Online Appendix

Assessing Ballot Structure and Split Ticket Voting: Evidence from a Quasi-Experiment

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Appendix A. Using ArcGIS to Recreate Precinct Boundaries

Appendix A describes the process of building an original dataset using ArcGIS to recreate the electoral precinct boundaries and estimate precinct-level demographics. To begin with, we know the precise locations of voting centers in Salta, and we use this information to identify the latitude and longitude coordinates of each voting center on a map. Similarly, we know the precinct that each voting center belongs to. Finally, we know that some precincts span multiple census tracts. Thus, we start by locating the coordinates for each voting center on a map using the address of the voting center that was provided by the provincial Electoral Tribunal. Given that we know the exact location of each vote center we can be certain of the demographics for the census tract where each center is located. But, since many precincts span multiple census tracts, we cannot be certain of the demographics for the entire precinct. This would require us to know the boundaries of the precinct so that we can identify all of the census tracts in a given precinct. Because the actual precinct boundaries are unknown, we approximate the precinct boundaries based on the following criteria: precincts are continuous geographical spaces that do not cross municipal or district boundaries and the voting centers for each precinct is located within the precinct. [1]

However, the shape of the electoral precincts is unknown, thus based on these parameters we use two different techniques, to develop polygons that approximate the precinct boundaries and to attribute the demographic data to voting centers by precincts. The first technique approximates the electoral precinct boundaries using Thiessen polygons. These polygons are created by assigning every point in space to the closest voting centers, regardless of census tract boundaries. The polygon boundaries are always exactly equal distance between the two voting centers they divide. Then,

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[1] Whereas the census tract boundaries were made available through the National Institute of Statistics and Censuses (*Instituto Nacional de Estadísticas y Censos*, INDEC), equivalent information containing the electoral precinct boundaries (e.g., maps, geocoded data, shape files, or latitude and longitude coordinates) was not publically available in Salta.

assuming an even population distribution within each tract, we calculate the census statistics of the Thiessen polygon using a weighted average of the proportion of each census tract within the polygon. Through these procedures, every school or voting center in the same electoral precinct is attributed the same demographic data.

The second technique, called Nearest Neighbor Resampling (here in Nearest Neighbor), approximates precinct boundaries by assigning each census tract to the polygon of the school nearest to the tract parameter. In this case the electoral precinct is comprised of: a) all of the census tracts containing a voting center in the given electoral precinct, and b) all of the census tracts that do not contain a voting center and are closer to the voting centers in the given electoral precinct than to any other precinct. Specifically, in this case the demographic attributes of each census tracts are aggregated to approximate the demographic attributes of the electoral precinct.

Appendix B. Electronic Machines Assignment

While the decision of a partial implementation of the reform was a joint decision of the governor and the provincial Electoral Tribunal, the rationale behind the assignment of the electronic devices to the precincts was not released. Then, we considered the case that either bureaucratic –concerns about the success of the implementation- or political –concerns about the effect of electronic devices on the districts that supported the runner up candidate (i.e., the opposition) in the previous election—considerations might silently underlie the treatment assignment. Thus, we matched the data over these potentially intervening factors.

The observations were matched over two socio-demographic characteristics, such as poverty and education, which were respectively measured as the proportion of the precinct living in poverty conditions and the proportion of the precinct population with elementary education or less. Also, the data was matched over its recent electoral history, measured as the percentage of votes received by Walter Wayar, the runner up candidate in the 2007 election.

In order to make an assessment of how relevant are these factors, we estimated the probability of the assignment through a Bernoulli-logistic model:

$$\Pr(y_i = 1) = logit^{-1}(X_i\beta)$$

$$X_i\beta = \alpha + \beta X_i + \varepsilon_i$$

$$\varepsilon_i \sim N(0, \sigma^2)$$

where i indexes the electoral precinct. The term y_i is a dummy variable that captures the type of voting procedure and it is coded '1' for electronic devices, β represents the coefficients capturing the effect of the X vector of demographic and electoral variables on y_i, α is an intercept and ε_i is an error term for the ith observation.

Regardless the technique used to estimate the precinct demographics, the results (see Table B1) showed that the assignment of electronic devices has some association with the control variables:

electronic devices were more likely to be assigned to precincts with more scholarly educated voters and with less support to runner up candidate in the previous gubernatorial election. Model predictions are considerably

Table B1. Assignment of Electronic Machines, by demographics and party vote (Salta District, 2011. Logit regression model)

	Thiessen Polygons			*Nearest Neighbor*		
	Coef.	St. Error	z-value	Coef.	St. Error	z-value
Poverty rate (%)	0.092	0.082	1.119	0.084	0.075	1.109
Non-educated (%)	-0.224*	0.087	-2.572	-0.198*	0.079	-2.501
Opposition vote share	-0.372*	0.160	-2.326	-0.320*	0.153	-2.089
Intercept	23.648**	7.802	3.031	20.491**	7.119	2.879
AIC	56.955			59.616		
N	54			54		

*** $p<0.001$; ** $p<0.01$; * $p<0.05$

First, the results show that the assignment was biased toward the more educated areas. The chances of assigning electronic machines markedly decline when the percentage of population with elementary education or less goes beyond 30 percent: the predicted probability of assigning electronic voting is about 96 percent when non-educated population is 30 percent, it falls to about 72 percent when non-educated population reaches 40 percent, and it falls to about 21 percent when the non-educated people is 50 percent of the precinct.

Second, we control for the vote share of the runner up in the previous gubernatorial election. The runner up's electoral support appears to have biased the criteria used to decide the assignment: the predicted probability of electronic voting being introduced in a given precinct in 2011 is lowest where the runner up's performance was highest in 2007. The predicted probability is about 64 percent in precincts where the runner up obtained 39 percent of the votes (15th quantile), it falls to about 41 percent where he obtained 41.5 percent (District median), and it falls to about 25 percent where he obtained 43.5 percent (85th quantile). These differences are statistically significant when we compare the extremes of the distribution. The provincial government's rationale behind this could have been to minimize resistance to the reform by avoiding the opposition stronghold precincts.

Finally, the poverty rates have a non-significant effect on the assignment. This is likely due to some correlation with the education rates. Overall, these findings also suggest that the variables used to match the data are a suitable pool of potentially intervening variables.

The district of Salta was divided in 54 electoral precincts: voters in 29 precincts voted using paper ballots, while in other 25 precincts, voters used electronic devices. Table B2 reports the distribution of voting centers and booths across electoral precincts.

