_2(\tilde{c}_1, \tilde{c}_2) > u_2(\hat{c}_1, \hat{c}_2)$

The voter is indifferent between the two bundles, $(\tilde{c}_1, \tilde{c}_2) \sim (\hat{c}_1, \hat{c}_2)$, if the following condition is satisfied:

- $u_1(\tilde{c}_1) = u_1(\hat{c}_1)$ & $u_2(\tilde{c}_1, \tilde{c}_2) = u_2(\hat{c}_1, \hat{c}_2)$

For all other cases, the latter bundle is strictly preferred to the former, $(\tilde{c}_1, \tilde{c}_2) \prec (\hat{c}_1, \hat{c}_2)$. This means that as long as a voter prefers the race 1 candidate of the tilde bundle, she will prefer that bundle. She only considers the candidates of the second race when she is indifferent between the candidates of the first. These preferences imply that voters first maximize the utility they get from voting on the one-seat race (race 1, governor), and with that taken as given, they maximize utility on the multiple-seat race (race 2, city council).

We assume that for race 1, which offers only one seat, voters vote strategically. That is, they vote the party that is closest to their ideology conditional on choosing among parties that have chances of winning the race. Voter i maximizes her utility on race 1 by choosing a candidate, c_1^i, for the race.

$$\max_{c_1^i} \; u_1^i\left(c_1^i\right) = \begin{cases} \max_{c_1^i} \; A_1 - \left(c_1^i - p^i\right)^2 & \text{if } Share_1(c_1^i) + \bar{\epsilon} \geqslant \max_{\tilde{c}_1^i \neq c_1^i} Share_1(\tilde{c}_1^i) + \underline{\epsilon} \\ 0 & \text{if } Share_1(c_1^i) + \bar{\epsilon} < \max_{\tilde{c}_1^i \neq c_1^i} Share_1(\tilde{c}_1^i) + \underline{\epsilon} \end{cases}$$

Where p^i is voter i's preferred value of the variable p and A_1 is a constant. $c_1^i \in \{C^L, C^{ML}, C^{MH}, C^H\}$, since voters can only chose a value of the variable p that some party

[6] As mentioned before, voters cannot choose the candidate within a party for a given race, they can only choose the party.

possess. The variable $Share_1(c_1^i)$ is the share of votes that party c_1^i is expected to get on race 1 in equilibrium. Voters form this expectation based on information from sources such as polls that take place before the election. Since polls are not perfectly accurate, voters know that the actual vote share of a party will be the expected vote share plus a random shock ϵ, that is, $Share_1(c_1^i) + \epsilon$. The values $\bar{\epsilon}$ and $\underline{\epsilon}$ are the maximum (positive) and minimum (negative) shocks that parties may receive to their vote shares.

Four shocks, one for each political party, are drawn on each election from a multivariate bounded function $e \sim g(e)$, where e is a vector whose elements sum to zero and all have the same support.[7] Voters know the distribution of the shocks. For party c_1^i to have a non-zero chance of winning the race, it has to be that $Share_1(c_1^i) + \bar{\epsilon} > \max_{\tilde{c}_1^i \neq c_1^i} Share_1(\tilde{c}_1^i) + \underline{\epsilon}$, that is, when it receives the most positive shock, its vote share has to be greater than the vote share of the largest party among the rest, when it receives the most negative shock. Voters only get positive utility if they vote a party with a non-zero probability of winning (strategic voting). Conditional on voting among such parties, the further away the level of the variable p of the party she votes (c_1^i) from her desired level (p^i), the lower her utility.

We assume the constant A_1 is large enough to make the utility of voting any party with chances of winning larger than zero. The optimal choice for the voter is to vote, among the parties that have chances of winning on race 1, the party that has a value of p closest to her desired one, that is, the choice that minimizes $\left(c_1^i - p^i\right)^2$. Figure 3 shows a possible location of parties (vertical lines) and voters preferences (density) over variable p. We denote by $f(p)$ the density of voters.

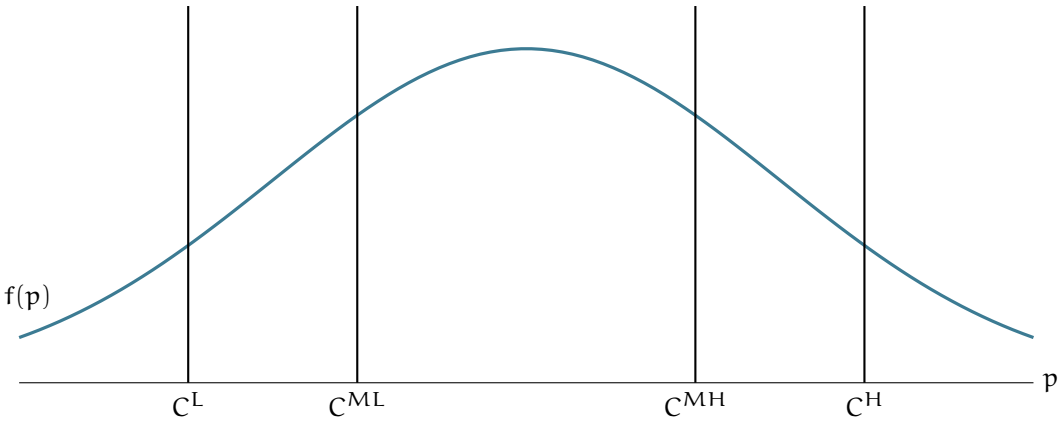

FIGURE 3 Parties' locations and density of voters. *Note:* $f(p)$ denotes the distribution of voter preferences over the policy variable p. C^L, C^{ML}, C^{MH}, and C^H are the locations along the policy variable of the four political parties.

The model defined so far has multiple equilibria. We impose further assumptions to reduce them to one, in a way that the remaining theoretical equilibrium is the most plausible one to emerge empirically. The assumptions are the following. First, using polls and other sources of knowledge on the distribution of other voters' preferences, voters calculate the vote shares that each party would get if everyone voted the party closest to their preferences. If under those circumstances a political party does not have chances of winning, not even under the best case scenario in terms of voting shares shocks, then nobody votes it (strategic voting). Second, voters re-compute the vote shares, assuming everyone votes their most preferred party among the parties remaining from step one. Once more, if a political party

[7] $e = (\epsilon^L, \epsilon^{ML}, \epsilon^{MH}, \epsilon^H)$; $\epsilon^L + \epsilon^{ML} + \epsilon^{MH} + \epsilon^H = 0$; $\underline{\epsilon} \leqslant \epsilon^\nu \leqslant \bar{\epsilon}$ $\forall \nu$

does not have chances of winning, then nobody votes it. This process is repeated until nobody is voting a party with no chances of winning. Assume initial conditions are such that only the two parties closest to the median of the distribution of p are voted in race 1 in equilibrium.[8]

After having decided her vote for governor (race 1), the voter decides which party to vote for the city council (race 2) solving the following utility maximization problem.

$$\max_{c_2^i} \; u_2^i\left(c_2^i\right) \;=\; \max_{c_2^i} \; A_2 - \left(c_2^i - p^i\right)^2 - \gamma 1_{\{c_1^i \neq c_2^i\}}$$

Where $c_2^i \in \left\{C^L, C^{ML}, C^{MH}, C^H\right\}$. Similarly to race 1, the further away the location of the party a voter votes (c_2^i) relative to her desired level (p^i), the lower her utility. If the voter decides to split her ticket and vote a party different than the one she voted in race 1, ($c_1^i \neq c_2^i$), she suffers a fixed cost γ.[9] We assume A_2 is large enough for the act of voting to always provide positive utility.

Given that for race 1 voters only vote the two parties closest to the median of $f(p)$ (not to waste their vote on parties which do not have chances of winning), and they only split and vote a different party for race 2 if that is optimal for them, the only voters who may split are the ones who prefer one of the parties on the extremes but did not vote it on race 1 to make their vote count. That is, voters on the tails of the $f(p)$ density.

For a voter whose preferred p level is to the right of C^{MH}, we know she votes C^{MH} for race 1 (governor). Her decision now is whether to split, pay the fixed cost, and vote the high-p value party C^H for race 2 (city council), or to not split and vote C^{MH} on both races.

If she splits ($c_1^i = C^{MH}$, $c_2^i = C^H$), her utility from race 2 is

$$u_2^{i,Split,H} = A_2 - \left(C^H - p^i\right)^2 - \gamma$$

If she does not split ($c_1^i = c_2^i = C^{MH}$), her utility from race 2 is

$$u_2^{i,NotSplit,H} = A_2 - \left(C^{MH} - p^i\right)^2$$

[8] If the following two conditions hold, nobody votes the parties with the lowest (L) and highest (H) values of p; they are eliminated in the first round of the mentioned elimination process.

1) $1 - F\left(\frac{C^H + C^{MH}}{2}\right) + \bar{\varepsilon} < F\left(\frac{C^H + C^{MH}}{2}\right) - F\left(\frac{C^{ML} + C^{MH}}{2}\right) - \underline{\varepsilon}$
2) $F\left(\frac{C^L + C^{ML}}{2}\right) + \bar{\varepsilon} < F\left(\frac{C^{ML} + C^{MH}}{2}\right) - F\left(\frac{C^L + C^{ML}}{2}\right) - \underline{\varepsilon}$

If the following four conditions hold, the two parties closest to the median of the distribution of p are voted in equilibrium in race 1. The first two conditions make sure neither party is eliminated in round 1, while the second two conditions make sure both parties have chances of winning in round 2, and therefore are not eliminated.

3) $F\left(\frac{C^{ML} + C^{MH}}{2}\right) - F\left(\frac{C^L + C^{ML}}{2}\right) + \bar{\varepsilon} > F\left(\frac{C^{MH} + C^H}{2}\right) - F\left(\frac{C^{ML} + C^{MH}}{2}\right) - \underline{\varepsilon}$
4) $F\left(\frac{C^{ML} + C^{MH}}{2}\right) - F\left(\frac{C^L + C^{ML}}{2}\right) + \underline{\varepsilon} < F\left(\frac{C^{MH} + C^H}{2}\right) - F\left(\frac{C^{ML} + C^{MH}}{2}\right) - \bar{\varepsilon}$
5) $F\left(\frac{C^{ML} + C^{MH}}{2}\right) + \bar{\varepsilon} \geqslant 1/2$
6) $1 - F\left(\frac{C^{ML} + C^{MH}}{2}\right) + \bar{\varepsilon} \geqslant 1/2$

Note that the middle points between the locations of two parties are used to establish which voters prefer each party.

