4G Democracy:
Mobile Internet and Electoral Outcomes in Chile

Benjamin Leiva Silva*

December 21, 2018

Abstract

The relationship between Internet access and political outcomes is an increasingly relevant subject given the current reshaping of several western democracies. In this paper, I study the effects of increased mobile Internet access on electoral outcomes like voter turnout and political vote shares. Using a panel data model with time and location fixed effects, I exploit municipality-level differences in the installation of antennas that provide mobile Internet. I find that a one standard deviation increase in the number of antennas of the average municipality decreases left-wing candidacies' vote shares in 8 p.p. while increasing outsider vote shares by 5 p.p., where this last result is mainly displayed at local elections. Turnout, on the other hand, is reduced in presidential elections but significantly increased in local elections under larger mobile Internet access. Finally, I find that this increase in connectivity influences political outcomes mainly through its effect on rural municipalities and institutional changes like the instauration of voluntary voting.

*Work developed under EH Clio Lab Master Thesis' Seminar, Instituto de Economía UC. I thank FONDECYT regular proyect #1170956 for providing funding for this research. I profoundly thank Francisco Gallego and Felipe Gonzalez for their continous support and guidance during this process. I also thank Emilio Depetris-Chauvin, Jose Diaz, Jeanne Lafortune, Rolf Lüders, Jose Tessada and Gert Wagner for their help and comments. I also would like to thank my family, friends and specially Jacinta Girardi for their unconditional support during my time at PUC. All errors are my own. Doubts and comments to: bleiva1@uc.cl.

1 Introduction

Only a few times in history there has been such a radical change regarding information availability as with the irruption of high speed Internet in the mid 2000s. Before that moment Internet access was cumbersome, and it was far away from being massive. The consequences of this phenomenon are diverse, but one that comes to attention is the effect it has on the electoral outcomes of a country, both nationally and locally. This last point takes even more relevance given the deterioration that western hemisphere's institutions and democratic systems have had during the last decade.[1] The weakening of socialdemocracies and the rise of new political movements, along with the growing ideological polarization and the low electoral turnout of new generations, makes the study of disruptive phenomenons like the Internet -and its massification- a subject of particular interest in the field of political economy.[2]

In order to shed some light onto the previous matter, I focus this paper on determining the causal effect that mobile high speed Internet access has on different electoral outcomes, such as voter turnout and vote shares obtained by either left-wing, right-wing or outsider candidates, as well as the proportion of null and white vote preferences. To do so, I compile several datasets obtained from the Chilean Electoral Service (SERVEL) that contain electoral results from every municipality in Chile between the first democratic elections held after Pinochet's dimission in 1989 to the last presidential and legislative elections carried out in 2017. Internet data, on the other hand, is obtained from the Telecomunications Subsecretary of Chile (SUBTEL), which provides the exact location and instalation date of every antenna that provides mobile Internet connections between said period. My focus on *mobile* Internet availability, rather than fixed or landline Internet access (as the current related economic literature does), comes from the exponential growth that mobile Internet connection has had around the world over the last decade, specially in developing countries.[3]

To estimate the effect of mobile Internet availability on Chile's electoral outcomes, I exploit the time variation across Chilean municipalities regarding the instalation of said antennas between

[1] According to The Economist's 2017 Democracy Index, 89 countries experienced a decline in their total democracy score compared to 2016 (including the United States and Western Europe), which is the worst performance since the aftermath of the financial crisis in 2010-11. Furthermore, the manifestations of said decline reside in: declining popular political participation, weaknesses in the functioning of government, reduction of trust in institutions, and a decline in media freedoms, among others.

[2] The ideological polarization is well depicted for the United States in Ladd, Tucker and Kates (2018), where they find that satisfaction with U.S. democracy and confidence in institutions are more driven by political partisanship than by demographic characteristics. For example, Republicans have a high (low) level of institutional confidence regarding the military, local police and religion (press, Facebook and political parties), while Democrats think highly (poorly) of Colleges and Universities or companies like Amazon or Google (the executive branch, congress, and religion).

[3] For further details, see International Telecommunications Union ICT Facts and Figures (2017).

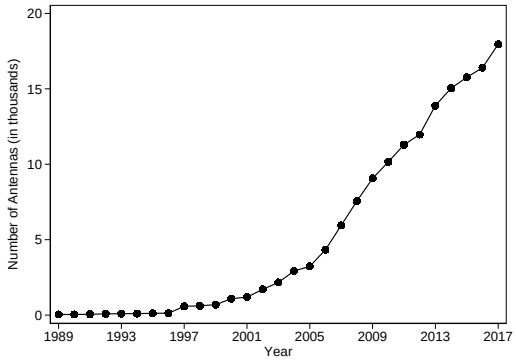


Figure 1: Number of Antennas in Chile

1989 and 2017. I plot that variation in Figure 1, where we can see that the massification of mobile high speed Internet began in the early 2000s and has experienced an accelerated growth rate since then, going from having nearly 700 operational antennas at the end of the 1990s to having almost 18,000 in 2017.

Nevertheless, the identification of the parameter of interest (i.e., the effect of the amount of mobile Internet antennas in a municipality at a certain period of time) is not trivial, since there may be time-varying unobservable local characteristics that could affect both mobile high speed Internet provision and voter turnout or the electoral performance of candidates and political coalitions. An example of the latter could be the average education or income level of a municipality, since it is not farfechted to assume that high income well-educated constituents tend to vote more (or differently) than less privileged ones. Therefore, in order to account for the potential existence of endogeneity through ommited variable bias, I control for municipality education and income levels across time, while also conducting a series of identification exercises (e.g., exogeneity, parallel trends, and randomization tests) that provide evidence that the instalation of antennas is not correlated with neither the municipality's socioeconomic characteristics nor its previous electoral outcomes. As for my estimation method, I use a panel data model with municipality and year fixed effects, therefore exploiting the time and location heterogeneity that Chilean municipalities have regarding the instalation of high speed Internet antennas.

The effect of the introduction of new mass media on different political outcomes is well documented in the economic and political science literature. As for voter turnout, evidence shows that more informed voters are more likely to vote than their less informed counterparts, even in costless voting scenarios (Federsen and Pesendorfer, 1996, 1999; Lassen, 2005; Larcinese, 2007). The means by which voters get informed is also relevant. Regarding radio diffusion, findings

state that the effectiveness of the transmited message was determined by pre-existing local preferences and by the effect that their sociodemographic characteristics had in terms of policy aid (Strömberg, 2004a; Adena et al., 2015). As for the effects of exposure to television, evidence reveals a significantly lasting positive turnout effect for the broadcaster's ideology, and a crowding-out effect of older mass media like radio or newspapers (Gentzkow, 2006; Durante, Pinotti and Tesei, 2014). Following the latter, empirical work also shows that new "global" newspaper circulation decreases the local newspapers' circulation, at the same time that boosts political participation and negatively affects incumbent reelections due to higher informed constituents (George and Waldfogel, 2006; Snyder and Strömberg, 2010; Gentzkow, Shapiro and Sinkinson, 2011).

There is also literature on the ideological spectrum that benefits from larger exposure to general or partisan information. As for the effect on party vote shares, evidence shows that providing voters with newspapers that come from different ideological spectrums increases Democrat voting in Washington (Gerber, Karlan and Bergan, 2009), while exposure to partisan television programming has a significant effect on the vote share of the channel's ideology in the United States and Russia (DellaVigna and Kaplan, 2007; Enikolopov, Petrova and Zhuravskaya, 2011). Theoretical models that try to understand and forecast this kind of situations have also been developed. In particular, models created by Strömberg (2004b) and Besley and Prat (2006) predict politics and policy outcomes when media or governments target their message through mass media, even if the decision to capture it is endogenous, finding that changes in the concentration level or ownership of mass media may affect welfare through consumer surplus, public policy bias and political accountability. Finally, and contrary to what is commonly assumed, recent evidence finds that ideological segregation of online news consumption is low on absolute terms, but higher that offline news consumption and face-to-face interactions (Gentzkow and Shapiro, 2011).

My research particulary complements the incipient literature on landline Internet's effects on electoral outcomes. The average empirical strategy of this literature focuses on exploiting temporal discrepancies between municipalities regarding the access to fixed broadband Internet, treating the main explanatory variable (i.e., Internet access or use) as endogenous, since Internet companies could choose to provide their services first and more intensively in municipalities that have higher adquisitive power and/or higher education levels. Therefore, most authors instrument said variable of interest, in many cases with the distance between the municipality's centroid (a proxy of its most populated location) and the nearest fixed Internet main distribution frame, which was generally built to suit the telephone landline needs way before the irruption of the Internet, therefore providing exogeneity to their instalation process. The 2SLS estimations of this

literature are calculated for different countries and contexts, and tend to provide mixed results.

For example, Czernich (2012) and Falck et al. (2014) study Internet access and electoral behavior in Germany at the municipality level. While the latter finds a negative (positive) effect of high speed Internet access on electoral turnout in west (east) Germany, the prior finds a positive but insignificant effect. Poy and Schüller (2016) and Campante et al. (2017) analyze this subject for Italy. While the second one only considers Internet access, the first one interestingly also estimates the effect of the intesity of the treatment (i.e., how many days has each municipality has had high speed Internet access), finding again mixed results: a negative effect of 7 p.p. on turnout and a positive one of 3.3 p.p., respectively. On the other hand, Gavazza et al. (2015) studies the effects of Internet on British voter turnout and public spending finding a negative local effect, specially among young uneducated voters. The case for the United States is studied by Jaber (2013) and Larcinese and Miner (2018). While the first one instruments for topographic characteristics, the second one uses a two-stage difference-in-differences strategy exploiting spacial discontinuities across municipalites belonging to different counties. Both papers find a positive effect on turnout and an increase in the vote share of the Democratic party. Finally, Miner (2015) studies this phenomenon for a non-democratic developing country like Malaysia, which has the particularity that at the time of the study, the central government had significant control over the country's mass media, providing a new context on which to evaluate the effects of the Internet on electoral outcomes. His research finds that Internet exposure reduces in 6.6 p.p. the vote share of the ruling coalition, but doesn't find any effect on voter turnout.

This paper provides several useful results concerning the effects of expanded mobile Internet access on turnout and vote shares, as well as the mechanisms that underlie these electoral changes. In my overall analysis, I find that since the beginning of the mobile Internet boom, a one within-municipality standard deviation increase in the number of antennas (i.e., 32) reduces left-wing vote share by 8 p.p. while rising outsider voter preferences by 5 p.p.. However, I find no significant effects for overall turnout rates nor right-wing or null/white vote shares. Then, by disaggregating the effects by type of election, I find that an additional antenna per municipality decreases turnout rates in presidential and legislative elections by 0.04 and 0.01 p.p. respectively, while increasing it in local elections by 0.04 p.p.. In terms of within-municipality standard deviations, said effects represent a 9 and 4 p.p. decrease and 5 p.p. increase, respectively. As for vote shares, there are no significant effects for left-wing candidacies, but I do find that a marginal increase in the number of antennas in the average municipality decreases right-wing vote shares in presidential elections by 0.02 p.p. and increases outsider preferences in local processes by 0.06 p.p..

As for the underlying mechanisms driving the mentioned results, I find that urban and rural municipalities have different electoral behaviors when they experience an increase in mobile Internet connectivity. In particular, I observe that the decrease in presidential turnout rates are driven mainly by rural municipalities, as it is for the before mentioned variation of left-wing and outsider vote shares. Voting regimes also have an effect on electoral outcomes. As for turnout, local elections keep being possitively influenced by higher mobile Internet access even when voluntary voting has been applied, although the antennas' effect ends up fading away. In legislative elections, on the other hand, the previous possitive effect of antennas turned into a marginally negative one once mandatory voting was abolished. Vote shares also experienced changes. While null/white vote shares do not show a clear effect of larger antenna installation accross different voting regimes, left-wing and outsider candidacies are in fact possitively affected by higher mobile Internet access. However, once mandatory voting becomes non-binding, the effect for the prior turns into a marginally negative one (for both election types), while outsider vote shares in local elections kept being benefited from larger Internet connectivity.

Electoral expenses, on the other hand, play a marginal role in explaining the heterogenous effects of mobile high speed Internet. Studying the last legislative and local elections of 2017 and 2016, I find that a larger provision of antennas in an electoral district increases the share of digital propaganda expenses over non-digital ones that Representatives incur in, but said effect is null for Mayors and marginally positive for Councilmen and Councilwomen. Finally, I study if being an incumbent or challenger has a role to play in defining the effects of mobile Internet access. In particular, I only find effects in presidential elections, where a larger number of antennas influenced negatively both incumbents and challengers when the prior was a left-wing politician, but possitively when the incumbent leaned right. This could be explained by a collective action hypothesis. Since most of the left-wing governments happened in the dawn of mobile Internet massification (1989-2010 and 2013-2017), said information shock was low and did not match with the rise of Web 2.0 applications among chilean voters (e.g., Whatsapp, Facebook, Twitter and Youtube), apps that facilitates collective action and could persuade and mobilize constituents to vote for a certain coalition. More details concerning this hypothesis is discussed further on in the paper.