Table B2. Number of Voting Centers and Voting Booths, by Electoral Precinct (Salta District, 2011)

Paper-ballot Electoral Precincts						*Electronic-ballot Electoral Precincts*					
Precinct	VCs	VBs	Precinct	VCs	VBs	Precinct	VCs	VBs	Precinct	VCs	VBs
2D	3	26	5A	3	27	1A	1	14	3A	3	39
2G	3	28	5B	2	17	1B	1	10	3B	4	54
2H	1	7	5C	2	21	1C	1	13	3C	2	25
2I	2	28	5E	3	39	1D	1	14	3D	2	22
2J	3	25	5F	2	27	1E	1	14	3E	2	17
2K	2	17	5G	2	26	1F	2	23	3F	2	21
2L	2	18	5I	3	32	1G	2	22	3K	1	9
2N	2	22	5J	1	2	2A	2	22	4A	2	20
2O	2	23	5K	1	5	2B	1	14	4B	1	2
2P	2	16	5L	2	22	2C	1	17	4C	1	7
2Q	3	28	5M	1	6	2E	1	8	5D	2	18
3G	3	25	5N	1	15	2F	2	20	5H	2	13
3H	2	25	6A	2	15	2M	2	21			
3I	3	26	7A	1	1						
3J	1	9									

Note: VCs: Number of Voting centers. VBs: Number of Voting booths

The median precinct in the district comprised two voting centers, and 20 voting booths. Voting centers in precincts which voted using the ballot-and-envelope system are slightly larger: while the median paper-ballot precinct comprised 22 booths; the median electronic voting precinct reunites 17 booths. Overall, in Salta District, while voters used the traditional ballot-and-envelope system in 578 voting booths, voters in other 459 booths voted using the electronic devices.

Appendix C. Balance Improvement in Matched Data

Matching methods attempt to construct a dataset where any background condition in the sample is equal across treatment conditions (see Ho et al. 2007, King and Zeng 2006, Iacus et al. 2011, Gelman and Hill 2007). Two alternative matching methods are used along this article to reconstruct the balance in the sample: Propensity Scores Matching (see Ho et al. 2007) and Coarsened Exact Matching (see Iacus et al. 2012, 2011). These methods proceed differently, and consequently, post-matching data differ in its balance. In this Appendix we report the balance improvements for each matching method, by each GIS technique used to estimate geo-referenced demographics.

The Q-Q plots in Figure C1 graph the distribution of the background confounders, one on each graph, for the control units on the x-axis and the value of the background confounders for the treated units on the y-axis. The left column plots this relationship for all precincts in our sample before the matching procedure and the right column plots the relationship for matched precincts in our sample after the matching procedure. The 45º lines represent a perfect balance between groups. The closer the units are to the diagonal, the better the generated balance. It is clear from comparing the Q-Q plots in the right and left columns that the balance improved substantially for two of the three background confounders (i.e., poverty and education) after the matching procedure. While the balance does not improve for the opposition vote share it was already well balanced prior to the matching procedure.

Figure C1. Post-Matching Balance in the Data, by GIS Technique: Coarsened Exact Matching

Thiessen Polygons	*Nearest Neighbor*

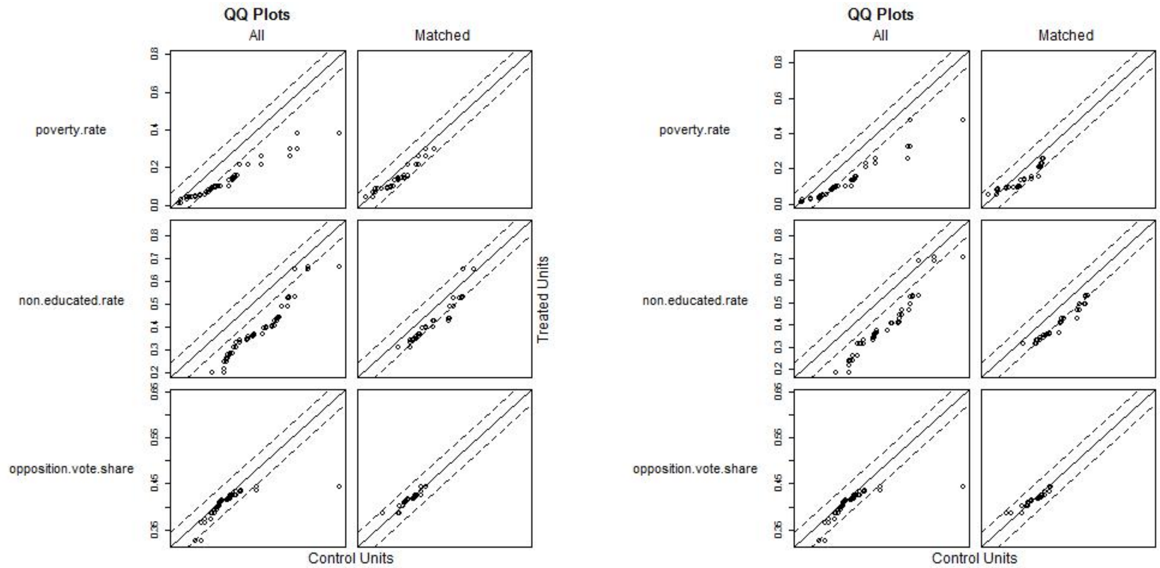

Figure C2. Post-Matching Balance in the Data, by GIS Technique: Propensity Score Matching

Thiessen Polygons	*Nearest Neighbor*

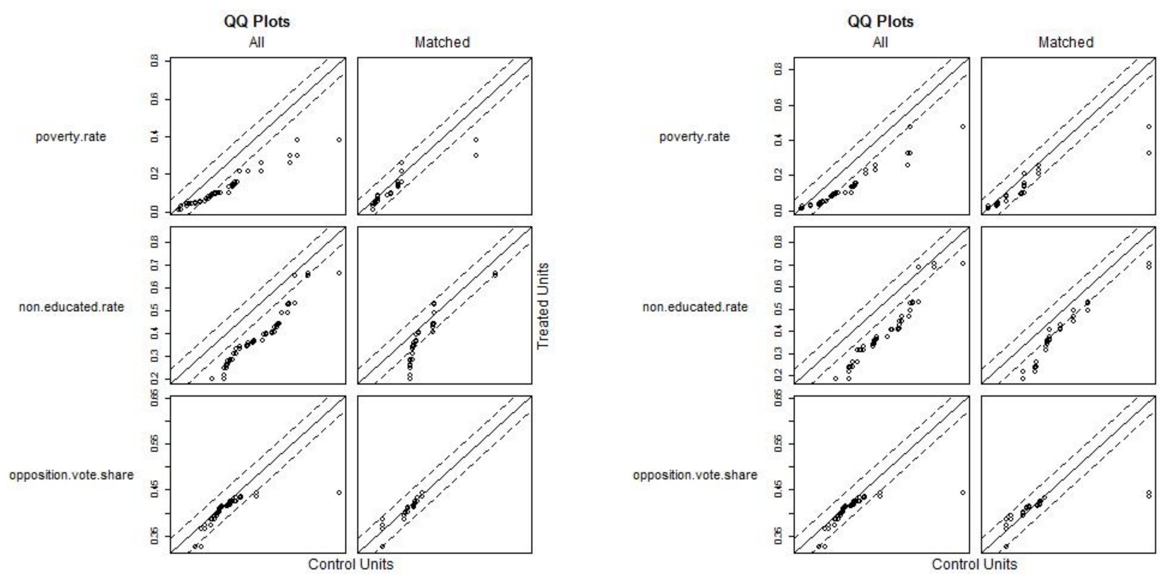

Table C1. Summary of Balance for All and Matched Data, by Matching Method, for Demographics estimated through Thiessen Polygons