[9] γ represents how much higher the cost of splitting the vote is compared to voting straight.

The voter splits as long as the following inequality is satisfied.

$$u_2^{i,Split,H} > u_2^{i,NotSplit,H}$$

$$A_2 - \left(C^H - p^i\right)^2 - \gamma > A_2 - \left(C^{MH} - p^i\right)^2$$

$$\gamma < \left(C^{MH} - p^i\right)^2 - \left(C^H - p^i\right)^2$$

Where the right hand side of the last equation is the reduction in the cost of misaligned voting caused by the fact that the voter votes C^H for race 2 instead of the same party that she voted for race 1.[10] The left hand side is the increase in the cost caused by splitting the ticket. The voter will split and vote C^H in race 2 if the reduction in the misaligned cost is larger than the increase in the cost caused by splitting the ticket.

For a given splitting cost γ, the further to the right the preference of the voter (p^i), the more likely she is to split the ticket. There is a cutoff $\tilde{p}^H$ for which voters with preferences to the right of it ($\tilde{p}^H < p^i$) will split the ticket and vote C^H for race 2, and people with preferences to the left of it ($p^i < \tilde{p}^H$) will not split the ticket and vote C^{MH} on both races. This is formalized in Lemma 1.

Lemma 1 $\exists\, \tilde{p}^H : \forall p_i > \tilde{p}^H,\ c_2^i = C^H$ *while* $\forall p_i :\ \frac{C^{ML}+C^{MH}}{2} < p_i < \tilde{p}^H,\ c_2^i = C^{MH}$

Proof Suppose $\exists\, p^0, p^1 :\ p^0 < p^1,\ c_1^0 = C^{MH},\ c_2^0 = C^H,\ c_1^1 = c_2^1 = C^{MH}$

That is, voter 1 has a higher optimal value of the policy variable than voter 0, and voter 1 does not split her ticket while voter 0 does. If voter 0 splits her ticket, it means that

$$\gamma < \left(C^{MH} - p^0\right)^2 - \left(C^H - p^0\right)^2$$

Since the RHS of the inequality is increasing in p, while the LHS is a constant, it means that voter 1 will also split her ticket.[11] $\Rightarrow\Leftarrow$

For voters whose preferences are to the left of C^{ML} there is a cutoff $\tilde{p}^L$. People with preferences to the left of it ($p^i < \tilde{p}^L$) will split the ticket and vote C^L for race 2, and people with preferences to the right of it ($\tilde{p}^L < p^i$) will not split the ticket and vote C^{ML} on both races.

Lemma 2 $\exists\, \tilde{p}^L : \forall p_i < \tilde{p}^L,\ c_2^i = C^L$ *while* $\forall p_i :\ \tilde{p}^L < p_i < \frac{C^{ML}+C^{MH}}{2},\ c_2^i = C^{ML}$

Proof Same steps as Lemma 1.

Figure 4 shows some possible $\tilde{p}^L$ and $\tilde{p}^H$ cutoffs. The gray areas are the fraction of voters that split their tickets. The change from the paper-ballot system to the electronic had

[10] It could be that her preferred party is C^{MH}, and the change in the misaligned cost caused by voting the C^H party is negative, and therefore she would vote the C^{MH} party in both races.

[11] The fact that $C^H > C^{MH}$ has to be used.

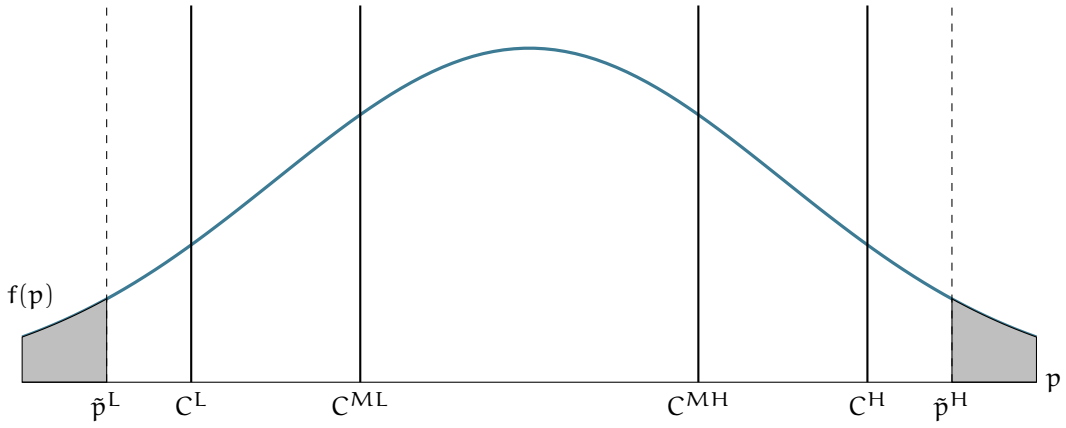

FIGURE 4 Indifference cutoffs between splitting or not the ticket. *Note:* $f(p)$ denotes the distribution of voter preferences over the policy variable p. C^L, C^{ML}, C^{MH}, and C^H are the locations along the policy variable of the four political parties. $\tilde{p}^L$ and $\tilde{p}^H$ denote the cutoff values that divide the voters who split their ticket from the ones that do not. Gray areas are the share of voters who split their ticket.

the effect of reducing the splitting cost γ.[12] This increased the incentive to split the ticket, shifting both cutoffs inwards, as shown in figure 5.

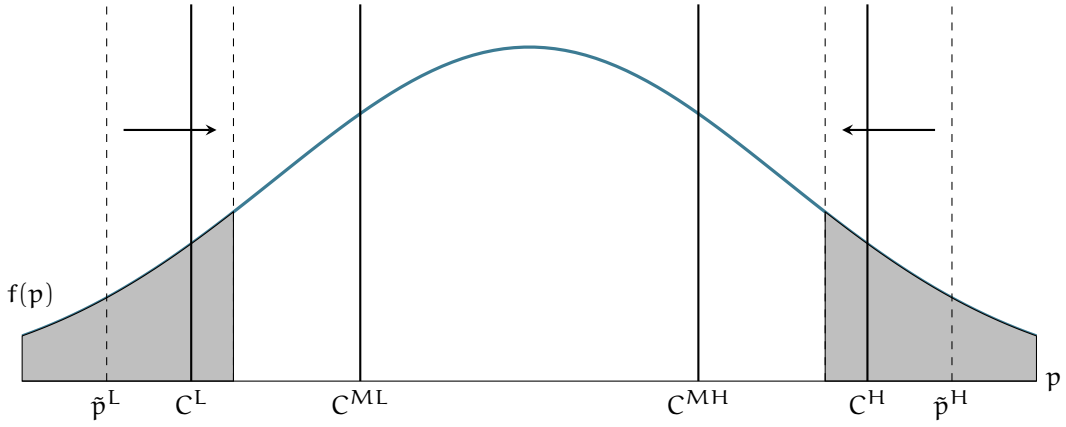

FIGURE 5 Shift in the split-ticket cutoffs when the splitting cost falls. *Note:* $f(p)$ denotes the distribution of voter preferences over the policy variable p. C^L, C^{ML}, C^{MH}, and C^H are the locations along the policy variable of the four political parties. $\tilde{p}^L$ and $\tilde{p}^H$ denote the cutoff values that divide the voters who split their ticket from the ones that do not. Gray areas are the share of voters who split their ticket. The cutoffs shift inwards when the cost of splitting the ticket falls.

Proposition 1: *The change in the electoral system, which reduces the cost of splitting the ticket,*

[12] In a poll performed during the 2011 elections and analyzed in Pomares et al. (2011), one of the questions asked was which system the voter would prefer to use if she was planning to split her vote. Of the people who used the electronic system to vote during that election, 82.6% answered that they would prefer to split using the new system. Of the people who voted using the paper system, 53.5% said that they would prefer to split using the new system. This suggests that the electronic system was perceived as less costly to split the ticket.

will increase the amount of split-ticket voting.

$$\frac{\partial \tilde{p}^L}{\partial \gamma} < 0 \qquad \frac{\partial \tilde{p}^H}{\partial \gamma} > 0$$

Proof The RHS of the following equation, which defines $\tilde{p}^H$, is strictly increasing in p^H.

$$\gamma = \left(C^{MH} - p^H\right)^2 - \left(C^H - p^H\right)^2$$

The same reasoning applies to the other derivative.

The fact that split-ticket increases means that while voters continue voting for large parties in the governor race (race 1), fewer voters vote for large parties in the city council race (race 2) and thus small parties gain vote shares in this race.

Proposition 2: *The change in the electoral system, through the increase in split-ticket voting, benefits small parties in the multi-seat race.*

$$\frac{\partial F(\tilde{p}^L)}{\partial \gamma} > 0 \qquad \frac{\partial [1 - F(\tilde{p}^H)]}{\partial \gamma} > 0$$

Where $F(\tilde{p}^L)$ and $[1 - F(\tilde{p}^H)]$ are the vote shares that the low and high parties receive in the city council race, respectively.

Proof Using the definition of a cumulative function, coupled with proposition 1.

We measure political competition using a fractionalization index as in Ferreira de Moraes (2012). If there are H parties, the fractionalization index is

$$Frac = 1 - \sum_{h=1}^{H} (vs_h)^2$$

Where vs_h is the vote share of party h. The index measures how evenly distributed votes are across parties and the number of parties. If its value converges to one, it means the vote shares of the parties converge to zero and that the elections are competitive. If its value converges to zero, it means the vote share of one party converges to one, and votes are concentrated. The variable can also be interpreted as measuring political fragmentation. Given that the reduction of the splitting cost increases the vote shares of small parties and decreases the shares of large parties, it makes the distribution of vote shares more evenly distributed across the political parties.