Therefore, I find that larger mobile Internet provision affects electoral outcomes depending (not only) on: (i) urban or geographic characteristics; (ii) the country's democratic institutional frame like (non) voluntary voting; (iii) the political coalition currently in office; and (iv) marginally by the digital expenses that legislative and local candidates incur in.

This paper improves the existing literature in several ways. First, it is the only study that focuses entirely on *mobile* high speed Internet, while previous research study only fixed or landlined high speed Internet. Second, unlike previous research, I have a large panel dataset disaggregated at the municipality level that spreads through multiple elections (i.e., 8 presidential, 8 legislative and 7 local), while also covering years in which the Internet was not available for the great majority of the population. This allows me identify heterogenous effects across different types of elections (where constituents tend to vote differently) and at the same time run placebo tests regarding the time in which the Internet was "introduced", therefore analyzing the possibility that my estimations are capturing other events or variables that affect electoral outcomes through antenna availability, and in consequence biasing my estimated parameters. Third, this paper is the second research that studies this subject for a non-developed country (Miner, 2015), therefore complementing the existing literature with evidence from a new-born democracy in a developing country. Finally, the period of time covered in my data allows me to study the effects of an exogenous event that affects directly the mentioned outcomes: automatic inscription and voluntary voting, which is not studied in any of the related economic literature.

This last contribution is of significant relevance since voting patterns and electoral methods (like abstention or the inhability or difficulty to vote of certain population groups), alongside online/mail voting and new attempts to change the existing electoral rolls (e.g., lowering the minimum age to become a constituent or modifying the electoral districts), are nowadays being discussed in several western democracies.[4] Therefore, the application of an electoral institutional change like automatic inscription and voluntary voting could be a relevant tool that could help decrease voting costs and facilitate the (re)construction of electoral rolls, altering previously sustained electoral outcomes in terms of turnout and mainstream political ideologies, while at the same time democratizing the constituents' right to vote.

The paper is structured as follows. Section 2 provides context on Internet access and use in Chile. Section 3 describes the data. Section 4 depicts the econometric strategy and the identification assumption. Section 5 shows the main results. Section 6 analyzes heterogenous effects and mechanisms. Section 7 conducts robustness exercises for previous estimations. Finally, Section 8 concludes.

[4]See electoral fraud allegations and voter supression in 2018's US mid-term elections, for example.

2 Access and Use of Internet in Chile

Before analyzing mobile high speed Internet access and its effects it is useful to first study: (i) how much Internet availability does the Chilean population has; (ii) which people are the ones in fact accessing the Internet; and (iii) by which means are they doing it. This is important because the means by which people access information, as well as the use they give to it, significantly affects the acquired information's type and quality, and therefore the (political) decisions that they make out of it. For example, traditional means of communication like newspapers, radio or television tend to provide different or relatively more unbiased information than the Internet, since the latter enables access to a wider range of both national and abroad partisan and non-partisan information, and at the same time allows people to communicate more easily and faster with each other through social media or direct messaging (where personal and biased opinions are more easily and directly transmited). To answer said questions, I use data provided by SUBTEL along with the 2017's IX National Survey of Access, Use and Users of the Internet (NSAUUI).

To study Internet access, I use SUBTEL data to depict in Figure 2 the number of Internet connections and the rate of penetration per 100 inhabitants that this mass media has had over the past 9 years, where we can see that it has experienced an exponential growth. Internet connections in 2017 have risen to 19.4 million, a 20.2% growth relative to 2016. As for Internet penetration, it went from reaching a 13.7 rate in 2009 to 105 in 2017. However, this does not translate to the fact that every person has access to Internet, since there could be more than one connection per person. Nevertheless, the most interesting conclusion that one can extract from Figure 2 is that this access growth is explained almost exclusively by the rise of mobile Internet connections (88.4 points of the penetration rate in 2017 are due to mobile Internet access) given that fixed connections have had little growth since 2009, therefore enhacing the relevance of studying the effects on electoral outcomes of mobile rather than landline Internet access.

In particular, 87.4% of households in Chile had private and paid Internet access in 2017, a 8 p.p. rise relative to 2016, according to NSAUUI. Out of the total of households with paid Internet access, 29.6% "go online" exclusively through mobile connections, exceeding households that access Internet only through fixed connections by 0.7 p.p.. This facts highlight even more the relevance of mobile Internet as a means of acquiring information, since people are choosing it because of its ussage flexibility or because of the lack of availability of landline connections caused either by their own financial constraints and/or the lack of public and private supply.

There is also significant heterogeneity regarding Internet access or use among certain munic-

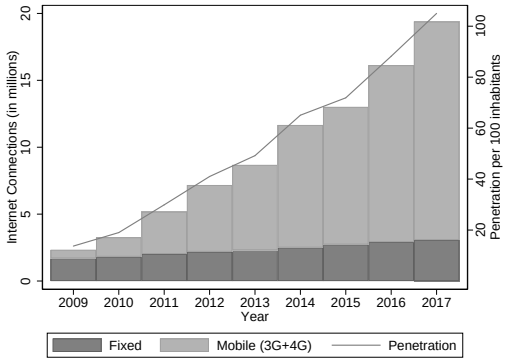


Figure 2: Internet Connections and Penetration

ipality and household characteristics. For example, the relevance of the mobile component of Internet access exacerbates in rural contexts. While in urban areas the household take-up rate of Internet reaches 89.1%, that percentage falls to 76.7% in rural zones. However, the availability of mobile means of connection has reduced said discrepancy over the last years. For instance, rural take-up had a growth rate of 10.3 p.p. in 2017 relative to 2016, while urban households increased their take-up by only 7.8 p.p. between those years. For a more detailed discussion regarding urban and rural municipalities and their connectivity, see Section 3.2.

The composition of households is also relevant. While the Internet access rate rises from 87.4% to 94% if households have people in schooling age (5-24 years old), that percentage falls to 54.6% if they only contain adults over 65 years old, revealing that the age and life cycle of its inhabitants are relevant variables concerning the take-up of Internet, and consequently, relevant to political outcomes. Household income is another important variable concerning Internet access. Households in the first three income quantiles have a take-up rate of aproximately 84%, while the ones in the highest two quantiles have a 92% rate. This difference hightens yet again if we consider households only with inhabitants over 65 years old. In that case, Internet access falls to 34%, 23% and 46% for the first three income quantiles, respectively.

These previously mentioned facts show that Internet connectivity has a significant correlation with some sociodemographic characteristics of the general population. In particular, this type of connectivity is still an issue for the elderly part of the population (specially in low income and rural contexts), while also having a close relationship with their education level. So, we can infere that these variables will have a role to play when we estimate the effects on turnout and vote shares, giving relevance to the fact that we need to control for sociodemograhic covariates in order to correctly estimate the effect of increased mobile Internet access.

3 Data

3.1 Electoral Data

Using public data from SERVEL, I compile disaggregated electoral datasets for all presidential, legislative and local elections held between 1989 and 2017. This consolidated dataset includes variables like: type of election, electoral round, year, candidate name, political party affiliation, running office, and the number of votes in men, women and mixed voting tables at the municipality level, among others. My main dependent variables are turnout and the vote shares obtained by the two main competing political coalitions (left-wing and right-wing) and outsiders, along with null/white vote shares. Since there are not any reliable electoral rolls for years prior to 2012, my turnout measure follows the literature by defining it as the proportion between the number of valid votes in a municipality and its population. As for vote shares, they are simply the ratio between the valid votes of right-wing, left-wing, outsider and null/white preferences, and the total number of votes issued in the municipality, although this measure is adapted later on so that I can make comparable results relative to the effect of mobile Internet on turnout.

The definition of which candidate represents which political coalition (i.e., left-wing, right-wing or outsider) is also relevant. The criteria used for determining partisan candidates is defined by their inclusion (or not) on electoral lists or pacts that contain left-wing or right-wing establishment parties. These main establishment parties are: *Union Democrata Independiente* (right-wing); *Renovacion Nacional* (center-right); *Democracia Cristiana*, *Partido Por la Democracia*, *Partido Radical Social Democrata* (center-left); and *Partido Socialista* and *Partido Comunista* (left-wing), where the first two are considered the right-wing of the Chilean political spectrum and the others are agglomerated as the left-wing coalition. Any other candidate that does not compete in a list that contains any of the political parties mentioned before is defined as an outsider.

Descriptive statistics for the main electoral variables are shown in Table 1. There we can see that the mean turnout rate of a municipality across time is around 50%, which is somewhat stable across different types of elections. This magnitude is very similar to the official average turnout rate that Chile has had over the years (once we account for the two voting regimes), fact that reasures us that this proxy is a valid measure of turnout. Even though turnout in local elections is a bit higher than in presidential and legislative ones, it has a higher standard deviation (25 vs 13, respectively) due to the fact that since voluntary voting was approved in 2012, local turnout rates fell significantly more in this type of election relative to the others (see Figure B.1 of Appendix B for a more detailed depiction of the evolution of voting across time).

Table 1: Electoral Descriptive Statistics at the Municipality Level (1989-2017)

	Presidential		**Legislative**		**Local**		**All**
	Mean	SD	Mean	SD	Mean	SD	N° Municip.
Turnout (%)	49.92	12.71	49.94	12.80	52.12	24.48	346
Left-wing (%)	45.91	12.53	47.64	11.91	47.80	12.85	346
Right-wing (%)	40.64	12.64	35.75	10.61	34.25	12.56	346
Outsiders (%)	9.91	8.26	6.26	9.00	11.24	10.57	346
Null/white (%)	3.54	1.78	10.34	4.13	6.71	3.16	346
N° Candidates	5.73	2.05	14.49	13.33	25.06	12.63	346

Results are derived from each municipality's political outcomes across time. Presidential elections exclude second rounds for representativity purposes. Legislative elections only considers the election of Representatives, since Senatorial elections are not carried out homogeneously across time for each of Chile's electoral circumscriptions.

On the other hand, we observe that left-wing parties consistently score a higher number of votes than right-winged ones, a difference that increases significantly as elections become more local and the electoral office is less centralized. In particular, left-wing candidates obtain around 46-48% of constituents' preferences in every election type, while right-wing representatives obtain 41% in presidential elections but around 34-36% in legislative and local processes. Outsider candidacies, however, have higher vote shares in local and presidential elections than in legislative processes, obtaining 11%, 10% and 6% of voter's preferences in each one, respectively. This is probably due to two facts. First, one can assume that in local processes an important number of Mayor and Councilmen/women candidacies are runned by well known local figures that constituents are more familiar with, therefore obtaining larger vote shares. The latter is analogue for presidential elections, where the contenders are mostly nationwide-known political figures that have been part of the political spectrum for a large number of years. Second, the binominal system that ruled legislative procedures prior to 2012 imposed high (implicit) barriers of entry for outsider candidates, making their election highly unlikely due to the relatively large number of votes that they had to obtain in order to get elected, relative to candidates competing in establishment parties electoral lists.

As for the null/white protest vote, we see that it is relatively low in presidential elections (4%) compared to legislative (10%) and local procedures (7%), where also its variability follows the same pattern. It seems that in "relevant" elections (i.e., presidential and local), constituents tend to have a clearer preference as for which candidate they are going to vote for, trend that could be due to the relative importance that voters give to those elections or to the fact that candidates in those processes tend to be more known by the population.

The number of approved candidacies is also a relevant variable in this analysis, since a larger or smaller electoral supply could affect the decision of constituents in the extensive margin (i.e., voting) and in the intensive margin (for whom he or she votes). In particular we observe that elections that offer a higher number of electoral slots have, as one could assume, a larger number of candidates. While presidential elections have on average 6 contenders, legislative and local elections see that number increased to 15 and 25, respectively. This increase emerges mainly due to the fact that local elections includes both Mayors and Councilmen/women.

Finally, and as a way to visualize the political trends that these variables have followed through the studied period, in Figures B.1 and B.2 of Appendix B I plot the total number of valid votes (as a proxy of turnout) and vote shares obtained by left-wing, right-wing or outsider candidacies. In Figure B.1 we see that ever since the voluntary law was approved in 2012, the number of people that casted their vote decreased significantly, specially for presidential and local elections. However, in the case of legislative elections, this decrease is less notorius. As for vote shares, the most highlighted trend that one can identify in Figure B.2 is the rise of the outsider vote share, particularly in legislative and local elections. Since 2012, the latter has achieved levels as near as 20%, showing that outsider candidates are becoming a valid electoral option for people with vote intention that now are exogenously registered in the electoral roll.