	All Data				*Matched Data*				Improve
	T	C	D	St.	T	C	D	St.	
Coarsened Exact Matching									
Distance	0.6899	0.2696	0.4203		0.5483	0.4027	0.1456		65.3491
Poverty rate (%)	0.1236	0.2378	-0.1142	-1.2680	0.1461	0.1316	0.0145	0.1612	87.2861
Non-educated (%)	0.3839	0.5228	-0.1390	-1.1421	0.4248	0.4407	-0.0160	-0.1311	88.5192
Opp. vote share	0.4073	0.4221	-0.0148	-0.5652	0.4141	0.4178	-0.0037	-0.1412	75.0180
Propensity Scores Matching									
Distance	0.6871	0.2894	0.3977		0.6871	0.6205	0.0666		83.2616
Poverty rate (%)	0.1236	0.2378	-0.1142	-1.2680	0.1236	0.1770	-0.0534	-0.5931	53.2291
Non-educated (%)	0.3839	0.5228	-0.1390	-1.1421	0.3839	0.4640	-0.0801	-0.6586	42.3343
Opp. vote share	0.4073	0.4221	-0.0148	-0.5652	0.4073	0.3873	0.0200	0.7661	-35.5307

Note: T: Means Treated; C: Means Control; D: Mean Difference; St.: Std. Difference in Means; Improve: Percent Balance Improvement.

Table C1 reports the balance improvement when the precincts are matched on demographic data estimated using Thiessen Polygon GIS technique. Again, for all the variables of interest, CE matching produces a better balance: the balance improvement goes from 75.0 percent for opposition's vote share, to 88.6 percent for education. The PS matching generates a poorer balance in the matched data, with an improvement of 53.2 percent in the best case.

Table C2. Summary of Balance for All and Matched Data, by Matching Method, for Demographics estimated through Nearest Neighbor

	All Data				*Matched Data*				Improve
	T	C	D	St.	T	C	D	St.	
Coarsened Exact Matching									
Distance	0.6719	0.2853	0.3866		0.5880	0.4508	0.1372		64.5097
Poverty rate (%)	0.1280	0.2370	-0.1090	-1.0339	0.1330	0.1382	-0.0052	-0.0490	95.2642
Non-educated (%)	0.3855	0.5214	-0.1359	-1.0274	0.4022	0.4371	-0.0348	-0.2633	74.3694
Opp. vote share	0.4073	0.4221	-0.0148	-0.5652	0.4139	0.4151	-0.0012	-0.0450	92.0398
Propensity Scores Matching									
Distance	0.6665	0.3083	0.3582		0.6665	0.6056	0.0609		83.0041
Poverty rate (%)	0.1280	0.2370	-0.1090	-1.0339	0.1280	0.2047	-0.0767	-0.7272	29.6628
Non-educated (%)	0.3855	0.5214	-0.1359	-1.0274	0.3855	0.4838	-0.0983	-0.7433	27.6526
Opp. vote share	0.4073	0.4221	-0.0148	-0.5652	0.4073	0.3898	0.0175	0.6697	-18.4823

Note: T: Means Treated; C: Means Control; D: Mean Difference; St.: Std. Difference in Means; Improve: Percent Balance Improvement.

Table C2 presents the balance improvement reached in matched data for both matching methods, when the data is matched on precinct demographics estimated using Nearest Neighbor GIS technique. For all the variables of interest, CE matching generates a better balance in the matched data. The balance improvement goes from 74.4 percent for education, to 95.3 percent for poverty rate. Contrary, the improvements are much smaller using PS matching. The largest improvement is only of 29.7 percent.

Finally, Table C3 reports the differences in sample size across matching methods and geo-reference techniques. There is frequently a trade-off between post-matching sample size and balance improvement (King et al. 2014), since a better balance might imply a larger number of discarded observations. However, both matching methods keep almost the same total number of observations.

Table C3. Sample Size, by Matching Method and Geo-Reference Technique

	Thiessen Polygons				Nearest Neighbor			
	CEM		PSM		CEM		PSM	
	C	T	C	T	C	T	C	T
All	232	200	230	200	230	200	230	200
Matched	152	112	57	200	160	112	57	200
Unmatched	78	88	173	0	70	88	173	0
Discarded	0	0	0	0	0	0	0	0

Note: CEM: Coarsened Exact Matching; PSM: Propensity Scores Matching; C: Control; T: Treated.

The complementary analysis reported in Table 2 of the text, based on 2007 and 2015 provincial election, comprises a different number of observations given that the number of parties competing in the election vary across election year. The balance between all and matched data, however, keeps the same distribution.

In sum, CE matching is generating a larger balance improvement in the matched data than the PS matching, while the sample size is not significantly different. As it was stated in the body of the article, given that CE matching has produced the best post-matching balance in the data, we only reported the results based on data matched through this method. Results do not differ substantially across matching methods though, what suggests that the results are robust.

Appendix D. Difference-in-Difference Analyses: Results from Alternative GIS Techniques and Matching Procedures

Appendix D reports the Difference-in-Difference test for the alternative GIS techniques and matching procedures used in our analysis. Specifically, we replicate the difference-in-difference analysis reported in the main text using the demographic data generated from the alternative GIS techniques and using precincts matched using the PS matching approach. As the tables below demonstrate, the results reported in the main text are robust to both alternatives. The difference-in-difference for each of the alternative tests has a similar size and magnitude as the results presented in the main body of the manuscript.

Table D1. Difference-in-Difference Analysis: CE Matching and Nearest Neighbor

No Implementation (2007) vs. Partial Implementation (2011)

	Control Group (Paper Ballots in 2011)	Treated Group (Electronic Ballots in 2011)	**Difference**
2007 Elections: No Implementation	8.3876	9.2877	0.9001
2011 Elections: Partial Implementation	5.4805	11.0760	5.5955***
Difference	-2.9071***	1.7883**	4.6954***

Partial Implementation (2011) vs. Full Implementation (2015)

	Control Group (Paper Ballots in 2011)	Treated Group (Electronic Ballots in 2011)	**Difference**
2011 Elections: Partial Implementation	5.4805	11.0760	5.5955***
2015 Elections: Full Implementation	7.5191	7.8835	0.3644
Difference	-2.0386***	3.1925***	5.2311***

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table D2. Difference-in-Difference Analysis: PS Matching and Thiessen Polygon

No Implementation (2007) vs. Partial Implementation (2011)

	Control Group (Paper Ballots in 2011)	Treated Group (Electronic Ballots in 2011)	**Difference**
2007 Elections: No Implementation	8.5056	10.3380	1.8324**
2011 Elections: Partial Implementation	5.3681	9.8741	4.5060***
Difference	-3.1375***	-0.4639	2.6736*