Proposition 3: *The change in the electoral system increases political competition in race 2, the multiple-seat race.*

$$\frac{\partial Frac_{Race_2}}{\partial \gamma} > 0$$

Proof Combining the assumptions made on initial parameter values, displayed again here for reference, with proposition 2 and the definition of the fractionalization index.

$$1 - F\left(\frac{C^H + C^{MH}}{2}\right) + \bar{\epsilon} < F\left(\frac{C^H + C^{MH}}{2}\right) - F\left(\frac{C^{ML} + C^{MH}}{2}\right) - \underline{\epsilon}$$

$$F\left(\frac{C^L + C^{ML}}{2}\right) + \bar{\epsilon} < F\left(\frac{C^{ML} + C^{MH}}{2}\right) - F\left(\frac{C^L + C^{ML}}{2}\right) - \underline{\epsilon}$$

4 | DATA AND EMPIRICAL APPROACH

The electoral data was gathered from the provincial electoral tribunal and the local branch of the federal tribunal. We obtained data of the provincial-level elections of 2007, 2011, 2015, and 2019, as well as the the legislative-only provincial-level election of 2009, which is used for robustness check analysis. During the 2007 and 2009 elections, the paper ballot system was used in the entire province. During the 2011 election the electronic system was partially introduced: some areas voted using the paper system and others using the electronic. Starting from the 2015 election the electronic system was fully implemented.

The province of Salta is subdivided into departments. We analyze the capital of the province, which is the only department in which both paper and electronic systems were used during the 2011 election. Departments are comprised of municipalities, which are subdivided into precincts, our units of analysis. Each precinct consists of a small number of voting centers (usually schools), and each voting center is divided into voting rooms.

$$\text{Room} \rightarrow \text{Voting Center} \rightarrow \text{PRECINCT} \rightarrow \text{Municipality} \rightarrow \text{Department} \rightarrow \text{Province}$$

To perform the analysis regarding split-ticket voting, political parties are grouped according to the governor candidate that they support (each governor candidate may have multiple political groups supporting him). For the investigation about the vote-share performances and political competition, we group parties according to their self-categorization into four categories: Peronism, Radicalism, Left, and Locals.[13]

In our remaining data processing steps, where we build sociodemographic data at the precinct-level and we perform a matching to address non-random assignment, we follow Barnes et al. (2017). To build sociodemographic data at the precinct-level we resort to the 2010 census.[14] Regarding the implementation of the change in the electoral ballot system, interviews with the bureaucrats report that the implementation of the electronic system during 2011 (treatment) was concentrated in the more developed areas, where the population had relatively higher socioeconomic and educational levels. The argued reason was that those areas had the best internet connection, which was important for a good test of the new system, and also because those segments of the population were more skilled to use the electronic system, reducing resistance to the reform (Alvarez et al., 2013; Pomares and Zarate, 2014; Barnes et al., 2017).

We have a non-random assignment of the locations where the electronic system was introduced first. However, the decision was made based on the development-level of the location, a variable that we approximate using the fraction of the population under the poverty line and the fraction of the population with primary or lower educational attainment. We use those variables and the pre-treatment value of the dependent variable to follow a coarsened exact matching (CEM) strategy. This matching method guarantees

[13] Results are robust to computing political competition without aggregating parties into the four mentioned categories.

[14] Census information is available at the census-tract level, the smallest official geostatistical unit (typically some blocks, or one block in densely populated areas). The census-tracts do not map exactly into electoral precincts, so we follow the Voronoi partitioning strategy to obtain precinct-level demographics. We first calculate a mean location of the voting centers by electoral precinct. Second, we assign each point in the territory to the closest mean precinct location, generating a set of Voronoi polygons that determine their area of influence. Voronoi partitioning constructs polygons based on a set of points in space so that every polygon side is equidistant to a pair of neighboring points. Last, we construct the set of socioeconomic variables of interest for each precinct by weighting the values of the census tracts contained in each corresponding polygon. The weight for each census tract contained in a polygon is the product of the fraction of the census tract area it covers and its population density, normalized so that the weights add up to one in each polygon.

balance improvement in all the variables used to perform the matching (Iacus et al., 2011). The identification assumption for our analysis is that the pruning of precincts that are not matched under CEM, using the dimensions that are known to have affected treatment assignment, allows us to satisfy the ignorability assumption and obtain unbiased causal estimates.[15]

Table 1 shows the mean of the poverty, non-education rates, and the measure of political competition for the City Council race, for the precincts first using the electronic system in 2011 (treated first) versus the precincts first using it in 2015 (treated second), both before and after performing the matching. The sample is balanced after the matching is performed. Appendix F shows a balance table with all the dependent variables analyzed in the paper. These variables are discussed in the next section.

	All Precincts			Matched Precincts		
	Treated in 2011	Treated in 2015	Diff.	Treated in 2011	Treated in 2015	Diff.
Poverty rate (%)	8.04	13.96	5.92***	9.10	8.74	-0.36
Non-education rate (%)	24.17	33.34	9.17***	27.72	28.89	1.18
Political competition City Council race (%)	39.13	24.72	-14.41***	30.85	30.79	-0.06

TABLE 1 Pre-treatment balance test for the Political Competition in City Council dependent variable. *Notes:* The table performs the balance tests using data from the 2007 elections, before any treatment took place. The statistics for matched precincts show results after a matching using the poverty rate, the non-education rate, and the political competition in the City Council race. Diff. = mean difference. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Using the matched observations, we estimate the effect of the introduction of the electronic system on electoral outcomes using a difference in difference approach, exploiting the fact that the change of the electoral system was performed in stages. The main regression specification is given by:

$$\text{Outcome}_{p,t} = \alpha_0 + \alpha_1 \text{Electronic}_{p,t} + T_t + P_p + \epsilon_{p,t} \quad (1)$$

Where $\text{Outcome}_{p,t}$ is the outcome variable to be analyzed of precinct p at time t. $\text{Electronic}_{p,t}$ is a dummy variable equal to one for a precinct-year when the electronic system is used and to zero otherwise. T_t and P_p are time and precinct fixed effects, respectively. Our coefficient of interest is α_1, which measures the effect of changing the electoral system from paper to electronic.[16] We cluster standard errors at the precinct-level to address potentially correlated shocks over time.

[15] The ignorability assumption states that conditional on the variables used to perform the matching, the treatment assigment is independent of the potential outcomes (Iacus et al., 2011). Since the development of the area is regarded by local informants as the variable used to decide whether the treatment is assigned, with more probability of assignment the more developed the area, for two precincts with the same level of development if only one receives the treatment, it is as good as random which of them receives it. This means that in our setting the ignorability assumption is satisfied.

[16] For α_1 to estimate the mentioned effect, we need to assume that individuals do not react in period t by knowing they will be treated in $t+1$, that the effect of being treated does not depend on how many periods ago they started being treated, and that the fact that there are treated precincts does not affect the behavior of the non-treated ones or vice versa (spillovers).

Our second regression specification takes the following form:

$$\text{Outcome}_{p,t} = \alpha + \beta_t \, \text{TreatedFirst}_p \, * \, T_t + T_t + P_p + \epsilon_{p,t} \tag{2}$$

Where TreatedFirst_p is a dummy variable equal to one if the precinct used the electronic system for the first time in 2011, and equal to zero if it used it in 2015 for the first time (differently to $\text{Electronic}_{p,t}$, TreatedFirst_p does not change over time for a given precinct). The estimated vector β shows the conditional mean difference of the dependent variable between those treated first (in 2011) and those treated second (in 2015) groups, for all electoral episodes. Each coefficient of the vector does so for a different election.

The main analysis is performed using the provincial-level elections of 2007, 2011, 2015, and 2019. Regression specification (2) allows us to check post-trends in the dependent variables, providing support for a causal interpretation of the results. For robustness, we include the intermediate 2009 election, which allows us to check pre-trends for some electoral outcomes. In Appendix D we show that results are robust to not performing any matching, and in Appendix E that they are robust to performing the matching only using the fraction of the population under the poverty line and the fraction of the population with primary or lower educational attainment.

5 | EMPIRICAL RESULTS

5.1 | Split-Ticket: Increases Across All Electoral Races

In this subsection we test proposition one of the model, which states that the change in the electoral system, which reduces the cost of splitting the ticket, will increase the amount of split-ticket voting.

Following Barnes et al. (2017), to measure the amount of split-ticket voting between the governor and city council races in precinct p, we take the absolute value of the difference between the number of votes obtained by the same political party j in the two races (if the party has more votes in one race than in the other, it means people split their ticket), sum across all parties in the precinct, divide by two (if one party got more votes for governor than for the city council, then another got more for the city council than for governor, and we want to avoid double counting the same split-ticket vote), and divide by the total number of valid votes in the precinct.[17]

$$\text{SplitTicketShare}_{\text{Govor}-\text{CCouncil}} = \left(\frac{\sum_j |\text{Votes}_{\text{Governor}_j} - \text{Votes}_{\text{CCouncil}_j}|/2}{\text{TotalVotes}} \right)$$

$\text{SplitTicketShare}_{\text{Governor}-\text{CCouncil}} \in [0, 1]$ is the share of split-ticket votes between the governor and city council races. The same share of split-ticket votes can be computed across any pair of races. Table 2 shows results from regression specification 1 using the split-ticket share as the dependent variable. Each displayed coefficient is, for a different regression, the estimate of the coefficient on the dummy variable which takes the value of one when the electronic system is used and zero otherwise, that is, α_1. The column name indicates among which two races the split-ticket share variable is computed. For example, the coefficient under “Governor vs City Council" is estimated using the split-ticket share

[17] The measured amount of split-ticket voting is a lower bound of the actual number of splits performed. The reason is that we measure it using the total votes for the candidates in the precincts. Therefore, if two people split the opposite way, on the aggregate that counts as zero split votes.

between the governor and city council races.