3.2 Internet Data

Information regarding the installation of high speed mobile Internet antennas across Chile between 1989 and 2017 is acquired from SUBTEL. Said database contains the exact geographical location of every antenna in the country, as well as the date in which it was authorized to operate. As described in previous sections, the expansion of mobile Internet started in the first years of the 2000s, but the instalation of antennas was not homogenous across municipalities. Table 2 describes the variation that those antennas had both between and within Chile's municipalities through the pre and post Internet boom years. There we can see that each municipality has, on average, less than one antenna in the pre-Internet years, but that number increases to 26 when we consider the time on which mobile Internet experienced its massification (2001-onwards). However, the interesting fact that emerges from Table 2 is the large dispersion that said variable has both between municipalities in a certain moment of time and inside each municipality across the years, specially in the Internet boom period. Seeing that the between dispersion is much larger than the within one we can assume that, on average, certain municipalities experienced an increase in their number of Internet antennas that was greater than the one experienced by other

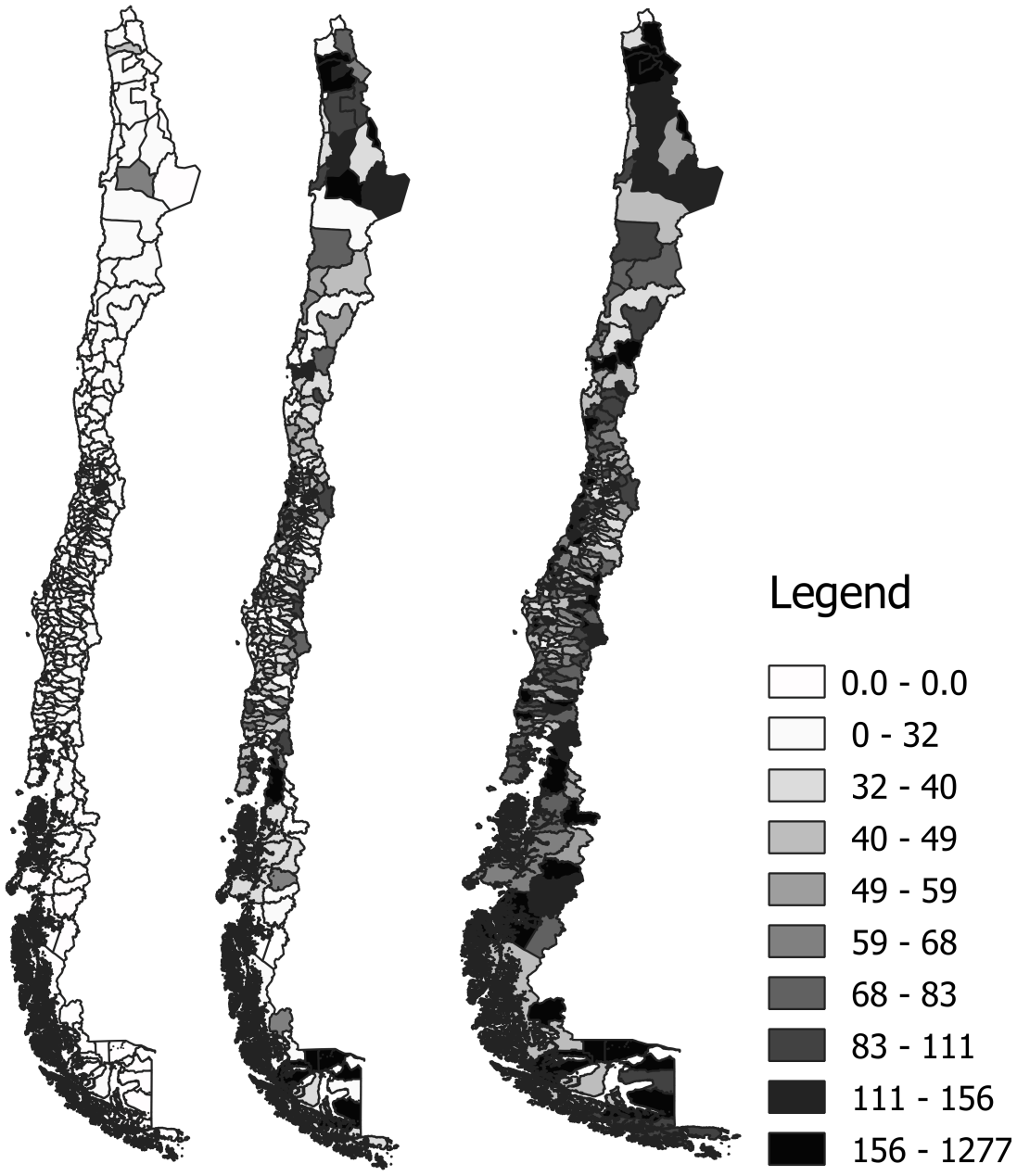
Table 2: Antenna Variation Within and Between Municipalities (1989-2017)

Variable	Panel	Mean	SD	Min	Max	Obs.
A. Pre-Internet (1989-2000)						
Antennas	Overall	0.88	2.24	0.00	39.00	N = 4,152
	Between		1.39	0.00	10.42	n = 346
	Within		1.76	-9.54	29.54	T = 12
B. Internet Boom (2001-2017)						
Antennas	Overall	25.60	54.92	0.00	893.00	N = 5,882
	Between		44.70	0.00	478.77	n = 346
	Within		31.99	-408.16	439.84	T = 17

locations, hence creating a time-varying and geographical heterogeneity regarding mobile Internet connectivity. This relates directly to the choosing of a panel data model with time and location fixed effects, since it exploits these heterogeneities through an (implicit) difference-in-differences strategy between municipalities across time.

Hence, the location of the antennas is a relevant matter for this study. Given Chile's widely diverse geography, there exists a significant number of municipalities in which the general provision of public goods is low, relative to more centric and largely populated regions. The latter is also the case for Internet provision. Given that fixed Internet access is highly correlated to pre-existing landline telephone infraestructure, the possibility of connecting an isolated area increases when one considers the availability of antennas that can provide wireless high speed Internet, relative to expanding the landline infraestructure and the costs that this type of connection involves. To describe the territorial dispersion of said antennas, I plot in Figure 3 the number of antennas per 50.000 inhabitants that each municipality has at the beggining of the mobile Internet boom (2002), during said massification (2012) and for 2017, where antenna provision is at its highest.

In Panel (a), which shows the dawn of the mobile Internet boom, we can see that almost every municipality in the country had the same low-to-null rate of mobile Internet connectivity, except for municipalities contained in the city of Santiago (at the center) and two other northern municipalities, which are probably highlighted due to their low population rather than a relatively high number of antennas. Panel (b) shows the situation ten years later, where we can observe that the location of antennas focuses primarly on the central regions of the country, as well as the more distant municipalities located in the far north and extreme south, zones that are probably less connected than the average Chilean municipality in terms of landline Internet. Finally, in Panel



(a) 2002 (b) 2012 (c) 2017

Figure 3: Number of Antennas per 50.000 Inhabitants by Municipality (2002-2012-2017)

(c) we can see that once the Internet boom has fully developed, mobile connectivity concentrates in municipalities that are contained in regional capitals and in areas that are most commonly near the coast rather than near the Andes Mountain Cord, treating therefore some of the previously

left out locations in the center-north and center-south regions of Chile. These municipalities tend to also have lower income levels, specially the ones located in the center and south regions of Chile. Moreover, while cities have larger population than rural locations (and therefore more antennas provided by telecomunication firms), isolated municipalities tend to have a relatively large number of antennas given their low population and institutional flexibility regarding antenna instalation. So, it is straightforward to see the heterogeneity that this proccess had regarding the timing and location of mobile Internet antenna instalation.

3.3 Sociodemographic Data

In order to build a dataset that contains sociodemographic characteristics of all municipalities across time, I compile information from the 1982-2017 Censuses and from National Socioeconomics Characterization Surveys (CASEN) carried out between 1990 and 2017. From the census I extract the municipality's population and interpolate it in order to obtain missing data for election years. As for socioeconomic variables, I use CASEN data to retrieve municipality characteristics like: age cohorts; urban, women, unemployment and poverty rates; proportion of national income quantiles; and secondary and tertiary education levels.

Appendix B Table B.1 shows the evolution of said variables over time. As we can see, Chile's average municipality population has grown significantly across time, going from approximately 38.000 in 1990 to 51.000 in 2017. Regarding age cohorts, municipalities have experienced a clear aging process of their inhabitants, with a decrease in young adults (aged 18-34) of aproximately 8 p.p. and a rise in the elder population of almost 10 p.p. between 1990 and 2017, fact that relates to the point discussed in Section 2 regarding the ussage of Internet by elderly people. On the other hand, the urban rate has had a significant decrease between 1990 and 2003. The latter is probably due to the rather low number of municipalities that were surveyed in 1990 (N=72), which was the second time it was implemented and therefore focused on more highly populated urban municipalities. Women and unemployment rates have stayed constant across time, while the income poverty rate has decreased notoriously, going from 39% in 1990 to 9% in 2017. Also, secondary and tertiary education levels have increased significantly during those years, going from a 15% and 5% in 1990 to 22% and 9%, respectively.

Therefore, we see that municipality characteristics have changed significantly over the studied period of time. This is a relevant factor in terms of my estimation, given that controlling for municipality covariates over time helps me capture time-varying observable characteristics that could affect turnout or political vote shares.

4 Empirical Strategy

4.1 Econometric Specification

In order to correctly identify the causal effect of mobile Internet antennas on municipality's electoral outcomes, I estimate a panel data model with municipality and year fixed effects. This allows me to control for unobservable time-invariant municipality characteristics as well as for temporal shocks that affect all municipalities at the same period of time. Equation (1) describes the specification:

$$Y_{i,t,e} = \alpha + \beta Antennas_{i,t} + \mathbf{X'}_{i,t}\gamma + \eta_i + \lambda_t + \epsilon_{i,t,e} \tag{1}$$

where $Y_{i,t,e}$ is either the turnout rate or vote share obtained by left-wing, right-wing, outsider or null/white preferences in municipality i in the year t in election type e; $Antennas_{i,t}$ is the number of antennas per 50.000 inhabitants of the municipality i in year t; $\mathbf{X}_{i,t}$ contains socioeconomic characteristics of municipality i in year t such as the age cohorts of its inhabitants, urban population rate, percentage of female inhabitants, unemployment rate, poverty rate, proportion of each national income quantile, and secondary and tertiary education completion rates; η_i and λ_t are municipality and year fixed effects, respectively; and $\epsilon_{i,t,e}$ is the error term, clustered at the municipality level.

Clustering the error term comes from the assumption that there might be unobservable characteristics affecting political outcomes uniformly within each municipality, but at the same time these phenomena being independent from the ones experienced by other municipalities. Therefore, to account for this kind of heteroscedasticity in the variance of electoral results, clustering at the municipality level results in unbiased standard error estimates, making inference much more reliable.

4.2 Identification Assumption

My identification strategy faces two main threats regarding the correct estimation of the causal effect of mobile Internet access on political outcomes, where each one either biases the parameter of interest or results in inconsistent coefficients.

The first one has to do with the potential endogeneity that the variable proxying mobile Internet access could have (i.e., Antennas per 50.000 inhabitants), in the way that it can be correlated with other time-varying unobservable variables that also have an effect on voter turnout

or on political coalition performance. The latter could be either the income and/or education levels specific to each municipality, where telecomunication firms could prefer to install an antenna given that its inhabitants will have larger purchasing power or where constituents would have a higher voting probability and choose a certain political tendency (for instance a coalition that promises to reduce corporative tax). This identification threat could have an effect on the estimation of the Internet parameter. In particular, if we are in the presence of endogeneity, the coefficient of the main explanatory variable will be biased and inconsistent, so I would not be estimating correctly the seeked effect, therefore not being able to claim causality.

The second identification threat involves measurement error. In particular, I measure one dependent variable (i.e. turnout) and the main explanatory variable with error. As for the first one, given the fact that electoral rolls are not available by municipality before 2012, I proxy the real turnout rate with the ratio between the total number of votes in the municipality and its estimated population. This, however, does not bias the estimation of the Internet parameter if we assume that the error component of the observed variable is not correlated with the main explanatory variable, but it will, however, increase its standard errors, therefore increasing the chances of committing type II error (where I do not reject the null hypothesis when I should). On the other hand, the measurement error of the Internet variable rises because of the fact that people do not usually stay, on a daily basis, in the same municipality where they live, given the fact that most of them could work on a different municipality that the one of their household, therefore causing an heterogenous access rate to mobile high speed Internet for each individual. In this case, I could be facing attenuation bias in the parameter of interest and inconsistency in all of the coefficients of my specification if the measurement error is classical. However, this might not be the case if we are in presence of a non-classical measurement error, where I would not be able to know the direction of the bias and the inconsistency.