Partial Implementation (2011) vs. Full Implementation (2015)

	Control Group (Paper Ballots in 2011)	Treated Group (Electronic Ballots in 2011)	**Difference**
2011 Elections: Partial Implementation	5.3681	9.8741	4.5060***
2015 Elections: Full Implementation	7.7178	7.5591	-0.1596
Difference	-2.3506***	2.3150***	4.6656***

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table D3. Difference-in-Difference Analysis: PS Matching and Nearest Neighbor

No Implementation (2007) vs. Partial Implementation (2011)

	Control Group (Paper Ballots in 2011)	Treated Group (Electronic Ballots in 2011)	**Difference**
2007 Elections: No Implementation	7.8125	10.3380	2.5255***
2011 Elections: Partial Implementation	5.5124	9.8741	4.3617***
Difference	-2.3001***	-0.4639	1.8362

Partial Implementation (2011) vs. Full Implementation (2015)

	Control Group (Paper Ballots in 2011)	Treated Group (Electronic Ballots in 2011)	**Difference**
2011 Elections: Partial Implementation	5.5124	9.8741	4.3617***
2015 Elections: Full Implementation	8.0126	7.5591	-0.4535
Difference	-2.5002***	2.3150***	4.8152***

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Appendix E. Party-Precinct Analyses: Results from Alternative GIS Techniques and Matching Procedure

Appendix E reports the Party-Precinct Analyses for the alternative GIS techniques and matching procedures used in our analysis. Specifically, Figure E1 plots the marginal effects of electronic voting on ballot splitting by party. The pink dots represent the marginal effects calculated based on the Nearest Neighbor GIS technique and the blue dots represent the results from the Thiessen Polygon GIS technique. The top panel in the figure shows the results from the CE matching approach and the bottom panel represents the results obtained from the PS matching approach. The results reported in this figure are based on Table 2 in the text and Tables E1, E2, and E3, in this appendix.

The results using the CE matching from both GIS techniques are remarkably robust. Consistent with our expectations, there are no differences in ballot splitting between the treatment and control group in 2007 (no implementation) or in 2015 (full implementation). In 2011 (partial implementation), however, the marginal effect of electronic voting on ballot splitting is significant for several of the political parties. Consistent with the results reported in the main text, electronic voting resulted in more ballot splitting in favor of Wayar's governor ticket and the Sur-PS's governor ticket than did traditional paper voting. Further, electronic voting resulted in more ballot splitting in favor of the legislative ticket than did paper ballots for Olmedo's party, the Partido Obrero, and the Unión Cívica Radical. All in all, the results from CE matching are extremely robust to the different GIS techniques using CE matching.

The bottom panel plots the results using the PS matching approach. The results for 2011 are also robust to the PS matching approach. Indeed, our analysis indicates that under partial implementation, precincts using electronic voting had higher levels of vote splitting than did precincts using paper ballots. Again, this resulted in significant gains for the Wayar and Sur-PS governor's tickets and for the Olmedo legislative ticket. Nonetheless, the results are slightly weaker using the PS matching approach for 2007 and 2015. This is not surprising given that the PS matching only produced modest improvements in the balance between the treatment and control groups. Recall that whereas CE matching resulted in a larger balance improvement in the distribution of background conditions across treated and control units (i.e., the balance of the variables of interest improves by more than 75 percent), the PS matching produces poor post-matching balance in the data (i.e., an improvement of 53 percent). The poor balance improvement suggests that some systematic differences between the treatment and control groups could remain in our sample using PS matching. Indeed, although the results for 2011 (partial implementation) are largely robust to the PS matching approach the results for 2007 and 2015 diverge slightly. For example, the results from PS matching sample indicate that among voters supporting the Romero/Olmedo ticket, those who used electronic voting in 2011 are slightly more likely than voters using the traditional paper ballots in 2011 to split their ballot in 2015. These differences may be the result of poor balance. Alternatively, the differences from 2015 could indicate that voters may have gone through a learning process, wherein voters in precincts previously using the electronic voting are more likely to be comfortable using the electronic device and to take advantage of the opportunity to split their ballots. If this is the case, than future research may consider how the effects of electronic voting change over time as voters and political parties adapt to the new voting procedure.

Figure E1. The Effect of Electronic on the Share of Split Ballots, by Party: Alternative GIS Techniques and Matching Approaches

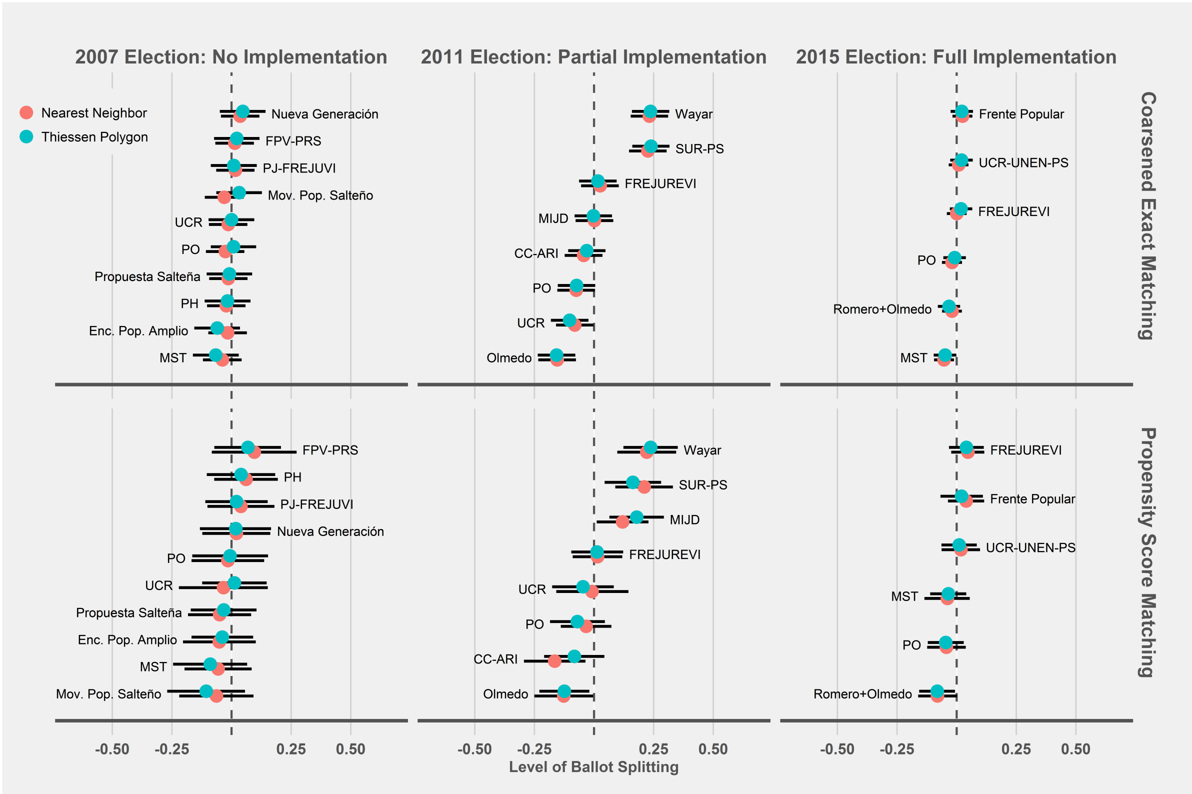

Table E1: The Effect of Ballot Structure on the Share of Split Ballots, by Party: CE Matching and Nearest Neighbor