Dependent Variable: Split Ticket Share						
	Governor vs Mayor	Governor vs Congress	Governor vs City Council	Mayor vs Congress	Mayor vs City Council	Congress vs City Council
Electronic = 1	0.019***	0.053***	0.056***	0.043***	0.123***	0.088***
	(0.006)	(0.004)	(0.007)	(0.008)	(0.013)	(0.010)
Obs	84	68	72	64	96	108
	[0.101]	[0.071]	[0.086]	[0.083]	[0.062]	[0.057]
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Precinct FE	Yes	Yes	Yes	Yes	Yes	Yes

TABLE 2 Regression results of split-ticket shares against a dummy for using the electronic system. *Notes:* Each coefficient is obtained from a different regression, one for each combination of races. The coefficients estimate the effect of using the electronic ballot system, rather than the French ballot-and-envelope, on the share of split ticket votes. Average split-ticket values are displayed in brackets. Standard errors are clustered at the precinct-level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

There is a statistically significant increase in the amount of split-ticket voting when the electronic replaces the traditional paper system, and the effect is present across all race combinations. The smallest estimated increase in the amount of split-ticket, of 1.9 percentage points, takes place when comparing two single-seat races, as is Governor vs Mayor. On the other end, the effect reaches 12.3 percentage points for the Mayor vs City Council case.

Figure 6 plots the beta coefficients (vector) from running regression specification 2 using the split-ticket share as the dependent variable. Each coefficient is the conditional mean difference of the split-ticket share between the treated in 2011 and the treated in 2015. During 2007, 2015 and 2019, when both groups were using the same electoral system, the difference in the amount of split-ticket between them is not statistically significant at the 5%-level in most cases. However, during 2011, when one group used the electronic while the other used the paper system, the former had a much higher share of split-ticket votes. This is evidence that the change in the system increased the amount of split-ticket voting. When estimating difference-in-difference models, pre-trends are usually checked for identification. Since data from previous elections is not available, we check post-trends instead, showing that both treatment and control groups have parallel trends after both are treated, as can be observed in Figure 6. For robustness, in section 6 we include in the analysis a legislative-only election that took place in 2009, which allows us to check for pre-trends for some outcome variables.

5.2 | Vote Shares: Small Parties Benefit in Multiple-Seat Races

In this section we test proposition two of the model, which states that the change in the electoral system, through the increase in split-ticket voting, benefits small parties in multiple-seat races.[18]

Each displayed coefficient on table 3 is the estimated coefficient on the Electronic dummy variable of specification 1 for a different regression, each using a different combination of electoral race and political party. The top column names indicate the political party for which the vote share dependent variable is measured. As was the case in the model, smaller political parties are located on the outside columns (Radicalism and Left), while

[18] Other mechanisms, related to the change in the electoral system, that may influence the vote shares of political parties are discussed in Appendix B.

Dependent Variable: Share of Votes by Party				
	Radicalism	Locals	Peronism	Left
	Governor (1 seat)			
Electronic = 1	0.003	0.008	-0.000	0.011
	(0.004)	(0.008)	(0.008)	(0.008)
Obs	100	64	72	72
	[.081]	[.325]	[.494]	[.064]
	Mayor (1 seat)			
Electronic = 1	0.009	0.009	0.009	-0.005
	(0.008)	(0.010)	(0.009)	(0.006)
Obs	92	76	76	84
	[.065]	[.325]	[.483]	[.069]
	Congress (9 seats)			
Electronic = 1	0.006	0.061***	-0.048***	-0.004
	(0.005)	(0.010)	(0.010)	(0.007)
Obs	100	80	80	84
	[.069]	[.326]	[.463]	[.073]
	City Council (21 seats)			
Electronic = 1	**0.040*** **	**-0.032*** **	**-0.038*** **	**0.038*** **
	(0.007)	(0.008)	(0.008)	(0.006)
Obs	100	76	80	84
	[.073]	**[.314]**	**[.447]**	**[.078]**
Time FE	Yes	Yes	Yes	Yes
Precinct FE	Yes	Yes	Yes	Yes

TABLE 3 Regression results of vote shares against a dummy for using the electronic system. *Notes:* Each coefficient is obtained from a different regression, one for each combination of race and political party. The coefficients estimate the effect of using the electronic ballot system, rather than the French ballot-and-envelope, on the vote shares of each party on each race. Average vote shares are displayed in brackets. Standard errors are clustered at the precinct-level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

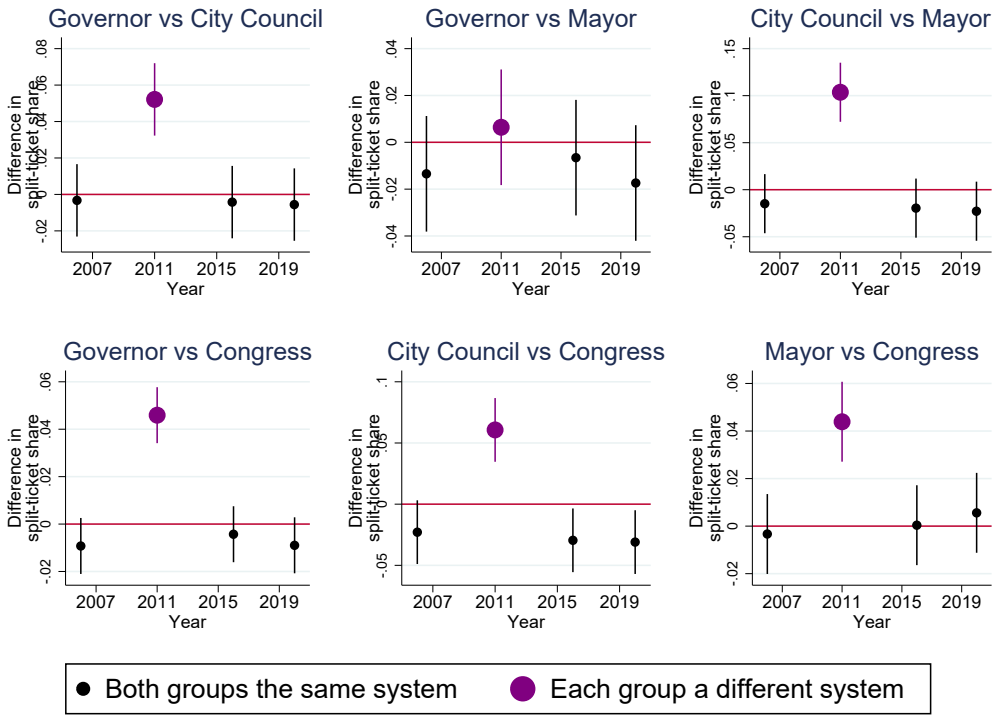

FIGURE 6 Conditional mean difference of split-ticket shares between precincts first treated in 2011 versus precincts first treated in 2015. *Note:* The displayed coefficients show, for each election, the conditional mean difference of the dependent variable between the treated first (in 2011) and treated second (in 2015) groups. Of particular interest is the year 2011, the only one in which each group used a different electoral ballot system. Vertical lines correspond to 95 percent confidence intervals.

large parties are located in the middle columns. Each row shows results for a different race. Races are ordered from the smallest number of seats offered (Governor and Mayor) to the greatest (City Council). In brackets are displayed the average vote shares by party for each race.[19]

The obtained results are in line with proposition 2 of the model. The statistically significant effects on vote shares are concentrated on the city council race, which is the one that offers the largest number of seats, and the small parties were positively affected in detriment of the large parties. The parties with low average vote shares, the Left and the Radicalism, saw their vote shares increase, while parties with large vote shares, the Peronism and the Locals, saw their vote shares decrease. The estimated coefficients imply that the introduction of the electronic voting system increased the vote share of the Left and Radicalist parties by approximately 4 percentage points. This is hugely relevant as approximately every 4.76 percentage points that a party receives, it obtains a city council seat (21 seats available)[20].

Figure 7 plots, for the city council race and for each political party, the conditional mean

[19] For each given electoral race, the estimated effects on vote shares across political parties of the change in the electoral system do not necessarily sum to one. The reason is that for each regression result a different matching is performed. The variables used for the matching are the fraction of the population under the poverty line, the fraction of the population with primary or lower educational attainment, and the pre-treatment value of the dependent variable.

[20] Seats are assigned following the D'Hont method.

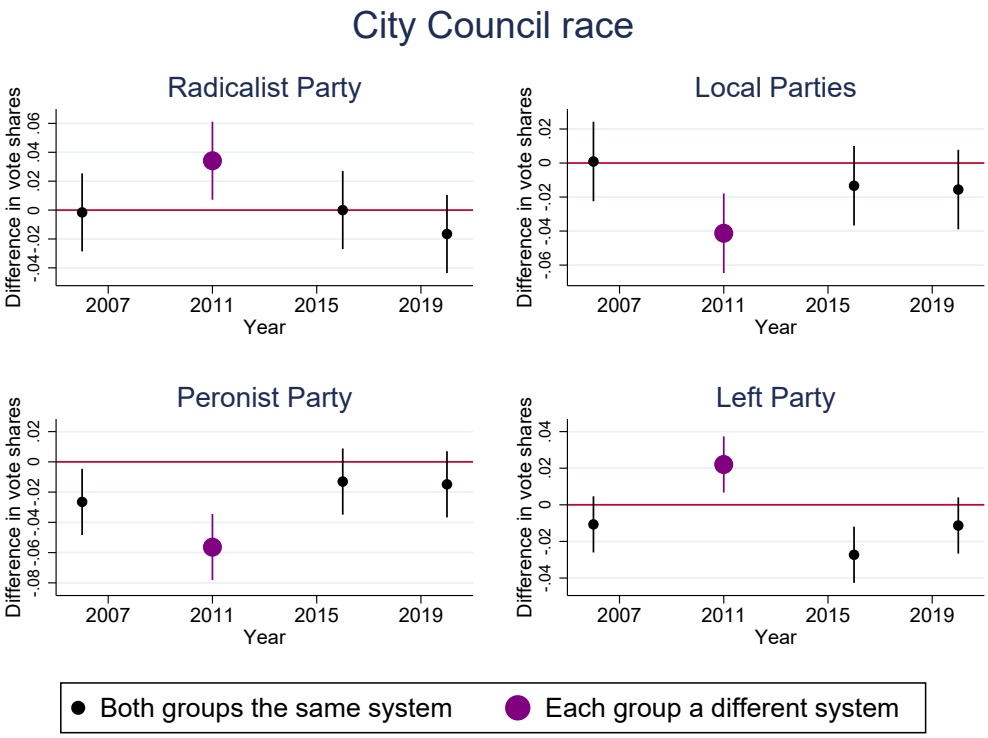

FIGURE 7 Conditional mean difference of city council vote shares between precincts first treated in 2011 versus precincts first treated in 2015. *Note:* The displayed coefficients show, for each election, the conditional mean difference of the dependent variable between the treated first (in 2011) and treated second (in 2015) groups. Of particular interest is the year 2011, the only one in which each group used a different electoral ballot system. Vertical lines correspond to 95 percent confidence intervals.

difference in vote shares between the precincts first treated in 2011 vs the precincts first treated in 2015. The only year in which each group used a different electoral system, 2011, precincts using the electronic system saw an increase in the share of votes obtained by small parties (Radicalism and Left) relative to precincts using the paper system. The opposite was the case for large parties (Peronism and Locals).