To adress the issue of potential endogeneity in equation (1), I first conduct a validity exercise where I study if the installation of antennas are exogenous to certain municipality characteristics that could have an effect on my outcome variables. In particular, I regress the number of antennas built between the past 15 years (which aproximates to the start of the Internet boom) in five year intervals against the previous evolution of four municipality characteristics that could be relevant to the installation of said antennas: the percentage of municipality population with completed secondary and tertiary education, their percentage below the income poverty rate and the fraction of people belonging to the 5th quintile of the income distribution. The results of this exercise are shown in Table 3. As we can see, none of the above mentioned municipality

Table 3: Antenna Construction and Previous Evolution of Socioeconomic Traits (2002-2017)

	Antennas per 50.000 Inhabitants Between:		
Dependent Variable:	Δ_t (2017-2012)	Δ_t (2012-2007)	Δ_t (2007-2002)
Δ_{t-1} Secondary Educ. Rate	2.3438	-7.5858	-1.2642
	(1.8819)	(4.6955)	(2.1955)
Δ_{t-1} Tertiary Educ. Rate	-2.4264	-5.1266	0.1909
	(2.4796)	(4.2025)	(1.2529)
Δ_{t-1} Poverty Rate	1.0334	-0.1634	0.1855
	(4.7114)	(1.9840)	(1.9545)
Δ_{t-1} 5th Income Quintile Rate	-0.9809	3.6593	-0.8344
	(2.7707)	(3.5579)	(1.1792)
Observations	337	337	337
Mean Δ *Antennas*	39.69	26.39	22.03
R^2	0.007	0.078	0.004

Coefficients are standarized. Clustered standard errors at the municipality level. Differentials of explanatory variables (Δ_{t-1}) are built upon their evolution between the years 2011-2009, 2006-2003 and 2000-1998 for the first, second and third columns, respectively. Nine of the 346 municipalities were not surveyed during this period. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

characteristics has a significant effect on the construction of antennas, for neither of the three five year periods. Therefore, this allows us to infere that the installation of antennas was exogenous to sociodemographic municipality characteristics.

This exogeneity is probably related to the fact that while urban municipalities tend to be relatively richer than rural ones on average, the latter have fewer restrictions than the prior on where telecomunication companies can install antennas, and how many of them. This relates to the incentives created by both national and local authorities. While the first ones regulate that there does not exist a saturation of antenna emissions in a certain location because of health reasons (there is an institutionalized upper bound), the second ones promote the installation of antennas to digitally connect their municipalities, specially the ones not located in cities. Then, as companies cannot focus their attention on concentrating their antennas on high income and educated municipalities (urban, mainly), they are "forced" to diversify the locations on which they install antennas in order to increase their revenues, therefore reaching less developed municipalities (i.e., rural) as well. This translates onto a non-significant correlation between the number of antennas installed during the mobile Internet boom and the socioeconomic characteristics of Chile's municipalities.

Another relevant issue that needs to be adressed concerning my identification assumption is the possibility that the evolution of the electoral outcomes of municipalities where not on the same

Table 4: Placebo Test: Pre-Internet Political Outcomes and Future Antenna Installation

	Pre-Internet Era (1999-1992):				
Dep. Var. (in %):	Δ Turnout	Δ Left	Δ Right	Δ Outsiders	Δ Null/White
Δ Antennas (2017-2000)	0.0084	0.0107	-0.0235*	0.0053	0.0075***
	(0.0115)	(0.0109)	(0.0139)	(0.0052)	(0.0019)
Observations	325	325	325	325	325
Mean Dep. Var.	-0.02	-0.06	0.14	-0.04	-0.04
Δ Controls	X	X	X	X	X
p-value of Controls	[0.0967]	[0.0372]	[0.0234]	[0.4637]	[0.0000]

Coefficients are standarized. Clustered standard errors at the municipality level. Differential of controls are built between the same years as the *Antennas* variable (2017-2000). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

trend prior to the construction of the antennas. This could mean that the results that I find for the effects of mobile Internet are not due to the installation of antennas in certain municipalities (and their quantity), but rather are a consequence of a previous unknown treatment of another sort or a natural evolution of said variables that led to their actual level. For this, I conduct a falsification or placebo exercise, where I regress the previous evolution of my dependent variables in the pre-Internet Era (1992-1999) against the differential of antennas per municipality in the XXI century (2000-2017).[5]

As shown in Table 4, we see no effect on turnout or left-wing and outsider vote shares, but we do observe a marginally and fully significant effect for right-wing ($t\text{-}stat = 1.69$) and null/white vote shares ($t\text{-}stat = 3.95$), respectively. This suggests that prior to the installation of antennas, these type of votes were affected by another "treatment", therefore rising doubts about the posterior estimations of the effect of antennas on those vote shares in the 2000s. However, considering the mean of said changes in electoral outcomes, the effects are considerably small (0.14 and 0.04%), which gives us a relative calm on to how much does this unknown treatment influences the effect of mobile Internet on null/white vote shares. So, in broad terms, we can somewhat confirm that unobservable municipality characteristics had parallel trends at the moment of the treatment.

In summary, and following the results shown in Tables 3 and 4, we can deduct that neither observable nor unobservable municipality charactetistics affected significantly the construction of Internet antennas in the 2000s, therefore validating the results to be shown in Sections 5 and 6.

[5] I exclude the presidential and legislative elections of 1989 from the pre-Internet era since those were the first democratic processes after 16 years of Pinochet's dictatorship, scenario that could bias the results of said variables due to voter suppression and ideological polarization during those years.

5 Main Results

In this section, I begin to estimate the effects of mobile Internet access on electoral outcomes like turnout or vote shares obtained by left-wing, right-wing, and outsider candidacies, as well as null/white preferences for the period 2001-2017. This is due to the fact that prior to 2001, the presence of antennas in municipalities was highly scarce, and practically no heterogeneity rose from said period of time. From this point forward, I modify my measure of vote shares in order to make their estimates comparable to turnout, redefining them as the share of votes over the estimated population of the municipality. The choosing of this measure of vote share, relative to the one that considers partisan votes against total votes in the municipality, is so I can obtain comparable results between the turnout rate and vote shares in the way that the impact of mobile Internet on turnout is separated by its corresponding effect on left-wing, right-wing, outsider and null/white vote shares.[6] These changes, however, do not alter the results shown in Table 1, since the descriptive statistics for vote shares using either of these two measures are, by construction, significantly similar once adjusting the population denominator for the proxied turnout rate, therefore allowing me to keep this new indicator of vote shares as a valid proxy of its real value, while also keeping the internal validity of this analysis intact.

Table 5 shows the OLS estimates for each political outcome without separating by election type, while clustering standard errors at the municipality level. The first column estimates equation (1) considering municipality and year fixed effects, but without controlling for sociodemographic covariates. There we can see that an additional antenna per 50.000 inhabitants (the average population of a municipality in 2017) decreases the turnout rate in 0.016 p.p., but that reduction is not statistically different from zero. As for vote shares, a marginal increase in the number of antennas reduces left-wing and right-wing preferences by 0.024 p.p. and 0.008 p.p. respectively, but only the first one is statistically significant. Outsiders, on the other hand, are indeed affected by the increase in mobile Internet provision through antennas, seeing their vote shares increased by 0.016 p.p. for each additional antenna in the municipality. Finally, the share of null and white votes rises in barely 0.001 p.p. with a marginal increase in the antennas per 50.000 inhabitants ratio, but this effect again is not statistically different from zero.

Columns (2), (3) and (4) add demographic, economic and education covariates to the regression respectively, marginaly changing the vote shares shown of column (1) in terms of point estimates. The turnout rate, however, varies to a 0.024 p.p. decrease for every additional antenna in the

[6] In other words: Δ Turnout = Δ Left-wing + Δ Right-wing + Δ Outsiders + Δ Null/white.

Table 5: The Effect of Mobile Internet on Electoral Outcomes (2001-2017)

Dependent Variable (in %):	(1)	(2)	(3)	(4)	(4sd)
A. Turnout [Mean=48.73]					
Antennas per	-0.0157	-0.0190	-0.0232	-0.0242	-0.04
50.000 inhabitants	(0.0219)	(0.0226)	(0.0227)	(0.0234)	
B. Left-wing [Mean=43.81]					
Antennas per	-0.0241**	-0.0244**	-0.0265**	-0.0268**	-0.08**
50.000 inhabitants	(0.0116)	(0.0119)	(0.0121)	(0.0118)	
C. Right-wing [Mean=36.71]					
Antennas per	-0.0084	-0.0103	-0.0110	-0.0113	-0.03
50.000 inhabitants	(0.0109)	(0.0115)	(0.0117)	(0.0119)	
D. Outsider [Mean=13.30]					
Antennas per	0.0158**	0.0144**	0.0130**	0.0128**	0.05**
50.000 inhabitants	(0.0068)	(0.0064)	(0.0060)	(0.0058)	
E. Null/White [Mean=6.18]					
Antennas per	0.0010	0.0013	0.0013	0.0011	0.02
50.000 inhabitants	(0.0025)	(0.0026)	(0.0026)	(0.0026)	
Year FE	X	X	X	X	X
Municipality FE	X	X	X	X	X
Demographic Controls		X	X	X	X
Economic Controls			X	X	X
Education Controls				X	X
Num. of Municipalities	337	337	337	337	337
Observations	5,725	5,725	5,725	5,725	5,725

Clustered standard errors at the municipality level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

municipality but this magnitude is still not diferent from zero. Finally, Column (4sd) expresses the results of column (4) in terms of within-municipality standard deviations (see Table 2), where we observe that with a one standard deviation increase in the number of antennas of a municipality, the left-wing vote share decreases in 8 p.p., while outsider preferences increases in 5 p.p.. Additionally, I confirm that these results are robust if we account for interactive fixed effects between years and election type, where the estimated coefficient's magnitude and significance holds.

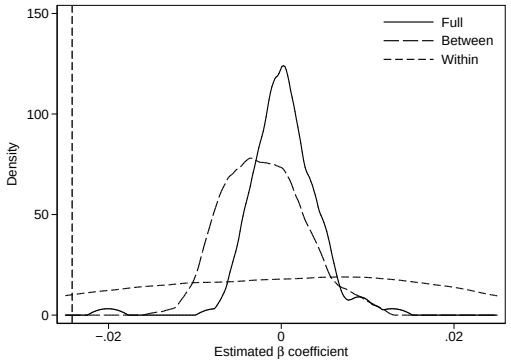
In order to check the robustness of the results shown in Table 5 and to see that they are indeed significant and not a consequence of spurious correlation, I conduct a randomization exercise where I randomize across my sample the antennas per 50.000 inhabitants ratio that each municipality has on every period of time. In particular, I randomize across the full sample (mixing the ratios of every municipality on every year), between municipalities (assigning the ratio of municipality i in year t to municipality j in the same year), and within municipalities (randomizing the ratios of municipality i between years). Then, I conduct 100 iterations of said process and estimate equation (1) in order to obtain the β parameter for each of those randomizations. Finally, I plot the distribution of said parameters and compare the β that rises from the estimation of the original sample to the ones estimated in these exercises.

Figure 4 shows the results of this exercise. As one could expect, by randomizing the ratio of antennas per 50.000 inhabitants of each municipality across time and location, the randomized coefficients tend to group around zero since there should not be any effect of said variable over neither of the output variables for those "new" areas and years, except for the within randomization in the turnout estimations, which is rather flat relative to other distributions. Additionally, we can see that for all of the dependent variables the corresponding real coefficient is far to each of the tails of the three randomized coefficient's distributions, therefore suggesting that the results shown in Table 5 are not the result of some spurious correlation and that their significance (or not) is in fact accurate, specially the statistically significant coefficient of left-wing and outsider vote shares, as shown in Table 5.

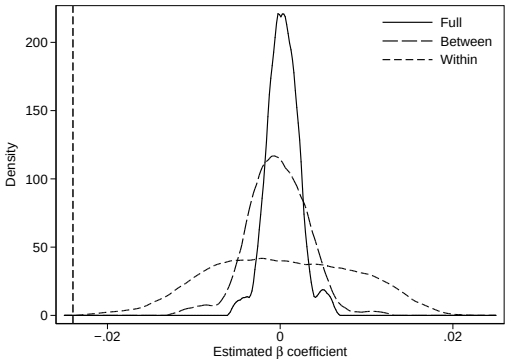
Then, in order to observe how the previously estimated coefficients may vary in different contexts, I estimate equation (1) separating by type of election: presidential, legislative and local, for the period 2001-2017. This distinction is relevant since people might tend to get informed differently depending on which electoral office is getting filled. While for presidential and legislative elections voters get more information about the candidates through regular channels like television and paperback or digital newspaper content (since those type of candidates get relatively more press coverage), for local processes constituents might rely more intensively on social media and direct messaging from their personal social networks, given that close acquaintances might tend to give more information about local Mayor and Councilmen/women candidates than the mainstream media does.[7]

The results of this exercise are displayed in Table 6. Estimates shown in columns (1), (3) and (5) only consider fixed effects at the municipality and year level, while columns (2), (4) and (6)

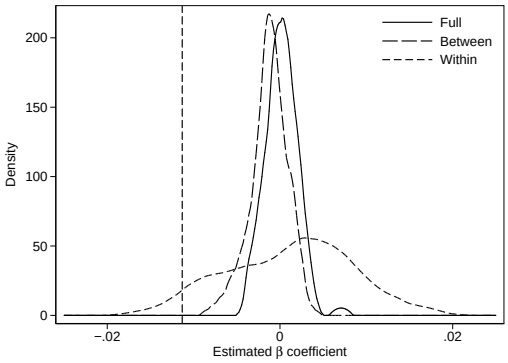
[7]See Lassen (2005) and Larcinese (2009) for evidence regarding voter's information acquisition.