2007 Elections: No Implementation		*2011 Elections: Partial Implementation*		*2015 Elections: Full Implementation*	
Electronic Device (EV)	0.0164	Electronic Device (EV)	-0.0809*	Electronic Device (EV)	-0.0528
	(0.0136)		(0.0350)		(0.0333)
PH	-0.2861***	PO	0.0624***	Frente Popular	-0.0364
	(0.0331)		(0.0099)		(0.0335)
MST	-0.3060***	Wayar	0.3684***	PO	-0.2061***
	(0.0374)		(0.0208)		(0.0201)
Mov. Pop. Salteño	-0.2663***	CC-ARI	0.0557	UCR-UNEN-PS	0.3346***
	(0.0442)		(0.0290)		(0.0205)
PO	-0.4134***	MIJD	0.0544	FREJUREVI	-0.1256***
	(0.0197)		(0.0457)		(0.0213)
Nueva Generación	-0.2303***	SUR-PS	0.2965***	Romero+Olmedo	0.0918***
	(0.0325)		(0.0203)		(0.0223)
Propuesta Salteña	-0.2716***	FREJUREVI	0.2129***		
	(0.0177)		(0.0193)		
FPV-PRS	0.0654***	Olmedo	0.0432**		
	(0.0076)		(0.0161)		
Enc. Pop. Amplio	-0.3253***				
	(0.0355)				
UCR	-0.3220***				
	(0.0237)				
ED x PH	-0.0385	ED x PO	0.0063	ED x Frente Popular	0.0777
	(0.0555)		(0.0413)		(0.0512)
ED x MST	-0.0547	ED x Wayar	0.3129***	ED x PO	0.0337
	(0.0566)		(0.0411)		(0.0320)
ED x Mov. P. Salteño	-0.0470	ED x CC-ARI	0.0371	ED x UCR-UNEN-PS	0.0613
	(0.0803)		(0.0578)		(0.0325)
ED x PO	-0.0425	ED x MIJD	0.0826	ED x FREJUREVI	0.0533
	(0.0313)		(0.1114)		(0.0320)
ED x Nva. Generación	0.0197	ED x SUR-PS	0.3066***	ED x Rom.+Olmedo	0.0337
	(0.0422)		(0.0413)		(0.0389)
ED x P. Salteña	-0.0307	ED x FREJUREVI	0.1063**		
	(0.0281)		(0.0378)		
ED x FPV-PRS	-0.0026	ED x Olmedo	-0.0738*		
	(0.0094)		(0.0338)		
ED x E. P. Amplio	-0.0327				
	(0.0552)				
ED x UCR	-0.0300				
	(0.0323)				
(Intercept)	0.1207***	(Intercept)	-0.1347***	(Intercept)	0.0160
	(0.0081)		(0.0139)		(0.0216)
Observations	329	Observations	264	Observations	198
Adjusted R2	0.6108	Adjusted R2	0.7316	Adjusted R2	0.8934

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
Coefficients from OLS regression with clustered standard errors by precinct.

Table E2: The Effect of Ballot Structure on the Share of Split Ballots, by Party: PS Matching and Thiessen Polygon

2007 Elections: No Implementation		*2011 Elections: Partial Implementation*		*2015 Elections: Full Implementation*	
Electronic Device (EV)	0.0253	Electronic Device (EV)	-0.0408	Electronic Device (EV)	-0.0500
	(0.0131)		(0.0426)		(0.0344)
PH	-0.3178***	PO	0.0486***	Frente Popular	-0.0496
	(0.0359)		(0.0108)		(0.0282)
MST	-0.3024***	Wayar	0.3333***	PO	-0.2248***
	(0.0219)		(0.0184)		(0.0125)
Mov. Pop. Salteño	-0.1230**	CC-ARI	0.1176***	UCR-UNEN-PS	0.3294***
	(0.0417)		(0.0235)		(0.0212)
PO	-0.4352***	MIJD	-0.0274	FREJUREVI	-0.1568***
	(0.0097)		(0.0457)		(0.0244)
Nueva Generación	-0.2612***	SUR-PS	0.3251***	Romero+Olmedo	0.0697***
	(0.0349)		(0.0176)		(0.0207)
Propuesta Salteña	-0.2692***	FREJUREVI	0.2061***		
	(0.0196)		(0.0160)		
FPV-PRS	0.0403**	Olmedo	0.0288		
	(0.0152)		(0.0180)		
Enc. Pop. Amplio	-0.3200***				
	(0.0240)				
UCR	-0.3249***				
	(0.0216)				
ED x PH	0.0065	ED x PO	-0.0274	ED x Frente Popular	0.1007*
	(0.0490)		(0.0397)		(0.0429)
ED x MST	-0.1133*	ED x Wayar	0.2796***	ED x PO	0.0129
	(0.0492)		(0.0496)		(0.0310)
ED x Mov. P. Salteño	-0.1360	ED x CC-ARI	-0.1005	ED x UCR-UNEN-PS	0.0617
	(0.0971)		(0.0613)		(0.0360)
ED x PO	-0.0384	ED x MIJD	0.1572	ED x FREJUREVI	0.0909**
	(0.0315)		(0.0895)		(0.0344)
ED x Nva. Generación	-0.0211	ED x SUR-PS	0.2154***	ED x Rom.+Olmedo	-0.0285
	(0.0532)		(0.0501)		(0.0437)
ED x P. Salteña	-0.0660*	ED x FREJUREVI	0.0530		
	(0.0272)		(0.0451)		
ED x FPV-PRS	0.0452	ED x Olmedo	-0.0851*		
	(0.0232)		(0.0408)		
ED x E. P. Amplio	-0.0624				
	(0.0437)				
ED x UCR	-0.0127				
	(0.0321)				
(Intercept)	0.1271***	(Intercept)	-0.1179***	(Intercept)	0.0439*
	(0.006)		(0.0146)		(0.0219)
Observations	329	Observations	264	Observations	198
Adjusted R2	0.4771	Adjusted R2	0.7220	Adjusted R2	0.7875

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
Coefficients from OLS regression with clustered standard errors by precinct.