One explanation for the larger increase in split-ticket voting when comparing single-seat to multiple-seat races vs when comparing two single-seat races, as shown in the previous subsection, and the performance premium of small parties in multiple seat races, is strategic voting. Suppose a voter's first choice is a small party, and she also cares the most about the governor race. Since her small party does not have chances of winning for governor, she votes one of the large parties on that race. Her first choice (small) party may have chances of winning one of the seats offered by the multiple-seat races. However, since splitting the ticket is costly, the voter may cast a straight-ticket, choosing the same large party on all races. Upon a change from the multiple paper ballot to the single electronic ballot system, the splitting cost was reduced and people started splitting more, increasing the vote share of small parties on multiple-seat races, races in which those small parties have chances of winning one of the seats. This explains why the smallest increase in the amount of split-ticket voting happened between two single-seat races, since in both of them only large parties have chances of winning, and therefore the incentives to split between

them are smaller.

5.3 | Political Competition: Increases in Multiple-Seat Races

In the current subsection we test proposition three of the model, which states that the change in the electoral system increases political competition in multiple-seat races. Political competition is measured by a fractionalization index, and it takes larger values the more evenly distributed are votes across political parties and the larger the number of parties (see Section 3).

Dependent Variable: Political Competition				
	Governor	Mayor	Congress	City Council
Electronic = 1	-0.018	-0.016	0.012*	**0.041*** **
	(0.012)	(0.012)	(0.006)	(0.010)
	(0.014)	(0.011)	(0.006)	(0.010)
Obs	72	76	84	84
Time FE	Yes	Yes	Yes	Yes
Precinct FE	Yes	Yes	Yes	Yes

TABLE 4 Regression results of political competition against a dummy for using the electronic system. *Notes:* Each coefficient is obtained from a different regression, one for each race. The coefficients estimate the effect of using the electronic ballot system, rather than the French ballot-and-envelope, on political competition. Standard errors are clustered at the precinct-level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

In the previous subsection we showed that the effect of the introduction of the electronic ballot system led to an increase in the share of votes of small parties and a decrease in the share of votes of large parties in the city council race. In line with those results, in table 4 we observe a statistically significant positive effect on political competition on that race. As predicted by the model, political competition increased in the race with the largest number of seats. Figure 8 shows how, in 2011, the precincts using the electronic ballot system saw an increase in their political competition on the city council race relative to the precincts using the paper ballot system.

This result is relevant, since an increase in political competition may lead to changes in public policies. As mentioned in the introduction, Fujiwara (2011) and Ferreira de Moraes (2012) show that a shift to an easier voting mechanism in Brazil was reflected on an enfranchisement effect which ultimately resulted in higher political competition and a reallocation of public spending towards health care and other services most needed by the poor. However, in other contexts, a more evenly distributed share of votes across parties may lead to higher political gridlock.

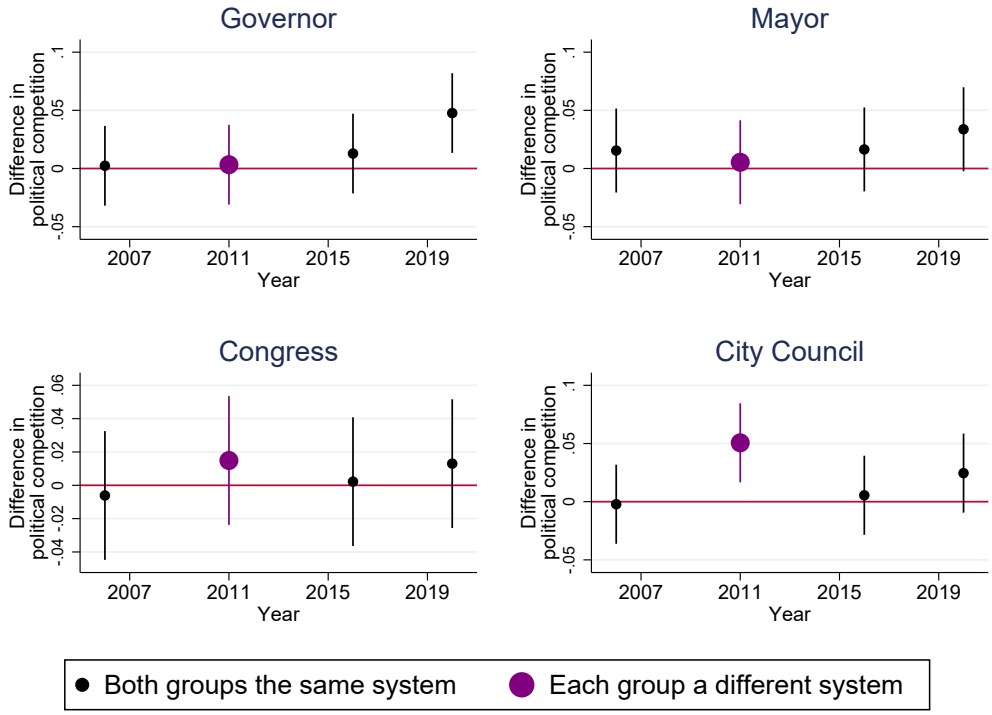

FIGURE 8 Conditional mean difference of political competition between precincts first treated in 2011 versus precincts first treated in 2015. *Note:* The displayed coefficients show, for each election, the conditional mean difference of the dependent variable between the treated first (in 2011) and treated second (in 2015) groups. Of particular interest is the year 2011, the only one in which each group used a different electoral ballot system. Vertical lines correspond to 95 percent confidence intervals.

6 | ROBUSTNESS CHECK

As a robustness check we incorporate to the analysis a legislative-only election that took place in 2009, which allows us to test for pre-trends for some outcome variables. On this section the variables used to perform the matching are the poverty rate, the education rate, and the pre-treatment trend of the dependent variable.

These results are presented as a robustness check rather than as part of our main analysis for two reasons. First, because as it is a legislative-only election, we can only use it for a subset of the outcomes. Second, because as a legislative-only election, voting incentives are potentially different relative to the rest of the elections where the population also voted for Governor and Mayor.

6.1 | Split-Ticket: Increases Across All Electoral Races

In the 2009 legislative election the population only voted for congressmen and city council members, and therefore we can only compute the split-ticket outcome between those races.

Figure 9 plots the conditional mean difference in split-ticket share between the precincts first treated in 2011 versus the precincts first treated in 2015. Both groups have parallel pre-trends before the new system started being implemented. For the years 2007 and 2009,

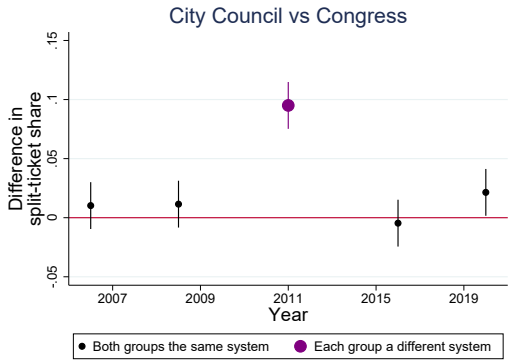

FIGURE 9 Conditional mean difference of split-ticket shares between precincts first treated in 2011 versus precincts first treated in 2015. *Note:* The displayed coefficients show, for each election, the conditional mean difference of the dependent variable between the treated first (in 2011) and treated second (in 2015) groups. Of particular interest is the year 2011, the only one in which each group used a different electoral ballot system. Vertical lines correspond to 95 percent confidence intervals.

before any group was treated, the difference in the amount of split-ticket votes between the groups was statistically insignificant. In 2011, when one group had been treated while the other had not, the treated precincts had a larger amount of split-ticket votes. Starting from 2015, when both groups had been treated, the difference became again statistically insignificant.

6.2 | Vote Shares: Small Parties Benefit in Multiple-Seat Races

Figure 10 shows, for the city council race, how both groups of precincts, the ones first treated in 2011 and the ones first treated in 2015, had parallel pre-trends before 2011. In 2011, the group that received the electronic ballot system saw an increase in the vote share of small parties (Radicalist and Left) and a decrease in the vote share of large parties (Local and Peronist) relative to the group that kept voting with the paper system. This difference was reverted when both groups started using the new ballot system from 2015.

6.3 | Political Competition: Increases in Multiple-Seat Races

Figure 11 shows how political competition increased in 2011 in the precincts that used the new electronic ballot system relative to the rest in the city council race, the race with the largest number of seats. This confirms our main empirical results and the predictions of the model.