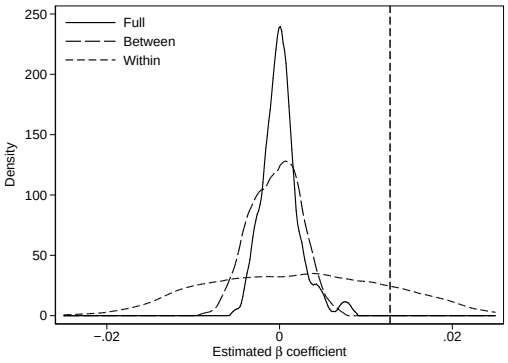
(a) Turnout



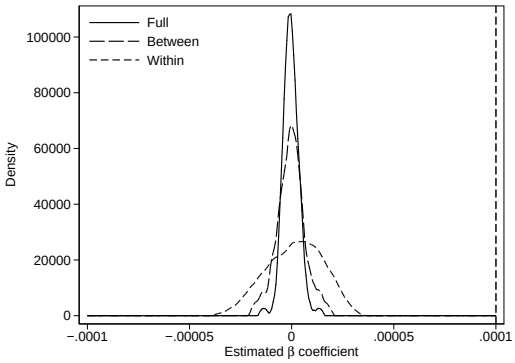
(b) Left-wing Vote Share



(c) Right-wing Vote Share



(d) Outsider Vote Share



(e) Null/White Vote Share

Figure 4: Randomization Exercise (vertical line denotes original estimated parameter)

include sociodemographic controls. As a first insight, we can see that for the now statistically significant effects, the turnout and outsider vote shares are consistenly larger than the ones shown in Table 5. In particular, turnout rates for presidential elections fall in 0.037 p.p. for every

Table 6: The Effect of Mobile Internet by Type of Election (2001-2017)

	Presidential		**Legislative**		**Local**	
Dependent Variable:	(1)	(2)	(3)	(4)	(5)	(6)
A. Turnout (%)	*[Mean: 46.74]*		*[Mean: 47.41]*		*[Mean: 50.59]*	
Antennas per	-0.0366***	-0.0370***	-0.0112	-0.0134*	0.0530***	0.0426**
50.000 inhabitants	(0.0114)	(0.0115)	(0.0075)	(0.0081)	(0.0173)	(0.0203)
B. Left-wing (%)	*[Mean: 43.04]*		*[Mean: 46.27]*		*[Mean: 43.57]*	
Antennas per	-0.0121	-0.0093	-0.0083	-0.0094	-0.0239	-0.0280
50.000 inhabitants	(0.0074)	(0.0062)	(0.0111)	(0.0103)	(0.0176)	(0.0170)
C. Right-wing (%)	*[Mean: 39.93]*		*[Mean: 35.84]*		*[Mean: 34.37]*	
Antennas per	-0.0169**	-0.0184***	-0.0025	-0.0024	0.0085	0.0063
50.000 inhabitants	(0.0065)	(0.0066)	(0.0037)	(0.0042)	(0.0134)	(0.0146)
D. Outsider (%)	*[Mean: 14.0]*		*[Mean: 7.86]*		*[Mean: 16.25]*	
Antennas per	-0.0062	-0.0079	-0.0015	-0.0016	0.0655***	0.0603***
50.000 inhabitants	(0.0042)	(0.0055)	(0.0051)	(0.0044)	(0.0212)	(0.0192)
E. Null/White (%)	*[Mean: 3.04]*		*[Mean: 10.03]*		*[Mean: 5.82]*	
Antennas per	-0.0014*	-0.0013*	0.0010	0.0001	0.0029	0.0040
50.000 inhabitants	(0.0007)	(0.0007)	(0.0021)	(0.0021)	(0.0045)	(0.0041)
Year and Municipality FE	X	X	X	X	X	X
Sociodemographic Controls		X		X		X
Num. of Municipalities	337	337	337	337	337	337
Observations	1,346	1,346	1,681	1,681	2,696	2,696

Clustered standard errors at the municipality level. Presidential elections only considers first rounds. Legislative elections only considers the election of Representatives. Local elections include Mayors and Councilmen.
$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

additional antenna in the average municipality [$SE = 0.012$] while, on the other hand, local elections see their turnout ratio increased in 0.043 p.p. in the same scenario [$SE = 0.02$]. Turnout rates in legislative elections containing only low chamber candidacies (i.e., Representatives) are reduced in 0.013 p.p. for every additional antenna in the average municipality, but that reduction is barely statistically different from zero.

Once mobile Internet availability is increased in a municipality, the fact that more descentralized elections (i.e., local) result in higher turnout rates than national or regional electoral processes

leads to think that there might be additional factors influencing the decision to vote. One explanation could be that the effects of policies executed or promoted by national authorities tend to be less visible to the common citizen than the ones led by local representatives, which could have higher visibility to the median municipality constituent (e.g., restauration of squares or local parks, fixing street holes, new schools or medical centers). The advertising of these actions, through municipality e-mails or social networking done by municipality's CM's or fellow neighbors, could be reaching voters more effectively than national policies promoted through the same channels or other ones like television or newspapers. Additionally, news concerning local authorities are relatively scarce compared to national politicans. Since bad political news tend to be relatively more covered by the mainstream media than good political news, constituents are supplied with a more common negative information shock concerning national and regional authorities, while local politicians remain relatively inmune to this phenomenon. This reinforces the fact that people might be attending local electoral processes more intensively than other elections, since their municipality's (prospected) authorities were not affected by the media's bad news coverage and are therefore more respected or admired by voters, encouraging constituents to participate more in local elections.

Another explanation could be due to the fact that presidential elections tend to have much fewer candidates than local ones (6 vs 25 on average, since local elections also considers councilmen/women), which could lead to a lack of representativity for a relevant part of the population relative to local elections, decreasing therefore their attendance to this type of elections. However, this hypothesis is discarted since interacting the *Antennas* and *Number of candidates* variables results in a negative electoral estimate for local elections. Discarting councilmen and councilwomen from the local sample does not change the estimated coefficients significantly, therefore an excessive information supply hypothesis lacks sustent, in the way that constituents could have beeen overwhelmed by the amount of candidates and political platform information available to them.

A third explanation to the heterogenous effect of mobile Internet availability on turnout could be that national representatives tend to be more "on the spotlight" than local leaders due to their greater exposure to the media, in which their opinions (past or present), bad policies or straight up corrupt activities are more known to constituents than the felonies or misconducts that local representatives could have incurred in. The latter could disenchant constituents from being part of electoral processes that involve higher authorities, and at the same time boost participation in local elections since those candidates (and their policies, opinions or misconducts) are probably

less known to the average municipality citizen.

As for establishment vote shares, we only see statistically significant effects on right-wing presidential candidacies, where an additional antenna per 50.000 inhabitants reduces their proportion of votes by 0.018 p.p., while legislative and local elections have mainly negative effects for either right or left-wing candidacies. On the other hand, a larger mobile Internet provision increases outsider vote shares in local elections by 0.06 p.p. $[SE = 0.019]$, but decreases their constituents preferences in 0.008 p.p. in presidential processes, though this last marginal effect is not statistically significant. The results for outsiders stated above, specially the ones from local elections, go in line with the fact that outsiders tend to have, on average, greater chances of winning in descentralized elections, since they are more well-known by the local community relative to politicians elected for more centralized offices like president or legislators, or even partisan local contenders. The fact that usually outsider candidates have less resources than estabilshment competitors (i.e., right-wing or left-wing contenders) could be leading them to exploit cheaper and more effective means of getting information to their constituents, and it is the Internet the means which fulfills those requirements. In particular, local outsider politicians could be using, for instance, micro-targeting techniques to identify their plausible voters more efficiently and at the same time inform them of their intended policies. The potential mechanisms that underlie the differences between ideological vote shares are furtherly discussed in Section 6.

Finally, the null and white "protest vote" is mainly unaffected by the increase in mobile Internet access, though it is marginally negative and statistically significant in presidential elections and mildly positive in local ones. This small effect in presidential elections could be caused by the fact that in said processes constituents tend to be more conservative in the way that they have a smaller likelihood to "waste" their vote by not marking any specific candidacy.

6 Heterogenous Effects and Mechanisms

Now that we have analyzed the broad effects that mobile Internet access has on turnout and vote shares in different types of elections, it is useful to see how these effects vary once we consider different units of study (e.g., groups of municipalities or politicians) or account for changes in regulation and electoral supply-sided expenses, which could be some of the mechanisms that drive the above mentioned effects. In particular, the topics studied in this section involves: the location of municipalities (urban or rural), voluntary vs. mandatory voting regimes, the effect on incumbents and challengers with different political ideologies and candidate's electoral expenses.

6.1 Urban vs. Rural Municipalities

The location of a municipality regarding its belonging to a medium or large urban center can be a relevant factor as for the effect that mobile Internet has on constituents, in terms of their decision to vote and for whom do they vote for. For this, I split my sample in two: municipalities contained in *Consolidated Urban Areas* (CUA) and the ones which are not contained in them (i.e., rural).[8] In particular, municipalities considered as a part of a CUA are the ones that are part of a regional capital or a major conurbation (i.e., urban). Once this distinction is made, I re-estimate equation (1) for these two subsamples. Results are shown in Table 7.

Estimates show that the previously observed reduction of turnout in presidential elections due to higher mobile Internet access is mainly caused by the decrease experienced in rural municipalities (-0.034 p.p.) rather than the effect it has on urban locations ($+0.06$ p.p.), since the number of rural municipalities under the previously mentioned criteria is more than three times the number of urban ones (260 vs 37, respectively). The same goes for the effects in legislative elections which have relatively similar magnitudes but, in this case, the effects are not statistically different from zero. On the other hand, the increase in the turnout rate for local elections is due to higher attendance both in rural municipalities (0.031 p.p.) as in urban ones (0.019 p.p.), though these are not statistically different from zero when analyzed separately.

Again, interpreting these effects is not trivial since there might be several factors influencing constituent's voting decisions. However, as for presidential and legislative elections, the direction of the effects go in line with the hypothesis that urban residents are more likely to see the effects of executive or legislative power policies relative to rural population, who percieve much more the effects of policies instaurated by their Mayor and Councilmen/women. A theory for the latter is that elected politicians or central government workers develop public policies that reach the highest number of their constituents in order to increase their chances of being reelected, and those voters concentrate mainly in urban locations. Then, as a consequence, urban constituents react to this way of policy making and decide to vote in order to recieve more of the policies' effects, a behaviour that is not seen for voters living in rural areas. Another plausible explanation could be that urban residents have greater access to mobile Internet, since many of the installed antennas concentrate in Chile's biggest cities, therefore accentuating their effect due to a higher intensity of the treatment. As for the turnout effect found in local elections, we see that this is boosted by increased mobile Internet access which is relatively more intense in rural municipalities than in urban (the effect is 50% larger in the prior), although the magnitudes are not statistically

[8] *Metodología para medir el Crecimiento Urbano de las Ciudades de Chile.* INE, MINVU and PNUD, 2017.

Table 7: The Effect of Mobile Internet by Municipality Location (2001-2017)

	Regional Capitals and Conurbations			Other Municipalities		
Dep. Var. (in %):	**Presidential**	**Legislative**	**Local**	**Presidential**	**Legislative**	**Local**
A. Turnout						
Antennas per	0.0595*	0.0583	0.0191	-0.0343***	-0.0122	0.0313
50.000 inhabitants	(0.0337)	(0.0371)	(0.0331)	(0.0117)	(0.0082)	(0.0214)
B. Left-wing						
Antennas per	-0.0049	-0.0278	-0.0036	-0.0079	-0.0088	-0.0339**
50.000 inhabitants	(0.0116)	(0.0220)	(0.0236)	(0.0060)	(0.0106)	(0.0170)
C. Right-wing						
Antennas per	0.0445	0.0459	-0.0059	-0.0176***	-0.0009	0.0014
50.000 inhabitants	(0.0313)	(0.0349)	(0.0203)	(0.0066)	(0.0040)	(0.0155)
D. Outsider						
Antennas per	0.0114	0.0322	0.0131	-0.0074	-0.0015	0.0615***
50.000 inhabitants	(0.0089)	(0.0196)	(0.0344)	(0.0060)	(0.0048)	(0.0196)
E. Null/White						
Antennas per	0.0084***	0.0081**	0.0155**	-0.0014*	-0.0011	0.0023
50.000 inhabitants	(0.0016)	(0.0040)	(0.0066)	(0.0008)	(0.0020)	(0.0043)
Year-Municip. FE	X	X	X	X	X	X
Sociodem. Controls	X	X	X	X	X	X
Num. of Municip.	77	77	77	260	260	260
Observations	306	383	616	1,040	1,298	2,080

Clustered standard errors at the municipality level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

different from zero. Nevertheless, the latter could be explained by either micro-targeting strategies done by local politicians (since it is easier to identify potential voters in reduced geographic areas like municipalities instead of electoral districts) and/or by a better communication of the implemented local policies done by incumbents, mainly through Internet-based channels like social networking and municipality's e-mails.