Table E3: The Effect of Ballot Structure on the Share of Split Ballots, by Party: PS Matching and Nearest Neighbor

2007 Elections: No Implementation		*2011 Elections: Partial Implementation*		*2015 Elections: Full Implementation*	
Electronic Device (EV)	0.0319*	Electronic Device (EV)	-0.0083	Electronic Device (EV)	-0.0737*
	(0.0158)		(0.0582)		(0.0296)
PH	-0.2901***	PO	0.0114	Frente Popular	-0.0306**
	(0.0482)		(0.0752)		(0.0106)
MST	-0.3316***	Wayar	0.3726***	PO	-0.2378***
	(0.0325)		(0.0541)		(0.0153)
Mov. Pop. Salteño	-0.1010***	CC-ARI	0.1432***	UCR-UNEN-PS	0.3262***
	(0.0298)		(0.0241)		(0.0454)
PO	-0.4347***	MIJD	-0.0369	FREJUREVI	-0.1906***
	(0.0085)		(0.0490)		(0.0140)
Nueva Generación	-0.2518***	SUR-PS	0.3809***	Romero+Olmedo	0.0541***
	(0.0524)		(0.0331)		(0.0143)
Propuesta Salteña	-0.2732***	FREJUREVI	0.2364***		
	(0.0190)		(0.0427)		
FPV-PRS	-0.0042	Olmedo	0.0497		
	(0.0335)		(0.0420)		
Enc. Pop. Amplio	-0.2937***				
	(0.0238)				
UCR	-0.3042***				
	(0.0148)				
ED x PH	-0.0212	ED x PO	0.0098	ED x Frente Popular	0.0818*
	(0.0587)		(0.0843)		(0.0340)
ED x MST	-0.0841	ED x Wayar	0.2403***	ED x PO	0.0259
	(0.0547)		(0.0710)		(0.0323)
ED x Mov. P. Salteño	-0.1580	ED x CC-ARI	-0.1261*	ED x UCR-UNEN-PS	0.0649
	(0.0925)		(0.0615)		(0.0539)
ED x PO	-0.0389	ED x MIJD	0.1667	ED x FREJUREVI	0.1247***
	(0.0311)		(0.0912)		(0.0279)
ED x Nva. Generación	-0.0304	ED x SUR-PS	0.1596**	ED x Rom.+Olmedo	-0.0129
	(0.0660)		(0.0574)		(0.0410)
ED x P. Salteña	-0.0621*	ED x FREJUREVI	0.0227		
	(0.0268)		(0.0600)		
ED x FPV-PRS	0.0897*	ED x Olmedo	-0.1060		
	(0.0379)		(0.0557)		
ED x E. P. Amplio	-0.0887*				
	(0.0435)				
ED x UCR	-0.0335				
	(0.0280)				
(Intercept)	0.1205***	(Intercept)	-0.1503***	(Intercept)	0.0677***
	(0.0106)		(0.0423)		(0.0131)
Observations	329	Observations	264	Observations	198
Adjusted R2	0.4821	Adjusted R2	0.7016	Adjusted R2	0.7778

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
Coefficients from OLS regression with clustered standard errors by precinct.

Appendix F. Addressing Data Limitations

In Appendix F we address the different data limitations discussed in the manuscript. To begin with, we report the Difference-in-Difference test for the subsample excluding those parties that run with more than one legislative list attached to their gubernatorial candidate. As the tables below indicate, the results presented in the body of our manuscript are robust to this subsample analysis. For 2007, we excluded the coalition Frente para la Victoria-Partido Renovador, which had four different legislative lists attached to the gubernatorial candidate, and Alianza Frente Justicialista para la Victoria, with three different legislative lists. We also excluded the Frente Justicialista Renovador de la Victoria and the Frente Olmedo Gobernador with six and three different legislative lists respectively in 2011 election, and Frente Olmedo + Romero with two legislative lists and Frente Justicialista Renovador de la Victoria with seven lists in 2015.

Using this subsample, we replicated the difference-in-difference test used for the main precinct level analysis using the demographic data generated from the alternative GIS techniques and the two matching approaches (PS and CE matching). Table F1 shows that the average share of split ballots between the executive and legislative election in 2007 is 10.71 in precincts that would continue to use paper ballots in 2011, and 11.50 in precincts that would be assigned to e-voting in 2011. The difference is not statistically significant. In 2011 however, the difference is larger and statistically significant. In precincts that used paper ballot (control group), the split vote share is 8.94, while it increases to almost twice (17.60) in districts with e-voting (treatment group). The difference of 8.66 is statistically significant. The difference-in-difference comparison between 2007 and 2011 is 7.87 points.

The bottom panel in Table F1 compares the partial implementation of electronic voting in 2011 to the full implementation in 2015. As noted, in 2011, the precincts with e-voting showed a two fold increase in ballot splitting compared to those using paper ballot. In 2015, however, difference is statistically insignificant between e-voting and paper districts. There too, the difference-in-difference test between 2011 and 2015 is 7.49 points and statistically significant.

The difference-in-difference test provides support for Hypothesis 1. The results hold for the alternative GIS technique using CE matching methods as well as for the PS matching technique, where the post matched balance does not show a good improvement compared to the complete sample.

Table F1. Difference-in-Difference Analysis: CE Matching and Thiessen Polygon

No Implementation (2007) vs. Partial Implementation (2011)

	Control Group (Paper Ballots in 2011)	Treated Group (Electronic Ballots in 2011)	**Difference**
2007 Elections: No Implementation	10.7720	11.2890	0.5170
2011 Elections: Partial Implementation	9.1935	18.3040	9.1105***
Difference	-1.5785**	7.0150***	8.5935***

Partial Implementation (2011) vs. Full Implementation (2015)

	Control Group (Paper Ballots in 2011)	Treated Group (Electronic Ballots in 2011)	**Difference**
2011 Elections: Partial Implementation	9.1935	18.3040	9.1105***
2015 Elections: Full Implementation	13.0120	13.9570	0.9450
Difference	-3.8185***	4.3470***	8.1655***

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table F2. Difference-in-Difference Analysis: CE Matching and Nearest Neighbor

No Implementation (2007) vs. Partial Implementation (2011)

	Control Group (Paper Ballots in 2011)	Treated Group (Electronic Ballots in 2011)	**Difference**
2007 Elections: No Implementation	10.7060	11.4960	0.7900
2011 Elections: Partial Implementation	8.9382	17.5960	8.6578***
Difference	-1.7678**	6.1000***	7.8678***

Partial Implementation (2011) vs. Full Implementation (2015)

	Control Group (Paper Ballots in 2011)	Treated Group (Electronic Ballots in 2011)	**Difference**
2011 Elections: Partial Implementation	8.9382	17.5960	8.6578***
2015 Elections: Full Implementation	12.7290	13.8920	1.1630
Difference	-3.7908***	3.7040***	7.4949***

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table F3. Difference-in-Difference Analysis: PS Matching and Thiessen Polygon

No Implementation (2007) vs. Partial Implementation (2011)

	Control Group (Paper Ballots in 2011)	Treated Group (Electronic Ballots in 2011)	**Difference**
2007 Elections: No Implementation	10.9380	11.2720	0.3340
2011 Elections: Partial Implementation	7.9930	16.7610	8.7680***
Difference	-2.9450***	5.4890***	8.4340***