7 | CONCLUSION

We analyze how small changes in perceived costs and benefits of voting can have profound implications for electoral outcomes. We exploit a quasi-experiment around a staggered adoption of a new voting technology: a change from a paper ballot-and-envelope to an electronic ballot system. The change reduced the cost of split-ticket voting. We build a model of voter behavior under a multiple-race election with fixed costs to split-ticket voting to guide the analysis and produce testable implications. We show how the presence of strategic

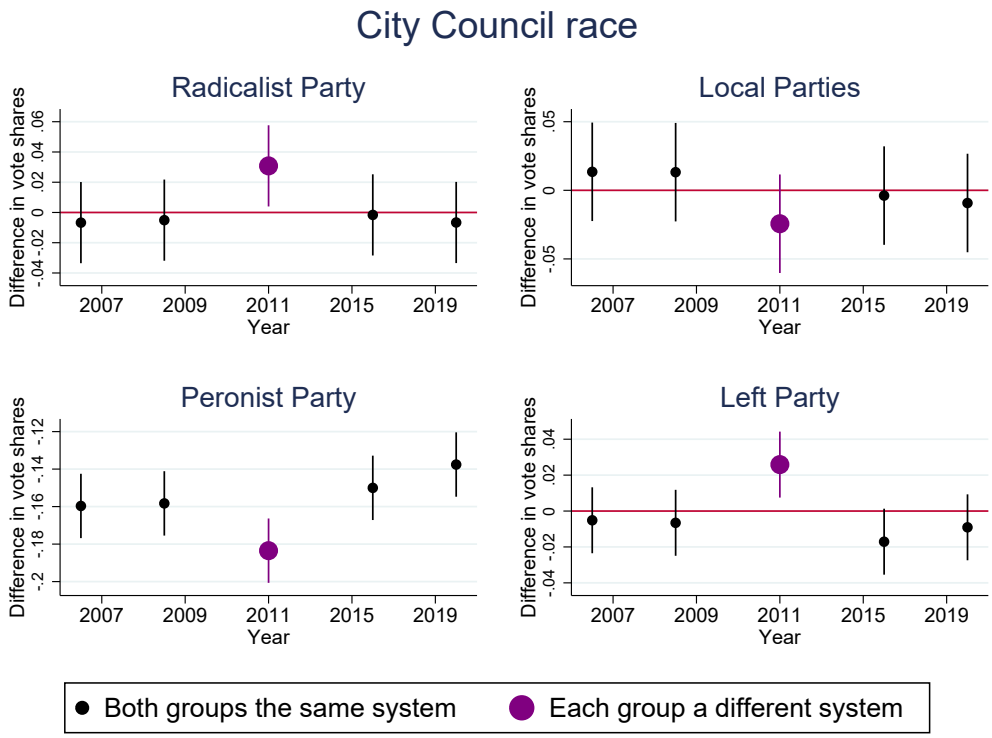

FIGURE 10 Conditional mean difference of city council vote shares between precincts first treated in 2011 versus precincts first treated in 2015. *Note:* The displayed coefficients show, for each election, the conditional mean difference of the dependent variable between the treated first (in 2011) and treated second (in 2015) groups. Of particular interest is the year 2011, the only one in which each group used a different electoral ballot system. Vertical lines correspond to 95 percent confidence intervals.

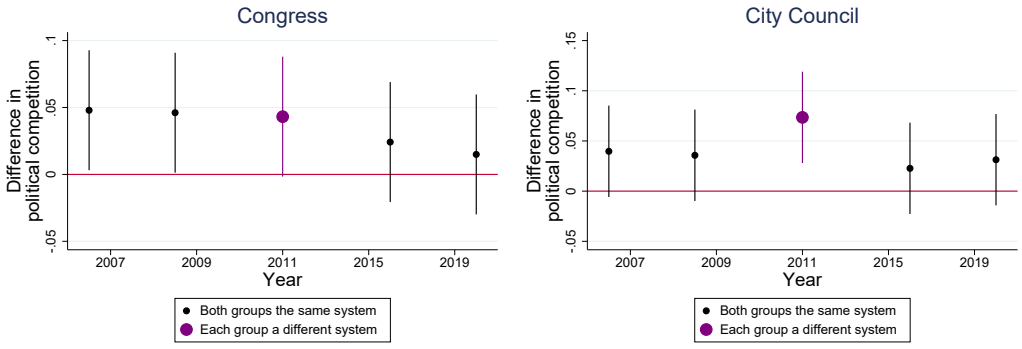

FIGURE 11 Conditional mean difference of political competition between precincts first treated in 2011 versus precincts first treated in 2015. *Note:* The displayed coefficients show, for each election, the conditional mean difference of the dependent variable between the treated first (in 2011) and treated second (in 2015) groups. Of particular interest is the year 2011, the only one in which each group used a different electoral system. Vertical lines correspond to 95 percent confidence intervals.

voters combined with costly ballot splitting can negatively affect effective enfranchisement and reduce political competition.

There are three main implications from the model. First, the cost reduction in split-ticket voting increases the number of split-ticket votes. Second, it improves the performance of small parties in multiple-seat races. Third, the improved electoral performance of small parties results in increased political competition. We verify these implications empirically and find, first, an increase of split-ticket voting of up to 12 percentage points when comparing governor versus city council races; second, an improved vote share performance of small parties of up to 4 percentage points; third, a corresponding similar-sized increase in political competition.

We argue that voters care the most about the highest level race, the race for the governor seat in the case of provincial election. Since only large parties have chances of winning that single-seat election, voters are drawn to choose among perceived large parties. The cost of ballot splitting reduces split-ticket voting and extends the consequences of strategic voting in the governor race to races where such strategic considerations do not intrinsically hold, thereby reducing political competition. That is, the perceived small political parties are negatively affected even in multiple-seat races, where incentives to vote strategically are smaller.

Even as democratic political institutions have been in place in most countries for decades, the widespread enfranchisement they pursue is not a binary variable. The nuances of electoral systems and technologies in place are crucial to fully enable voters to express their preferences. Our results show how minor changes that affect perceived costs and benefits from voting can have profound implications. Studying electoral systems can lead to reforms that increase the intensity of enfranchisement, improving democracy. Moreover, electoral reforms, unless rigorously analyzed before being implemented, can lead to important unintended consequences.

Our findings do not inform whether one of the ballot systems analyzed is preferable to the other, as these systems may have further implications than then ones analyzed in this paper. Moreover, an increase in political competition/fragmentation has trade-offs. For instance, while the reduction in the cost to split the ticket allows voters to better express their preferences, the increased political competition/fragmentation may lead to higher political gridlock.

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APPENDIX A: OTHER EMPIRICAL RESULTS

In this appendix we explore other effects of the change in the electoral ballot system, through mechanisms that are not part of our model.

| Blank Votes

With the paper ballot system, people that wanted to express their dissatisfaction with politicians sometimes nullified their vote on purpose. The fact that the new system does not allow for nullification, may have led to an increase in blank voting as a way to express dissatisfaction. A second reason that could have led to an increase in the share of blank votes is that the electronic machines give the option to vote blank, and may make it more salient. A third reason is that if some people only care about some races but not about all of them, during the period that the paper system was in place it was costly to vote blank on the other races, since those parts of the ballot needed to be cut out. The cost of splitting the ticket to vote blank was reduced with the electronic system.

Table A.1 confirms that the change in the electoral system increased blank voting. We argued in the paper that voters care the most about the governor race, and this is consistent with the result that the governor race is the one with the smallest increase in blank voting.

Dependent Variable: Share of Blank Votes				
	Governor	Mayor	Congress	City Council
Electronic = 1	0.028***	0.038***	0.039***	0.068***
	(0.003)	(0.006)	(0.003)	(0.005)
Obs	92	60	80	96
Time FE	Yes	Yes	Yes	Yes
Precinct FE	Yes	Yes	Yes	Yes

TABLE A.1 Regression results of blank vote shares against a dummy for using the electronic system. *Notes:* Standard errors clustered at the precinct-level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Figure A.1 plots the conditional mean difference in blank vote shares between precincts first treated in 2011 vs precincts first treated in 2015. During 2011 the precincts using the electronic system had a larger blank vote share.

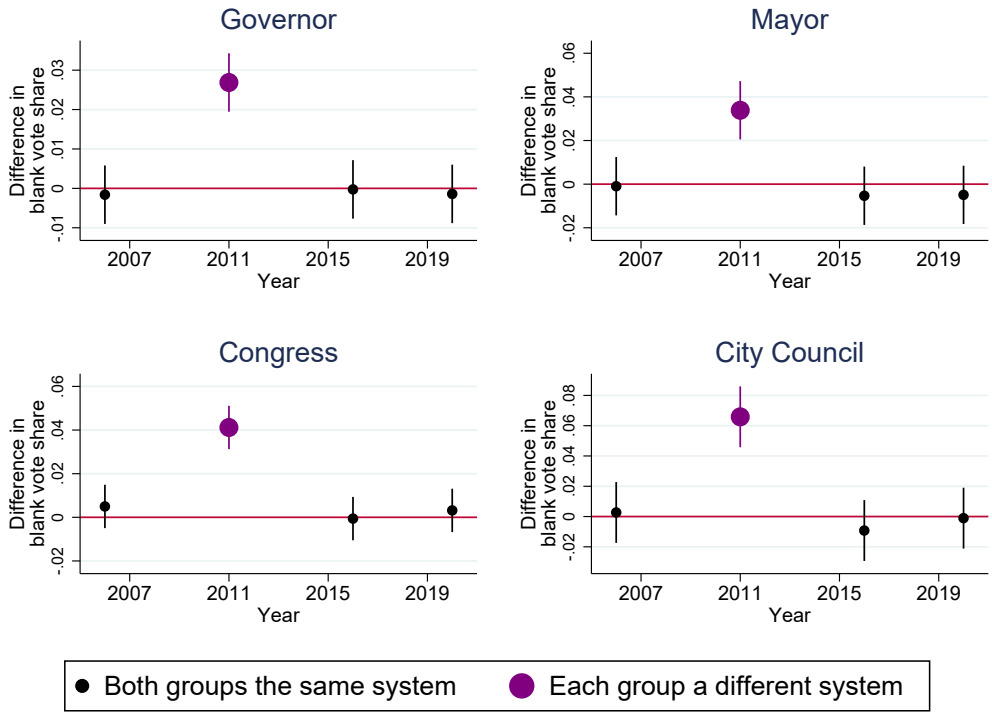

FIGURE A.1 Conditional mean difference of blank vote shares between precincts first treated in 2011 versus precincts first treated in 2015. *Note:* The displayed coefficients show, for each election, the conditional mean difference of the dependent variable between the treated first (in 2011) and treated second (in 2015) groups. Of particular interest is the year 2011, the only one in which each group used a different electoral ballot system. Vertical lines correspond to 95 percent confidence intervals.

| Turnout

A positive impact on turnout from the change in the electoral system could have been expected, as the reduction in the split-ticket cost increases the net benefit of voting, at least for the voters that would split their ticket if facing a zero split-ticket cost. However, both table A.2 and figure A.2 provide no evidence of an increase in turnout caused by the change in the electoral system.[21]

Dependent Variable: Turnout	
Electronic = 1	0.030
	(0.028)
Obs	68
Time FE	Yes
Precinct FE	Yes

TABLE A.2 Regression results of turnout against a dummy for using the electronic system. *Notes:* Standard errors clustered at the precinct-level. *** p < 0.01, ** p < 0.05, * p < 0.1.