As for establishment vote shares, we observe that the decrease in the proportion of votes obtained by left-wing candidates shown in Table 5 is mainly driven by the effects that mobile Internet access has on rural municipalities in local elections. In particular, an additional antenna

in the average rural municipality decreases left-wing vote shares in 0.034 p.p.. This negative impact of larger antenna availability is present in all other election types, but those effects are not statistically different from zero, even in urban municipalities. As for right-wing vote shares, we now observe that the decrease in observed presidential elections in Table 6 is again driven by results in rural municipalities, where a marginal increase in the availability of mobile Internet reduces right-wing candidates vote shares by 0.018 p.p.. Interestingly, the effect is strikingly positive and high in urban municipalities for presidential and legislative elections (0.045 p.p.), but said effect is not statistically significant.

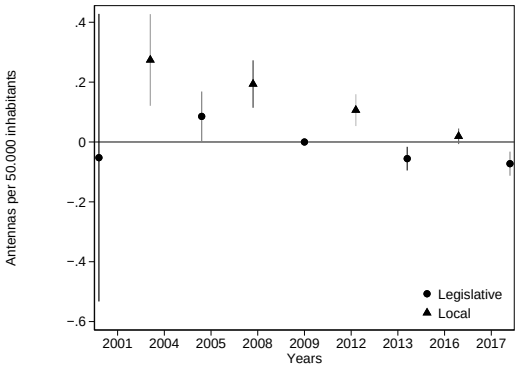
As for outsider vote shares, we observe that the previously shown possitive effect due to higher mobile Internet access shown in Tables 5 and 6 is caused by votes casted in rural municipalities. The magnitude of this effect is far larger than any of the other vote shares studied so far, were an additional antenna per 50.000 inhabitants increases their voter's preferences in 0.062 p.p.. As for other elections, the effect is practically null for rural areas (as predicted before) while possitive but indisctint from zero in urban areas except for legislative processes, where the effect is borderline significative (mainly caused by 2017's election were outsiders recieved far more votes than in any other previous election due to the change in the electoral system). Finally, we see that the effects on null and white preferences concentrates heavily in suffrages issued in urban municipalities, with a smaller positive effect in presidential and legislative elections (0.008 p.p., aproximately), relative to local ones (0.0156 p.p.). Rural estimates, on the other hand, are mostly negative or null, except for presidential elections were higher mobile Internet access decreases said preferences in 0.001 p.p..

These effects on voter preferences -particularly outsider vote shares- could be explained by the fact that many rural municipalities only have access to mass media through the Internet, specifically through a wireless mobile channel, where local non-partisan candidates can reach them more directly and efficiently than they could before the irruption of mobile wireless Internet, since probably before they could not compete with left-wing or right-wing candidates in terms of available monetary and human resources (in addition to the fact that local outsiders tend to be more competitive than partisan contenders, relative to presidential and legislative elections). As for null/white vote shares, the increase in the protest vote can be caused by the politicians "spotlight" hypothesis mencioned earlier, or due to a saturation of information suffered by the constituents in terms of negative news about the candidates.

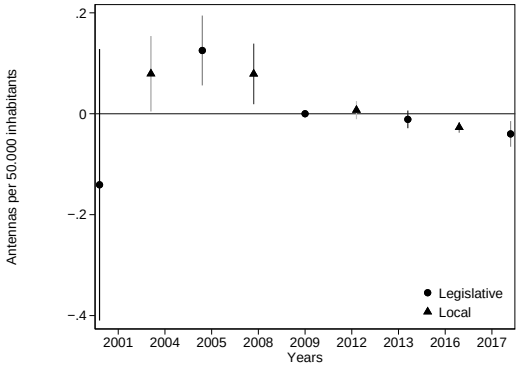
6.2 (Non) Mandatory Voting

Heterogeneities can also arise from exogenous institutional changes. In this subsection, I focus on one of the main electoral reforms that Chile made since its return to democracy: automatic electoral inscription and voluntary voting. This particular legislation is relevant to this research since it diminishes considerably the costs of voting for constituents, which not only includes transportation and time expenses at the moment of inscription and voting, but also the monetary fees that they had to incur in if they were part of the electoral roll and did not accordingly justify their absence in a given election. As from the year 2012, said non-election day costs were abolished, and voters have nowadays a greater incentive (or less costs) to show up on election days. To analyze the effect of this institutional change, I re-estimate again equation (1) but now including an interactive term that relates the *Antennas* variable with yearly dummies covering all elections held on 2001 and onward. In this subsample I only consider local and legislative elections, since the latter have a broader ideological spectrum than presidential elections, so that outsider vote shares are better represented in the sample. Then, I plot the estimated β coefficient of antennas per 50.000 inhabitants across time for each of the dependent variables to better understand the evolution of said effect and the trend it had before and after the inclusion of voluntary voting. The results of this exercise are shown in Figure 5.

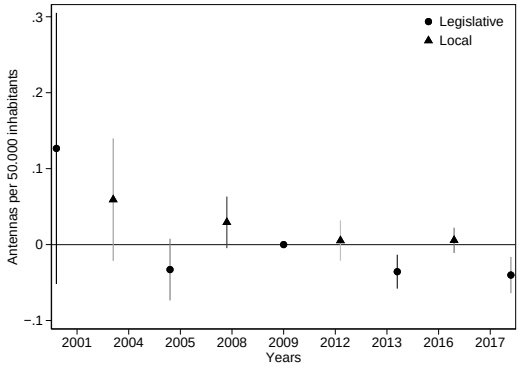
In Panel (a) of Figure 5 we see the evolution of the effect that mobile Internet antennas had on turnout rates for four elections prior and post the approval of voluntary voting in 2012 (2009 is left as a reference year). It is straightforward to notice the relatively large and highly significant effect that mobile Internet provision had on the first local elections carried out in this subsample. In particular, we observe a marginal effect of 0.27 p.p. per additional antenna in 2004 where, considering that during that time antennas were scarce, increasing their supply in one standard deviation of that year [SD=15.24], the turnout rate would increase in 4.1 p.p. on average. However, this large local effect fades out across time and it seems that the introduction of voluntary voting did not alter this decayed trend, which in 2016 still has a positive magnitude of 0.02 p.p., but this is significantly lower than the one observed in 2004. Legislative elections on the other hand (held in 2005, 2009, 2013 and 2017), also experienced a decay in the effect of an additional antenna on turnout rates, but said effect is considerably smaller during mandatory voting: -0.05 (indisctint from zero) and 0.09 p.p. in 2001 and 2005, respectively. The fact that the estimate for 2001 is different from the posterior years trend is probably due to the overall null existance of antennas in that moment of time. For posterior years (2005-onward), and even when



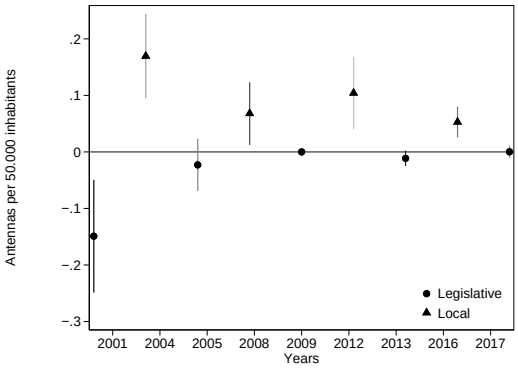
(a) Turnout



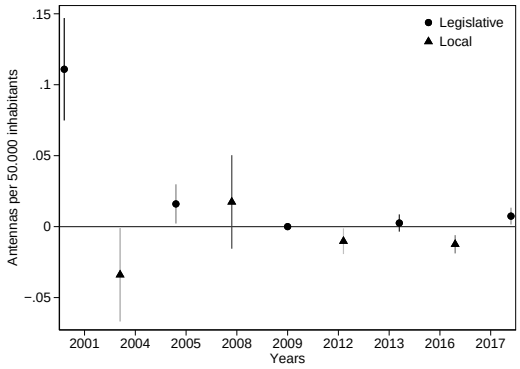
(b) Left-wing Vote Share



(c) Right-wing Vote Share



(d) Outsider Vote Share



(e) Null/White Vote Share

Figure 5: The Effects of Mobile Internet by Voting System (2009 denoted as reference year)

voluntary voting was implemented, these marginal effects became more negative and significant, but considerably smaller than the ones experienced in 2005.

The fact that both legislative and local elections experienced a negative trend beyond the

voting regime change as mobile Internet access expanded may reflect the disenchantment that constituents have on the reigning political class due to the previously mentioned "spotlight" hypothesis, where non-local representatives have their mistakes or misconducts covered by the national press and therefore disencourage electors from attending legislative elections. Local representatives on the other hand do not suffer from this exposure, so voters do not have access to negative news regarding their representatives and therefore cannot be dissapointed of them, causing constituents to still be motivated to attend electoral processes (although the possitive effect of mobile Internet access fades in time). Additionally, this overall analysis overlaps with the previously made argument that local constituents are or seem more influenced by the Mayor's or Councilmen/women's policies than the ones implemented by national authorities.

Regarding partisan vote shares, we observe a positive effect of left-wing preferences which fades out and turns to negative as the exposure to higher mobile Internet access broadens and voluntary voting comes into effect. In particular, the latter goes from 0.08 p.p. in 2004's local elections to -0.04 p.p. in 2017's legislative electoral process. As for right-wing vote shares, the marginal effect of an additional antenna is almost always positive but indistinct from zero during mandatory voting, but just like left-wing voter preferences, when voluntary voting applies these effects start to inhibit voting for right-wing candidates in a magnitude similar to the one experienced by left-wing candidacies, specially in legislative elections. These vote losses experienced by the political establishment are taken by outsider candidates during voluntary voting, where their vote shares increase in 0.1 and 0.05 p.p. in 2012 and 2016's local elections but, however, the votes lost by right and left-wing candidates in parliamentary elections are not obtained by outsider candidacies since the effect for 2013 and 2017 are not different from zero. In mandatory voting, on the other hand, outsider vote shares rose significantly with broader mobile Internet access, where an additional antenna increased in 0.17 and 0.07 p.p. the preferences obtained by non-establishment politicians in 2004 and 2008. Finally, as for null and white vote shares, we observe that the introduction of antennas had a significant effect on "protest vote" shares in legislative elections, with an 0.11 and 0.02 p.p. effect in 2001 and 2005 elections, although these effects fade once voluntary voting is binding. In addition, we observe that in local elections the effect is marginally negative for null/white votes once mandatory voting is abolished.

Therefore, to sum up, we observe that the instauration of voluntary voting did not seem to vary the decaying trend that mobile Internet access had on turnout rates, but it did affect negatively the vote shares of estabilshment parties in benefit of outsider candidacies.

6.3 Incumbent vs Challenger Effect

Another mechanism on which mobile Internet access could affect political outcomes is through its influence on the vote shares obtained by incumbents and challengers in either presidential, legsilative or local elections. Given the fact that the means available to politicians that are in office are presumably higher than the ones at the hands of challengers (e.g., constituent's information, public policy details, influential networks), one could expect that in locations with higher Internet connectivity, incumbents could seize this scenario and transmit information to their constituents more intensively and effectively, giving them an ex ante advantage in the next election, relative to their future challengers. On the other hand, challengers could eventually use their time to rally constituents physically or virtually and get information from them regarding their view of the respective authority, and at the same time announce their candidacy's policies. So, give and take, we could observe either a positive or negative effect for both incumbent and challengers, or a mixed effect where one is negatively affected by increased mobile Internet access while the other is benefited by it.

To test this assumption, I group all candidates that run for office between 2001 and 2017 as either incumbents (i.e., if they won the last election for the same seat they are running for now) or challengers, whom are any other candidates that are not the actual politician in the respective office seat. Additionally, I classify them as left-wing, right-wing or outsider candidates to see if an additional heterogenous effect rises from partisan differences. As for challenger classification, I depict a politician as a challenger independently if he or she belongs to the same ideology as the incumbent, detail that specifically and more intensively applies to the case of outsiders, since it is more likely than two outsiders run for the same office seat than two left-wing or right-wing candidates doing so.