Partial Implementation (2011) vs. Full Implementation (2015)

	Control Group (Paper Ballots in 2011)	Treated Group (Electronic Ballots in 2011)	**Difference**
2011 Elections: Partial Implementation	7.9930	16.7610	8.7680***
2015 Elections: Full Implementation	12.8340	15.0250	2.1910**
Difference	-4.8410***	1.7360	6.5770***

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table F4. Difference-in-Difference Analysis: PS Matching and Nearest Neighbor

No Implementation (2007) vs. Partial Implementation (2011)

	Control Group (Paper Ballots in 2011)	Treated Group (Electronic Ballots in 2011)	**Difference**
2007 Elections: No Implementation	8.4394	11.2720	2.8326
2011 Elections: Partial Implementation	9.6119	16.7610	7.1491***
Difference	1.1725	5.4890***	4.3165**

Partial Implementation (2011) vs. Full Implementation (2015)

	Control Group (Paper Ballots in 2011)	Treated Group (Electronic Ballots in 2011)	**Difference**
2011 Elections: Partial Implementation	9.6119	16.7610	7.1491***
2015 Elections: Full Implementation	12.6430	15.0250	2.3820
Difference	-3.0311*	1.7360	4.7671**

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Robustness Tests to Detect the Prevalence of Missing Ballots

Under the ballot-and-envelope system, parties are responsible for printing, distributing, and stocking their own ballots. Smaller parties are more likely to lack the required resources to assure the provision of ballots across hundreds of polling stations and thousands of voting booths (see Table B2). While major parties are able to monitor every single booth and to supply more ballots any time they detect their absence, small parties face more difficulties to recruit enough monitors and to keep the provision of ballots. This element is important for our analysis because the number of available options in an election affects the probability of casting a split ticket vote.

As the number of parties competing in each contest decreases, the probability that a voter randomly choosing between different parties for each contest at stake splits his/her ticket also decreases (Ames et al. 2009). Thus, ballot splitting may be lower under the ballot-and-envelope system if smaller parties are not able to consistently supply ballots to each polling location. By contrast, the provision of ballots is centralized under the new e-voting system, and thus guarantees ballots for every part at every voting center. Ballot availability may present a challenge for our analysis: the magnitude of the increase in ballot splitting might be due to the combination of the new ballot structure and the lack of ballots.

Although, it is not easy to retrospectively establish the lack of ballot availability, we can assess whether any party in the election preformed systematically worse at any voting center in our sample. This information can provide some insights about whether or not the lack of ballot availability in some voting centers biases the results in our analyses. We make two assumptions. First, the lack of ballots would preclude voters not only from splitting their vote, but from casting *any* vote for the party with missing ballots. Thus, the lack of ballots will be associated with unusually poor election performances. Second, a party member can monitor many voting booths in the same voting center, but she will find it more difficult to monitor more than one voting center, even when they are located in the same neighborhood or precinct. Thus, the lack of ballots will be reflected in differences in electoral performance of political parties at different polling stations rather than the difference in the party's performance at the same polling station but different voting booths.

In order to detect the prevalence of missing ballots in the precincts using the paper-and-envelope system in the 2011 provincial election, we run separate linear models for each party:

$$y_{ijk} = \alpha + \beta X_i + \gamma_{jk} + \varepsilon_{ik}$$

$$\gamma_j \sim N\left(0, {\sigma_\gamma}^2\right)$$

$$\varepsilon_{ik} \sim N(0, {\sigma_\varepsilon}^2)$$

where i indexes the voting booth, j indexes the voting center, and k indexes the party. The term y_{ijk} is the number of gubernatorial votes obtained by the kth party in ith voting booth. The term β represents the coefficients capturing the effect on y_{ijk} of the X vector of demographic variables, such as precinct population, education level, and poverty rate. Finally, the term γ_{jk} captures a voting center-level intercept for the kth party at jth voting center, while α is an intercept and ε_{ik} is an error term for the ikth observation.

The expectation is that the lack of ballots of one party should be reflected as a deviation in the group intercept. If a party is performing systematically worse in one voting center, compared to its performance in the average polling station in our sample, this may be preliminary evidence of a lack of ballot availability in that location. To the contrary, voting center intercepts around the party average suggest no systematic differences at the voting center compared to the rest of the sample. In a sum, the presence of negative outliers will be a sign of problematic cases.[2]

[2] An outlier above the mean indicates that the party showed a salient performance in a given voting center. This situation naturally implies that ballots were available.

The results of the analysis are reported in Figure F1.[3] Although ballot availability may have been a problem in other precincts in the province of Salta, our analysis suggests that the lack of ballots was not an extended problem in our sample. Across the eight parties included in this analysis, there's only one outlier, out of 943 voting booths, across 84 voting centers; and these findings are consistent across GIS techniques. Moreover, this outlier corresponds to FREJUREVI, the political party that won the gubernatorial race and not for any of the smaller parties in our analysis, which would be our expectation. Once we control for demographic characteristics of the electoral precinct, there are no major differences at the voting center-level.

This evidence does not completely rule out the lack of ballots in the election. Anecdotal evidence indicates that major parties have the resources to consistently supply ballots to all polling stations, whereas the leaders of smaller parties have more difficulty doing so.[4] That said, the potential lack of ballots would have to have been homogeneously distributed across polling stations in order to not influence the overall success of parties in our analysis. To the contrary, our additional analysis provides evidence to suggests that ballot availability is not a major concern in our sample.