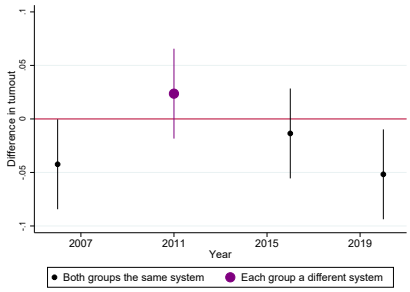

FIGURE A.2 *Conditional mean difference of turnout between precincts first treated in 2011 vs precincts first treated in 2015. Note: The displayed coefficients show, for each election, the conditional mean difference of the dependent variable between the treated first (in 2011) and treated second (in 2015) groups. Of particular interest is the year 2011, the only one in which each group used a different electoral ballot system. Vertical lines correspond to 95 percent confidence intervals.*

[21] Even though voting is compulsory in Salta, the fee was 50 pesos during the 2011 election, which was approximately 12 dollars at the time. If the offender does not pay the fee, he cannot perform formalities in the municipal, provincial, or national offices for a year, but there are no other penalty besides that. The low cost of not voting meant that for the 2011 election only 76% of Salta's population voted.

APPENDIX B: OTHER POTENTIAL DRIVERS OF THE RESULTS

In this appendix we list other mechanisms caused by the change in the electoral system, not directly captured by our model, that could have affected the analyzed electoral variables. We also expand on the mechanisms mentioned in the paper.

| Split-Ticket

- Reduction of the splitting cost

On the traditional paper ballot system each political party has its own ballot. If the voter wants to vote different political parties for different races, she has to cut the different ballots, choose the desired combination of candidates, and introduce them into the envelope. If she chooses more than one political party for the same race, or if when cutting the ballots relevant parts are cut away, then the vote is nullified.

If people realize that they don't fully understand the voting system, and that they may make mistakes that would make their votes be nullified, they have incentives to reduce the probabilities of making those mistakes. They face a trade-off, either vote their most preferred candidates for each race, which would presumably give them higher utility, but increasing the probability of getting their vote nullified, or vote the same political party in all races and reduce the probability of nullification of their votes. With the electronic system, the machine guides the voter while choosing the candidates, and only prints valid combinations, which basically prevents from getting the vote nullified.

Moreover, cutting the ballots takes time when using the paper system, which is costly, and is even costlier in this situation because the person voting knows that there is a row of people outside the voting room waiting for her to finish. However, for some segments of the population this problem may be more pronounced under the electronic system.

Reducing the cost of splitting the tickets may increase the amount of splitting if there is any reason for people to split. One of the reasons is to vote strategically, that is, to vote parties that have chances of winning and avoid wasting the vote. If someone likes a small party that has chances of winning a seat only on races that offer many seats, that person may vote his preferred (and small) party for the races with many seats and another large party for the races that offer only one seat. The more seats the race offers, the more chances the small parties have of winning one of them and the more incentives voters have to split.

- Ballot availability

Another positive effect that the new system may have on vote splitting stems from the fact that it ensures that all the electoral options are available in the voting room. With the paper ballot system, each party was responsible for printing and supplying the ballots to each voting place. Even though the government provided funds to the parties for them to perform such tasks, some small parties could not supply their ballots to all voting rooms, or they could not supply for a second time if the ones initially supplied ran out. In many cases the ballots of some political parties were destroyed or stolen by voters knowing that it was difficult for them to supply more ballots. This means that in some rooms the electoral options were smaller, and this may have decreased vote splitting. With the electronic system the supply of the machines and the ballots is taken care of by the government, which means that full supply is assured everywhere. The machines print any chosen party/parties on the blank ballots, meaning that all options are available.

- Reduction of nullification

Split-ticket voting may also be relatively larger in places with the electronic system if this new system reduces nullification of the split votes relatively more. As previously mentioned, the machine only prints valid votes, helping voters not to get their vote nullified. If most nullifications with the paper system happened when voters tried to split their vote, even in the case where the vote splitting action does not increase with the new system, if it reduces nullification relatively more on those votes, then the observed amount of split votes may increase.

- Vote buying possibilities

The change in the electoral system altered the possibilities of performing certain vote-buying actions. A way of vote-buying that was eliminated by the introduction of the electronic voting is called chain-voting. The practice, performed in places using the paper ballot system, was as follows. By bribing the voting room authorities, sometimes the bribers managed to get a signed empty envelope that was valid to vote. The vote-buyers, with the empty valid envelope in their possession, transported a group of voters to the voting room. They gave the first voter the envelope they got, sealed and with their desired ballot inside, and the voter had to use that to vote and when he got out of the voting place he had to give to the bribers the new empty envelope he received from the voting room authorities. The bribers introduced their desired ballot into this new envelope, sealed it and gave it to the next person. This process continued until all the transported people voted, and the bribers were sure everyone voted the candidate they desired. The voters agreed to do this in exchange for something or by coercion.

This practice is not possible with the new system. The electronic ballot includes two easy-cut-through stubs, one at each end of the ballot, containing a ballot number. Before delivering the blank ballot to the voter, precinct authorities remove the first stub and preserve it until the voter finishes voting. Then the voter proceeds with the ballot to the vote-printing machine to choose the desired candidates. Finally, the voter returns to the precinct authorities, removes the second numbered stub and delivers it to them. Authorities check that the fist and second stubs contain the same number, before allowing the voter to finish casting her vote by inserting the printed ballot in the ballot-box and discarding both stubs. Importantly, the main body of the ballot does not contain any identification number, so that it cannot be traced back to any voter.

Since when votes are bought they vote a straight-ticket, the reduction in the vote-buying possibilities may increase split-ticket voting.

| Parties' Performances

- Reduction of the splitting cost

The electronic system reduced the cost of splitting the tickets and led to an increase in the share of splitting across all electoral races. With the paper-ballot system, many voters that would have preferred to split their vote found splitting too costly and had to decide for a unique political party and vote all their candidates. This reduced the share of people that for example voted a large party for the Governor race and a smaller party for the City Council in order not to waste their Governor vote. Thus, the increase in the vote splitting caused by the change in the electoral system may differently affect the candidates of the same political party that run for different races.

- Ballot availability

As previously discussed, with the paper ballot system each political party was responsible for printing and supplying their ballots to each voting site. Some parties could not supply their ballots to all places, or even if they did initially, they could not supply again if needed. This made it impossible for the voters of some areas to vote some political parties, negatively affecting their vote shares. With the new system the machines were supplied by the government to the voting places, machines that printed on the ballot any chosen political party or combination of them.

- Vote buying possibilities

Some political parties may be more prone than others to buy votes, and the fact that vote-buying became more difficult with the new system may have influenced vote shares.

- Intensive enfranchisement

Each electoral system may make it easier for different segments of the population to effectively vote their desired candidates without getting their votes nullified. For example, the new system may make it easier to vote for voters who split their ticket, but it may make it more difficult for old voters who do not feel comfortable with technology. Since these segments of the population may have diverse preferences over the political parties, vote shares may be affected.

APPENDIX C: ROBUSTNESS CHECK RESULTS TABLES

Dependent Variable: Split Ticket Share	
	City Council vs Congress
$\texttt{Electronic} = 1$	0.085***
	(0.010)
Obs	80
Time FE	Yes
Precinct FE	Yes

TABLE A.3 Regression results of split-ticket shares against a dummy for using the electronic system. *Notes:* Each coefficient is obtained from a different regression, one for each combination of races. The coefficients estimate the effect of using the electronic ballot system, rather than the French ballot-and-envelope, on the share of split ticket votes. Standard errors are clustered at the precinct-level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Dependent Variable: Share of Votes by Party				
	Radicalism	Locals	Peronism	Left
	Congress (9 seats)			
Electronic = 1	0.003	0.072***	-0.040***	0.001
	(0.004)	(0.018)	(0.007)	(0.005)
Obs	105	110	120	110
	[.069]	[.326]	[.463]	[.073]
	City Council (21 seats)			
Electronic = 1	**0.036*** **	**-0.028** **	**-0.032*** **	**0.035*** **
	(0.005)	(0.013)	(0.007)	(0.006)
Obs	115	110	110	95
	[.073]	**[.314]**	**[.447]**	**[.078]**
Time FE	Yes	Yes	Yes	Yes
Precinct FE	Yes	Yes	Yes	Yes

TABLE A.4 Regression results of vote shares against a dummy for using the electronic system. *Notes:* Each coefficient is obtained from a different regression, one for each combination of race and political party. The coefficients estimate the effect of using the electronic ballot system, rather than the French ballot-and-envelope, on the vote shares of each party on each race. Average vote shares are displayed in brackets. Standard errors are clustered at the precinct-level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Dep. Variable: Political Competition		
	Congress	City Council
Electronic = 1	0.010	**0.041*** **
	(0.006)	(0.006)
	115	105
Time FE	Yes	Yes
Precinct FE	Yes	Yes

TABLE A.5 Regression results of political competition against a dummy for using the electronic system. *Notes:* Each coefficient is obtained from a different regression, one for each race. The coefficients estimate the effect of using the electronic ballot system, rather than the French ballot-and-envelope, on political competition. Standard errors are clustered at the precinct-level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

APPENDIX D: RESULTS WITHOUT MATCHING THE OBSERVATIONS

In this appendix we perform the same empirical analysis as in the paper but using all the precincts from the capital instead of performing a matching. The results support our previous conclusions from the empirical analysis and the model.