The results of this exercise are shown in Table 8. As we can see, the only scenarios in which there exists a significant effect of mobile Internet connectivity on incumbent and challengers' vote shares is in presidential elections, where an incumbent is defined as one if the candidate(s) belong to the same political coalition than the one of the current President, since inmediate reelection is not available for the presidential office. In those elections, when a left-wing coalition had the executive power in Chile, an additional antenna per 50.000 inhabitants decreased both the incumbents vote share in around 0.014 p.p. and the challengers vote shares (right-wing and outsiders) in 0.025 p.p.. These effects are almost half of the ones estimated for when the right-wing coalition had the presidency and searched for a second period in office, and point out

Table 8: The Effect of Mobile Internet on Incumbents and Challengers Vote Shares (2001-2017)

	Presidential		**Legislative**		**Local**	
	Incumbent	Challenger	Incumbent	Challenger	Incumbent	Challenger
A. Left-wing Incumbent						
Antennas per	-0.0139**	-0.0245***	0.0093	-0.0247	-0.0291	-0.0011
50.000 inhabitants	(0.0059)	(0.0079)	(0.0084)	(0.0256)	(0.0338)	(0.0218)
B. Right-wing Incumbent						
Antennas per	0.0211***	0.0474***	0.0101	0.0157	0.0085	0.0017
50.000 inhabitants	(0.0080)	(0.0103)	(0.0120)	(0.0150)	(0.0151)	(0.0130)
C. Outsider Incumbent						
Antennas per	.	.	-0.0038	0.0332	0.1023	-0.0611
50.000 inhabitants	.	.	(0.0195)	(0.0238)	(0.0999)	(0.0528)
Fixed Effects	X	X	X	X	X	X
Sociodemographic Controls	X	X	X	X	X	X

Clustered standard errors at the municipality level. Legislative elections consider only Representative's elections between 2001 and 2013, while local elections only consider Mayor elections. In presidential elections, I consider a candidate incumbent if it represents the ruling political coalition. In presidential and legislative elections, I sum up the vote shares of all potential incumbents. I consider only elections that have a competing incumbent. Fixed effects in column one only apply to panel A, since there was only one year in the sample that contained an incumbent presidential right-wing candidate. There were no outsider presidential incumbents in the analyzed sample. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

in a different direction. In particular, an additional antenna in the average municipality increased right-wing incumbent preferences by 0.021 p.p., but also increased the opposition's vote share in 0.047 p.p. in 2013, when the next election was held. On the other hand, there has never been an outsider president, so there are no estimations to show in Panel for in presidential elections.

One plausible reason for the results described above is that during the first decade of the 2000s, antenna installation was not as massive as it was in the early 2010s, where the right-wing hold the executive power. Therefore, there could be an intensity effect regarding mobile Internet provision affecting the results for scenarios when the left-wing ruled or when right-wing politicians did. Another possible explanation is that in the early 2010s, the role of digital media regarding the transmission of ideas and its ability to alienate people was far more developed in society than it was in the first years of the new millenium. Then, politicians and political parties could have exploited more the use of Internet as a mean of communicating their ideas, as well as constituents could have done with the rise of Web 2.0 applications.

As for legislative or local elections, we observe no effect on either incumbent or challenger's vote shares. However, the magnitudes of the point estimates are significantly bigger for outsider local candidacies than for any other interaction between type of election and partisan ideology. This points in the direction that local politicians that do not belong to establishment parties tend to use the Internet more effectively than partisan representatives in terms of getting an electoral advantage. In particular, we observe that incumbents obtain a possitive gain in vote shares the more connected the municipality is (0.1 p.p.), while challengers see their voter's preferences reduced by 0.06 p.p., fact that suggests that since non-partisan representatives tend to have fewer resources at their disposal, they focus on the efficiency of the Internet in terms of information transmission at the same time that they profit from the benefits of holding office. However, these effects are not significantly different from zero, so these conclusions need to be analyzed carefully.

6.4 Electoral Expenditures

Another way mobile Internet access can affect electoral outcomes is through the expenditures that candidates or political parties incur in during campaigns. In 2003, Chilean legislation determined that all competing candidates and their respective political parties (if they belong to one) have to declare the expenses that they have incurred in personally or by third party donations. This expenses include propaganda, surveys, rental of movable property or real state, payments of services, and travel expenses, among others. In this subsection I analyze if the presence of mobile Internet antennas in an electoral district or municipality affects the kind of electoral expense that politicians incur in said location. Since I am particularly interested in online or digital electoral propaganda, I focus on 2017's and 2016's legislative and local elections candidate expenses because they are the only processes in which this kind of expenditure is catalogued separately from other media propaganda (e.g., television, radio, newspapers), as well as for the location in which they did said expense.[9] *A priori*, one should expect that more connected locations in terms of Internet access experience larger amounts of digital propaganda than less connected ones, since it is a much cheaper, direct and effective way to get to constituents than non-digital propaganda. To test this hypothesis, I regress the amount of digital and non-digital media propaganda, as well as other electoral expenses in 2017 and 2016 against the number of antennas at the electoral district and municipality level in 2016 and 2015 respectively, to see if the latter predicts the prior, controlling at the same time for district and municipality level sociodemographic characteristics.

[9]Political party electoral expense data is also available, but it does not depict the location on which they targeted said money, making it impossible to trace back to a certain district or municipality.

Table 9: Antenna Infraestructure and Electoral Expenses of Candidates

	Share over Total Expenses of:			
Dep. Variable:	Digital Media	Non-Digital Media	Other Expenses	Digital/Non-Digital
A. 2017's Representative Candidacies	[*Mean:* 0.012]	[*Mean:* 0.162]	[*Mean:* 0.826]	[*Mean:* 0.138]
Antennas per	0.0042	-0.0388*	0.0346*	0.1026**
District in 2016	(0.0028)	(0.0190)	(0.0176)	(0.0460)
B. 2016's Mayor Candidacies	[*Mean:* 0.001]	[*Mean:* 0.061]	[*Mean:* 0.939]	[*Mean:* 0.017]
Antennas per	-0.0001	-0.0019	0.0019	-0.0079
Municipality in 2015	(0.0002)	(0.0042)	(0.0043)	(0.0054)
C. 2016's Councilmen Candidacies	[*Mean:* 0.001]	[*Mean:* 0.057]	[*Mean:* 0.943]	[*Mean:* 0.030]
Antennas per	0.0005***	-0.0027	0.0022	0.0417
Municipality in 2015	(0.0002)	(0.0035)	(0.0035)	(0.0295)
Sociodemographic Controls	X	X	X	X

Clustered standard errors at the electoral district or municipality level. Results only consider Representatives. Coefficients are standarized. Electoral expenses consider actual expenses issued by candidates or third party donations. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The results of this exercise are displayed in Table 9, where for Legislative elections an additional antenna per district (which on average contains twelve municipalities) increases barely the share of digital media propaganda over total expenses in 0.004 points (although this increase is not different from zero), while at the same time decreases and rises non-digital media and other expenses shares in 0.038 and 0.035 points, respectively. The proportional level of expense for these categories is also relevant for the analysis. In particular, digital media expense only accounts for 1.2% of the total expenses incured by Representatives, while non-digital media like television or newspapers represent over 16%. Therefore, the interpretation of the point estimate of the first column needs to consider the (still) low relevance that candidates give to digital propaganda, which has a growing potential of becoming a relevant asset for electoral campaigns. However, if we look at column 4, we observe a substitution effect between digital and non-digital media propaganda, where a marginal increase in the number of antennas per district indeed rises the proportion of digital expenses relative to non-digital in 0.103 p.p. at a 95% confidence level (with a non-neglible sum of 14% of the total non-digital expenses). This result indeed highlights the assumption that politicians are turning their attention into digital ways of reaching their constituents, for example through social media or by paid advertisments in Web 2.0 applications.

As for local elections, we observe that the distribution of electoral expenses moves more towards traditional non-media expenses, were media accounts for barely 6% of total expenses. Having said that, the marginal effects of higher mobile Internet connectity on media expenses are significantly lower. Regarding Mayor candidacies' expenses, we do not observe a significant effect for neither of the depicted shares, and surprisingly, the digital over non-digital one is negative, meaning that Mayor candidates do not use the increased connectivity of their municipality to their advantage. On the other hand, Councilmen/women do in fact take advantage of this, which is shown in columns 1 and 4 of Panel C. In particular, an additional antenna in the municipality in the previous year increases the digital media share over total expenses by 0.0005, and rises the digital over non-digital share in 0.042, although this last estimate is not statistically different from cero. Considering the low level of expenses that said candidates incur in regarding digital media (given that their budgets are probably the lowest of all types of candidacies), the increase in those shares shows again that low-budget candidates are using efficient means like the Internet to reach more effectively their constituents, which is not the case for Mayors, for reasons not yet discovered.

These results aim at the fact that politicians can benefit largely electorally speaking from using digital means of propaganda. This is a particularly interesting tool for low budget candidates given the efficiency that digital propaganda means provides relative to regular non-digital expenses. However, because I am only studying two elections, the external validity of these conclusions is to be treated with caution, since there could be different dynamics or events affecting these two close in time elections, which could impact the level or distribution of expenses that candidates are incurring in, as well as having a low number of observations for each election (28 for 2017's legislative election and 337 for 2016's local one). For instance, 2016 and 2017 were low growth years for the Chilean economy, which could affect the income or donations that candidates or political parties recieved during those years, therefore having an impact in their expenses. In addition, we have to consider that in 2017 there was a legislation change that altered the political landscape through a reshaping of the electoral districts, which could have changed the electoral strategies of contenders in terms of where and how do they spend their money.

7 Robustness Checks

7.1 Accounting for Landline Connections

So far, I have not considered the possibility that fixed Internet connections could have changed at the same time that antennas were being installed across Chile's municipalities. Even though Figure 2 shows that fixed Internet connections are stable across a significant part of my sample, it is still plausible that the landline connectivity rates across municipalities could have varied through those years, while maintaining the total number of connections unchanged. So, to see if that is the case, I add landline Internet connections per 50.000 municipality inhabitants as an explanatory variable to equation (1), and then observe if once accounting for this type of connection the marginal effect of an additional antenna changes significantly. The latter is only available for the last ten years, so my sample is reduced. Results are shown in Table 10.

There we see that, even when accounting for landline Internet connectivity at the municipality level, point estimates of the *Antennas* variable and its statistical significance levels remain virtually unchanged, discarting then the hypothesis that the mobile Internet access coefficient was confounded with the actual fixed Internet connectivity that municipality inhabitants had during the instalation of the antennas. Even though landline connections have a highly significant effect on political outcomes, this effect is considerably smaller than the ones we find for mobile Internet access in turnout rates, for instance (being approximately 1-2% of the mobile Internet estimates). The estimated coefficients for *Antennas*, however, may vary from the ones obtained in previous sections since this is a subsample, which eliminates one presidential and two legislative and local elections from the baseline sample.

In particular, we observe that the negative effect on turnout in presidential and legislative elections shown in previous sections rises significantly in absolute terms, which is probably due to the fact that during these subsample years mobile Internet connectivity is more massive relative to the years considered in the full sample, and the constituents and politicians give now a more intense use of it, intesifying the effect of the treatment. However, the previously significant effect for local turnout rates faded away, even though it has the same magnitude (due to higher standard errors). This might indicate that those large estimates for local elections we found before were mainly caused by an increase in turnout in the first years of the instalation of antennas (2001-2007), where the information shock they brought hit harder. The effect on partisan vote shares, on the other hand, remains mainly unchanged, specifically for left-wing candidacies where the effect of mobile Internet access is rather null in non-local elections. Right-winged candidates,

Table 10: The Effect of Mobile Internet Access and Landline Internet Connections on Electoral Outcomes by Election Type (2008-2017)

	Presidential		**Legislative**		**Local**	
Dependent Variable:	(1)	(2)	(3)	(4)	(5)	(6)
A. Turnout (%)						
Antennas per	-0.0635***	-0.0591***	-0.0643***	-0.0593***	0.0522	0.0455
50.000 inhabitants	(0.0191)	(0.0192)	(0.0192)	(0.0193)	(0.0411)	(0.0411)
Landlines per		0.0006*		0.0006**		-0.0009**
50.000 inhabitants		(0.0003)		(0.0003)		(0.0003)
B. Left-wing (%)						
Antennas per	-0.0025	0.0020	-0.0195	-0.0185	-0.0308**	-0.0348**
50.000 inhabitants	(0.0042)	(0.0042)	(0.0121)	(0.0125)	(0.0142)	(0.0140)
Landlines per		0.0006***		0.0001		-0.0005***
50.000 inhabitants		(0.0001)		(0.0001)		(0.0001)
C. Right-wing (%)						
Antennas per	-0.0218**	-0.0210*	-0.0304*	-0.0273*	0.0229	0.0191
50.000 inhabitants	(0.0108)	(0.0109)	(0.0165)	(0.0163)	(0.0180)	(0.0181)
Landlines per		0.0001		0.0004***		-0.0005**
50.000 inhabitants		(0.0002)		(0.0002)		(0.0002)
D. Outsider (%)						
Antennas per	-0.0370***	-0.0380***	-0.0103	-0.0091	0.0537**	0.0556**
50.000 inhabitants	(0.0128)	(0.0132)	(0.0081)	(0.0085)	(0.0227)	(0.0229)
Landlines per		-0.0001		0.0001		0.0002
50.000 inhabitants		(0.0001)		(0.0001)		(0.0002)
E. Null/White (%)						
Antennas per	-0.0022**	-0.0021**	-0.0041*	-0.0044*	0.0064	0.0056
50.000 inhabitants	(0.0010)	(0.0009)	(0.0024)	(0.0024)	(0.0068)	(0.0070)
Landlines per		0.0000		-0.0000		-0.0001**
50.000 inhabitants		(0.0000)		(0.0000)		(0.0000)
Year and Municipality FE	X	X	X	X	X	X
Sociodemographic Controls	X	X	X	X	X	X
Num. of Municipalities	337	337	337	337	337	337
Observations	1,009	1,009	1,011	1,011	2,022	2,022

Clustered standard errors at the municipality level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

however, suffer a now significant negative effect in legislative elections of around 0.027 p.p. per additional antenna, which is probably caused by the treatment intensification explained above, relative to prior years on which antennas were not massified. As for outsiders, we observe that in this subsample they suffer a negative and significant marginal effect of increased mobile Internet access of around 0.04 p.p. in presidential elections, while maintaining the possitive effect it has on local elections. The latter could be caused by the fact that before the 2009 presidential election, outsider candidates obtained very few voter preferences related to the ones recieved in posterior elections, smoothing then the effect that mobile Internet had on their electoral results. Finally, we observe a now negative effect of increased mobile Internet connectivity in the null/white "protest vote" relative to the one obtained in Table 6. From this we can infere that as mobile Internet is more accesible to constituents, they recieve more political information from either mass media or personal networks and therefore give their votes to a candidate that they know represents their ideals.