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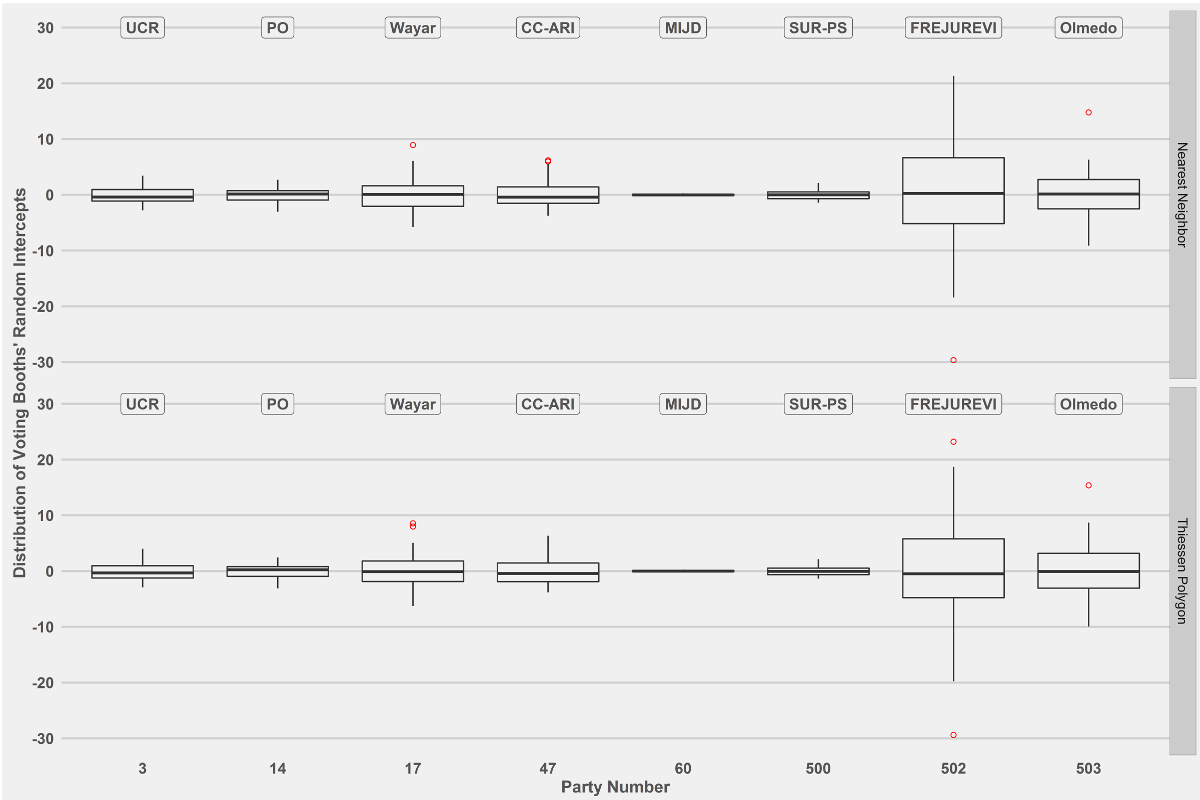
[3] Additionally, Tables F5 and F6 report the regression results for each party, using both GIS techniques to estimate the demographic characteristics of the electoral precinct.
[4] See for example: "Con el voto electrónico no hay manera de que haya fraude" (La Gaceta, 08/11/2014). Available at: <http://www.lagaceta.com.ar/nota/602958/politica/con-voto-electronico-no-hay-manera-haya-fraude.html>, accessed: 05/01/2016.

Figure F1. Robustness Tests to Detect the Prevalence of Missing Ballots (Salta District, 2011. OLS regression model). Nearest Neighbor and Thiessen Polygons



Note: Figure F1 plots the mean, range, and outliers for the voting centers' random intercepts by party using a standard box and whisker plot. Negative outliers indicate that a given candidate preformed worse at a polling station than expected based on his average performance elsewhere.

Table F5. Robustness Tests to Detect the Prevalence of Missing Ballots (Salta District, 2011. OLS regression model). Nearest Neighbor

	UCR		*PO*		*Wayar*		*CC-ARI*	
	3		*14*		*17*		*47*	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Fixed effects								
Population	0.000	-1.260	0.000	0.953	0.000	4.105	0.000	-1.075
	(0.000)		(0.000)		(0.000)		(0.000)	
Non-educated (%)	-19.626	-2.103	-0.883	-0.100	43.357	2.313	-30.099	-2.321
	(9.334)		(8.820)		(18.741)		(12.967)	
Poverty rate (%)	4.103	0.344	-9.715	-0.859	-65.389	-2.732	16.897	1.028
	(11.923)		(11.304)		(23.931)		(16.444)	
Intercept	14.217	6.330	10.868	5.137	11.551	2.561	15.328	4.891
	(2.246)		(2.116)		(4.511)		(3.134)	
Random effects								
Intercept	1.846		1.642		3.725		2.760	
Residual	2.884		3.268		5.673		2.577	
Observations	458		458		458		458	
Groups	42		42		42		42	
AIC	2,354.6		2,454.1		2,970.4		2,286.0	
	MIJD		*Morello*		*FREJUREVI*		*Olmedo*	
	60		500		502		503	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Fixed effects								
Population	0.000	-0.221	0.000	3.003	0.000	-1.673	0.000	-0.715
	(0.000)		(0.000)		(0.000)		(0.000)	
Non-educated (%)	0.804	0.590	-8.088	-1.231	222.373	4.478	-19.228	-0.686
	(1.361)		(6.572)		(49.664)		(28.047)	
Poverty rate (%)	-0.915	-0.522	-5.914	-0.700	-73.393	-1.164	-60.436	-1.690
	(1.751)		(8.451)		(63.046)		(35.769)	
Intercept	0.406	1.257	10.824	6.901	41.563	3.465	78.530	11.623
	(0.323)		(1.568)		(11.996)		(6.756)	
Random effects								
Intercept	0.173		1.070		10.486		5.662	
Residual	0.774		3.059		10.643		7.944	
Observations	458		458		458		458	
Groups	42		42		42		42	
AIC	1,113.8		2,376.8		3,568.0		3,281.2	

Table F6. Robustness Tests to Detect the Prevalence of Missing Ballots (Salta District, 2011. OLS regression model). Thiessen Polygons.

	UCR 3		*PO* 14		*Wayar* 17		*CC-ARI* 47	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Fixed effects								
Population	0.000	-1.516	0.000	1.030	0.000	4.277	0.000	-1.220
	(0.000)		(0.000)		(0.000)		(0.000)	
Non-educated (%)	-17.573	-2.098	-2.739	-0.338	39.649	2.405	-28.551	-2.475
	(8.376)		(8.099)		(16.483)		(11.537)	
Poverty rate (%)	2.629	0.252	-6.026	-0.592	-57.015	-2.775	15.963	1.132
	(10.442)		(10.185)		(20.548)		(14.105)	
Intercept	13.740	6.796	11.112	5.716	11.940	3.001	14.942	5.312
	(2.022)		1.944		3.979		2.813	
Random effects								
Intercept	1.814		1.649		3.570		2.728	
Residual	2.885		3.269		5.674		2.577	
Observations	458		458		458		458	
Groups	42		42		42		42	
AIC	2,354.2		2,455.0		2,968.3		2,285.7	

	MIJD 60		*Morello* 500		*FREJUREVI* 502		*Olmedo* 503	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Fixed effects								
Population	0.000	-0.244	0.000	2.916	0.000	-1.223	0.000	-1.107
	(0.000)		(0.000)		(0.000)		(0.000)	
Non-educated (%)	0.895	0.707	-5.614	-0.916	163.923	3.742	-12.528	-0.515
	(1.266)		(6.129)		(43.801)		(24.333)	
Poverty rate (%)	-1.106	-0.682	-7.481	-0.960	-6.371	-0.119	-64.345	-2.127
	(1.622)		(7.794)		(53.716)		(30.249)	
Intercept	0.397	1.332	10.082	6.917	54.767	5.136	77.089	13.104
	(0.298)		(1.458)		(10.663)		(5.883)	
Random effects								
Intercept	0.171		1.088		10.242		5.355	
Residual	0.774		3.058		10.641		7.941	
Observations	458		458		458		458	
Groups	42		42		42		42	
AIC	1,114.0		2,377.6,		3,566.7		3,277.8	