Dependent Variable: Split Ticket Share						
	Governor vs City Council	Governor vs Mayor	City Council vs Mayor	Governor vs Congress	City Council vs Congress	Mayor vs Congress
Electronic = 1	0.046***	0.023***	0.120***	0.035***	0.086***	0.063***
	(0.008)	(0.007)	(0.007)	(0.006)	(0.008)	(0.011)
Obs	216	216	216	216	216	216
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Precinct FE	Yes	Yes	Yes	Yes	Yes	Yes

TABLE A.6 Regression results of split-ticket shares against a dummy for using the electronic system. *Notes:* Each coefficient is obtained from a different regression, one for each combination of races. The coefficients estimate the effect of using the electronic ballot system, rather than the French ballot-and-envelope, on the share of split ticket votes. Standard errors are clustered at the precinct-level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Dependent Variable: Share of Votes by Party				
	Radicalism	Locals	Peronism	Left
	Governor (1 seat)			
Electronic = 1	-0.001	-0.009	-0.001	0.013***
	(0.003)	(0.019)	(0.018)	(0.004)
Obs	216	216	216	216
	[.081]	[.325]	[.494]	[.064]
	Mayor (1 seat)			
Electronic = 1	0.003	-0.066	0.064*	-0.002
	(0.005)	(0.044)	(0.038)	(0.004)
Obs	216	216	216	216
	[.065]	[.325]	[.483]	[.069]
	Congress (9 seats)			
Electronic = 1	-0.001	0.023	-0.023	0.002
	(0.004)	(0.025)	(0.023)	(0.004)
Obs	216	216	216	216
	[.069]	[.326]	[.463]	[.073]
	City Council (21 seats)			
Electronic = 1	**0.038*** **	**-0.076** **	-0.005	**0.039*** **
	(0.004)	(0.032)	(0.031)	(0.004)
Obs	216	216	216	216
	[.073]	**[.314]**	**[.447]**	**[.078]**
Time FE	Yes	Yes	Yes	Yes
Precinct FE	Yes	Yes	Yes	Yes

TABLE A.7 Regression results of vote shares against a dummy for using the electronic system. *Notes:* Each coefficient is obtained from a different regression, one for each combination of race and political party. The coefficients estimate the effect of using the electronic ballot system, rather than the French ballot-and-envelope, on the vote shares of each party on each race. Average vote shares are displayed in brackets. Standard errors are clustered at the precinct-level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Dependent Variable: Political Competition				
	Governor	Mayor	Congress	City Council
Electronic = 1	0.011	-0.020	0.001	**0.044****
	(0.018)	(0.022)	(0.015)	(0.021)
Obs	216	216	216	216
Time FE	Yes	Yes	Yes	Yes
Precinct FE	Yes	Yes	Yes	Yes

TABLE A.8 Regression results of political competition against a dummy for using the electronic system. *Notes:* Each coefficient is obtained from a different regression, one for each race. The coefficients estimate the effect of using the electronic ballot system, rather than the French ballot-and-envelope, on political competition. Standard errors are clustered at the precinct-level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

APPENDIX E: RESULTS MATCHING ONLY ON POVERTY RATE AND EDUCATIONAL ATTAINMENT

In this appendix we perform the same empirical analysis as in the paper but performing the matching using only the poverty and non-education rates. The results support our previous conclusions from the empirical analysis and the model.

Dependent Variable: Split Ticket Share						
	Governor vs City Council	Governor vs Mayor	City Council vs Mayor	Governor vs Congress	City Council vs Congress	Mayor vs Congress
Electronic = 1	0.044***	0.023***	0.120***	0.029***	0.087***	0.060***
	(0.011)	(0.008)	(0.009)	(0.008)	(0.010)	(0.014)
Obs	164	164	164	164	164	164
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Precinct FE	Yes	Yes	Yes	Yes	Yes	Yes

TABLE A.9 Regression results of split-ticket shares against a dummy for using the electronic system. *Notes:* Each coefficient is obtained from a different regression, one for each combination of races. The coefficients estimate the effect of using the electronic ballot system, rather than the French ballot-and-envelope, on the share of split ticket votes. Standard errors are clustered at the precinct-level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

APPENDIX F: BALANCE TESTS

Table A.12 shows a balance table with all the dependent variables analyzed in the paper. These are the share of split-ticket votes across all electoral races, the shares of votes that each political party (Radicalism, Locals, Peronism, and Left) receives on each race, and the

Dependent Variable: Share of Votes by Party				
	Radicalism	Locals	Peronism	Left
	Governor (1 seat)			
Electronic = 1	-0.011	0.022	-0.022	0.011**
	(0.011)	(0.052)	(0.042)	(0.005)
Obs	164	164	164	164
	[.081]	[.325]	[.494]	[.064]
	Mayor (1 seat)			
Electronic = 1	-0.006	-0.051	0.049	0.002
	(0.012)	(0.064)	(0.057)	(0.006)
Obs	164	164	164	164
	[.065]	[.325]	[.483]	[.069]
	Congress (9 seats)			
Electronic = 1	-0.011	0.036	-0.027	0.001
	(0.012)	(0.046)	(0.036)	(0.006)
Obs	164	164	164	164
	[.069]	[.326]	[.463]	[.073]
	City Council (21 seats)			
Electronic = 1	**0.027****	-0.065	-0.007	**0.039*****
	(0.012)	(0.051)	(0.043)	(0.005)
Obs	164	164	164	164
	[.073]	**[.314]**	**[.447]**	**[.078]**
Time FE	Yes	Yes	Yes	Yes
Precinct FE	Yes	Yes	Yes	Yes

TABLE A.10 Regression results of vote shares against a dummy for using the electronic system. *Notes:* Each coefficient is obtained from a different regression, one for each combination of race and political party. The coefficients estimate the effect of using the electronic ballot system, rather than the French ballot-and-envelope, on the vote shares of each party on each race. Average vote shares are displayed in brackets. Standard errors are clustered at the precinct-level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Dependent Variable: Political Competition				
	Governor	Mayor	Congress	City Council
Electronic = 1	0.006	-0.026	-0.012	**0.038**
	(0.023)	(0.027)	(0.017)	(0.024)
Obs	164	164	164	164
Time FE	Yes	Yes	Yes	Yes
Precinct FE	Yes	Yes	Yes	Yes

TABLE A.11 Regression results of political competition against a dummy for using the electronic system. *Notes:* Each coefficient is obtained from a different regression, one for each race. The coefficients estimate the effect of using the electronic ballot system, rather than the French ballot-and-envelope, on political competition. Standard errors are clustered at the precinct-level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

measure of political competition on all the electoral races.

The table performs the balance tests using data from the 2007 elections, before any treatment took place. As discussed in section 4, for each regression result we perform a different matching, using the poverty rate, the non-education rate, and the pre-treatment value of the dependent variable. Therefore, statistics displayed for matched precincts in each row are generated after a different matching, which is performed using the variable from the corresponding row, the poverty rate, and the non-education rate. For the poverty and non-education rows, the statistics for matched precincts show results after a matching using the poverty rate, the non-education rate, and the measure of political competition for the City Council race.

Empirical results are robust to matching on pre-trends and the poverty and non-education rates (section 6), to matching only on the poverty and non-education rates (appendix E), and to not performing any matching (appendix D).

	All Precincts			Matched Precincts		
	Treated in 2011	Treated in 2015	Diff.	Treated in 2011	Treated in 2015	Diff.
Poverty rate (%)	8.04	13.96	5.92***	9.10	8.74	-0.36
Non-education rate (%)	24.17	33.34	9.17***	27.72	28.89	1.18
Split-Ticket (%)						
Governor vs Mayor	11.23	7.88	-3.35**	8.67	8.93	0.25
Governor vs Congress	9.66	6.66	-2.99***	7.74	7.75	0.01
Governor vs City Council	11.75	7.75	-4.00***	8.36	8.47	0.11
Mayor vs Congress	8.12	5.21	-2.90***	6.17	6.20	0.04
Mayor vs City Council	2.88	2.02	-0.86***	2.22	2.56	0.34
Congress vs City Council	6.65	4.46	-2.19**	4.90	4.80	-0.10
Governor vote shares (%)						
Radicalism	3.55	1.93	-1.61***	2.25	2.32	0.07
Locals	9.53	4.26	-5.27***	5.20	5.20	0.00
Peronism	82.76	90.20	7.43***	87.93	88.12	0.19
Left	4.16	3.61	-0.55*	4.17	4.28	0.11
Mayor vote shares (%)						
Radicalism	4.48	2.42	-2.06***	2.82	3.02	0.20
Locals	14.80	5.69	-9.11***	6.78	6.90	0.12
Peronism	75.12	87.21	12.09***	83.57	83.71	0.14
Left	5.60	4.67	-0.92**	5.91	6.02	0.11
Congress vote shares (%)						
Radicalism	4.86	2.66	-2.20***	3.48	3.53	0.05
Locals	12.82	5.43	-7.40***	6.60	6.69	0.09
Peronism	75.56	86.56	10.99***	82.31	83.66	1.35
Left	6.75	5.35	-1.40***	6.80	6.71	-0.09
City Council vote shares (%)						
Radicalism	5.10	2.65	-2.45***	2.90	3.47	0.55
Locals	15.33	6.05	-9.28***	7.16	7.39	0.23
Peronism	73.44	86.21	12.78***	81.75	82.64	0.89
Left	6.13	5.08	-1.05**	6.81	6.61	-0.20
Political competition (%)						
Governor	29.34	18.18	-11.15***	22.50	22.34	-0.16
Mayor	36.67	23.14	-13.54***	29.14	28.87	-0.27
Congress	38.74	24.15	-14.59***	29.90	30.31	0.41
City Council	39.13	24.72	-14.41***	30.85	30.79	-0.06

TABLE A.12 Pre-treatment balance tests. *Notes:* The table performs the balance tests using data from the 2007 elections, before any treatment took place. Statistics displayed for matched precincts in each row are generated after a different matching, which is performed using the variable from the corresponding row, the poverty rate, and the non-education rate. For the poverty and non-education rows, the statistics for matched precincts show results after a matching using the poverty rate, the non-education rate, and the political competition in the City Council race. Diff. = mean difference. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.