7.2 Upscaling the Unit of Analysis

Another robustness test I conduct is changing the unit of analysis, from municipalities to a larger unit (i.e., provinces) since one could expect that some of the effects fade once we see electoral outcomes at a more aggregated level. This argument particularly relates to the effects found for local elections. In previous sections, we observed highly significant and relatively large coefficients for local elecions related to the ones obtained from presidential and legislative processes. Therefore, if I upscale the unit of analysis to provinces for instance, one should expect a fading out effect of local turnout and vote shares, while relatively maintaining the "relevance" of mobile Internet access for the other two types of elections, since the representatives elected in said processes have province or national-level constituents rather than municipality ones. If the latter occurs, then we could claim with relative certainty that the local effects found in previous sections are indeed the ones that drive the changes in turnout and outsider vote shares, since those dependent variables are the ones that have a significant effect in the overall analysis conducted in Section 5. The results of this exercise are shown in Table 11.

As we anticipated, all local effects dissapear for turnout and vote shares, with magnitudes significantly close to zero. On the other hand, the effects found for presidential and legislative elections follow the results shown in previous sections in terms of the direction of the effect of antennas, but with the conjecture that their magnitudes are considerably smaller than the ones of the analysis at the municipality level. The latter has a straightforward explanation. Since I

Table 11: The Effect of Mobile Internet by Type of Election at the Province Level (2001-2017)

Dependent Variable:	**Presidential**	**Legislative**	**Local**
A. Turnout (%)			
Antennas per	-0.0022***	-0.0011	0.0005
800.000 inhabitants	(0.0008)	(0.0008)	(0.0013)
B. Left-wing (%)			
Antennas per	0.0009	0.0015	0.0005
800.000 inhabitants	(0.0006)	(0.0018)	(0.0008)
C. Right-wing (%)			
Antennas per	-0.0018***	-0.0023**	-0.0010
800.000 inhabitants	(0.0004)	(0.0010)	(0.0014)
D. Outsider (%)			
Antennas per	-0.0011***	-0.0003	0.0008
800.000 inhabitants	(0.0002)	(0.0004)	(0.0012)
E. Null/White (%)			
Antennas per	-0.0001	0.0000	0.0002
800.000 inhabitants	(0.0001)	(0.0005)	(0.0002)
Year and Province FE	X	X	X
Num. of Provinces	54	54	54
Observations	216	270	216

Clustered standard errors at the province level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

upscaled the unit of analysis, the geographical distribution of antennas within a province has the within-unit dispersion that previous exercises lacked, therefore attenuating the effects of antennas over electoral outcomes at the province level. This is probably due to the fact that there are certain municipalities that concentrate a significantly larger number of antennas than other ones of the same province, causing that the effect of an additional antenna (which could be located in any municipality) has a much smaller effect on the overall turnout or vote shares in said province. In addition, some effects are now statistically significant when before they were not. This is probably caused by the new unit of analysis used for these estimations, since province fixed effects now capture a broader landscape which overlooks some plausible heterogeneities in the shocks that only affected certain municipalities in the province, but not others.

8 Concluding Remarks

Internet has changed the way society acts and communicates. The information shock that this relatively new means of communication brought to people's lives has affected many personal and aggregate outcomes like consumption, labor, and education, among others. This paper focuses on the relationship between Internet and one particular outcome: politics. Using the installation of antennas that provide high speed mobile Internet across time and space, I study the relation between this type of Internet access and electoral outcomes like turnout or vote shares in Chilean national and local elections.

I find that increased mobile Internet access decreases left-wing vote shares and rises outsider vote preferences in general terms, leaving turnout rates and right-wing and null/white vote shares unaffected by the irruption of high speed mobile Internet. However, if we consider each type of election separately, I find that in presidential processes turnout is negatively affected by a marginal increase in the number of antennas in the average municipality, while in local elections this effect is possitive and considerably larger. These variation in turnout is mainly translated in fewer right-wing votes in presidential elections and a higher number of voter preferences for outsiders in local processes.

Some heterogeneities also arise regarding the effect of larger mobile Internet access on electoral outcomes. In particular, rural municipalities tend to be the main drivers in the increase in turnout and outsider vote shares in local elections, as well as the main agent that causes the decrease in turnout for presidential elections and left-wing vote shares in local processes. Also, there seems to be a relatively null effect of mobile Internet access on the results obtained by incumbents and challengers in legislative and local elections. However, I do observe in presidential processes a negative and possitive effect on incumbents and challengers when the ruling coalition is left-wing and right-wing, respectively. Additionally, the switch from mandatory to voluntary voting in 2012 did affect electoral outcomes through mobile Internet. As for turnout, I observe a continously possitive effect under both regimes for local elections, but a slow transition from possitive to negative ones in legislative elections once voluntary voting became law. Vote shares were also affected by this institutional change. Left-wing preferences benefited from increased mobile Internet access during mandatory voting, but this effect decayed and turned marginally negative once this regime ended. Outsider vote shares, on the other hand, kept being possitively influenced by the Internet with the regime change, but the possitive effects only apply for local elections. Finally, I find that Representative candidates substitute non-digital propaganda for

digital expenses the higher the mobile Internet connectivity of their district, but find little evidence of this for local candidacies.

In conclusion, this paper provides some new insights onto the relationship between Internet and politics. Now, given the political changes that western hemisphere's democracies have experienced during the last decade, along with the greater connectivity that Internet and other technological advances have caused on countries economically and information-wise speaking, the study of its effects keeps being a central topic of research for political economy. The rapid growth of Web 2.0 applications (e.g., Twitter, Facebook, Whatsapp and Youtube) and their effects on democracy is the next step for these kind of research, and it is capital that economists and other social scientists dive into the effects that these apps can have on forging the way the world sees and (re)shapes democracy.

9 References

Adena, M., Enikolopov, R., Petrova, M., Santarosa, V., & Zhuravskaya, E. (2015). Radio and the Rise of the Nazis in Prewar Germany. The Quarterly Journal of Economics, 130(4), 1885-1939.

Besley, T., & Prat, A. (2006). Handcuffs for the grabbing hand? Media capture and government accountability. American economic review, 96(3), 720-736.

Campante, F., Durante, R., & Sobbrio, F. (2017). Politics 2.0: The multifaceted effect of broadband internet on political participation. Journal of the European Economic Association.

Czernich, N. (2012). Broadband internet and political participation: Evidence for Germany. Kyklos, 65(1), 31-52.

DellaVigna, S., & Kaplan, E. (2007). The Fox News effect: Media bias and voting. The Quarterly Journal of Economics, 122(3), 1187-1234.

Durante, R., Pinotti, P., & Tesei, A. (2014). No News, Big News. The Political Consequences of Entertainment TV. (No. 063).

Enikolopov, R., Petrova, M., & Zhuravskaya, E. (2011). Media and political persuasion: Evidence from Russia. American Economic Review, 101(7), 3253-85.

Falck, O., Gold, R., & Heblich, S. (2014). E-lections: Voting Behavior and the Internet. American Economic Review, 104(7), 2238-65.

Feddersen, T. J., & Pesendorfer, W. (1996). The swing voter's curse. The American economic review, 408-424.

Feddersen, T. J., & Pesendorfer, W. (1999). Abstention in elections with asymmetric information and diverse preferences. American Political Science Review, 93(2), 381-398.

Gavazza, A., Nardotto, M., & Valletti, T. M. (2015). Internet and politics: Evidence from UK local elections and local government policies. CEPR Discussion Paper No. DP10991.

George, L. M., & Waldfogel, J. (2006). The New York Times and the market for local newspapers. American Economic Review, 96(1), 435-447.

Gerber, A. S., Karlan, D., & Bergan, D. (2009). Does the media matter? A field experiment measuring the effect of newspapers on voting behavior and political opinions. American Economic Journal: Applied Economics, 1(2), 35-52.

Gentzkow, M. (2006). Television and voter turnout. The Quarterly Journal of Economics, 121(3), 931-972.

Gentzkow, M., & Shapiro, J. M. (2011). Ideological segregation online and offline. The Quarterly Journal of Economics, 126(4), 1799-1839.

Gentzkow, M., Shapiro, J. M., & Sinkinson, M. (2011). The effect of newspaper entry and exit on electoral politics. American Economic Review, 101(7), 2980-3018.

Jaber, A. (2013). Broadband Internet and Political Behavior: Evidence from the United States. Job Market Paper.

Ladd, Jonathan M., Joshua A. Tucker, and Sean Kates. 2018. "2018 American Institutional Confidence Poll: The Health of American Democracy in an Era of Hyper Polarization." A Report by the Baker Center for Leadership & Governance, Georgetown University, and the John S. and James L. Knight Foundation.

Lassen, D. D. (2005). The effect of information on voter turnout: Evidence from a natural experiment. American Journal of political science, 49(1), 103-118.

Larcinese, V. (2007). Does political knowledge increase turnout? Evidence from the 1997 British general election. Public Choice, 131(3-4), 387-411.

Larcinese, V. (2009). Information acquisition, ideology and turnout: theory and evidence from Britain. Journal of Theoretical politics, 21(2), 237-276.

Larcinese, V., & Miner, L. (2018). Was Obama Elected by the Internet? Broadband Diffusion and Voters' Behavior in US Presidential Elections. CESifo Working Paper, no. 6882.

Lassen, D. D. (2005). The effect of information on voter turnout: Evidence from a natural experiment. American Journal of political science, 49(1), 103-118.

Miner, L. (2015). The unintended consequences of Internet diffusion: Evidence from Malaysia. Journal of Public Economics, 132, 66-78.

Poy, S., & Schüller, S. (2016). Internet and Voting in the Web 2.0 Era: Evidence from a Local Broadband Policy. CESifo Working Paper, no. 6129.

Snyder Jr, J. M., & Strömberg, D. (2010). Press coverage and political accountability. Journal of Political Economy, 118(2), 355-408.

Strömberg, D. (2004a). Radio's impact on public spending. The Quarterly Journal of Economics, 119(1), 189-221.

Strömberg, D. (2004b). Mass media competition, political competition, and public policy. The Review of Economic Studies, 71(1), 265-284.

10 Appendix A

10.1 The Chilean Electoral System

This paper's period of study includes all elections held between 1989 and 2017. During those years, all three election types suffered changes regarding the election criteria of their candidates and/or their length in office, as well as significant institutional changes regarding voter registration. The objective of this section is to explain the details of said changes and provide a brief overview of Chile's political system during those years, since further on we will study the effects of increased mobile Internet access on the election of both incumbents and challengers in presidential, legislative and local elections, along with the effects of voluntary voting.

Presidential Elections. The rules regarding Chile's presidential elections did not suffer any changes during the studied period. For these, the winner is the candidate that obtains simple majority (50% of the valid votes, plus one). If no candidate reaches said number of votes, a second voting process will begin, in which the winner and runner-up of the first round compete again in a second and final round. The winner of the latter is simply the candidate with the highest number of valid votes, even if he/she does not reach the 50%+1 threshold. As for the length of the presidential period, this went from being of four years (1990-1994), to six years (1994-2006) and then back again to four years (2006-present).

Legislative Elections. The Chilean congress is bicameral, and it is composed by the Senate and the Chamber of Deputies. Prior to 2017, they contained 38 and 120 members respectively, which rose to 43 and 155 after the adoption of a proportional system to the detriment of the former binominal system. The latter was an electoral derivative of the more known plurinominal system, under which more than one candidate is elected per electoral circunscription/district, but for two candidates of the same list to be elected, they had to at least double the votes of the runner-up list. If that did not happen, each of those lists elected their most voted candidate as a member of parliament. On the other hand, the actual proportional electoral system elects candidates through the proportion of valid votes obtained by each electoral list and the number of positions available. As for the duration in their positions, Deputies stay in office for four years while Senators do it for eight, and both types of legislators can run for reelection indefinitely.

Local Elections. Municipalities in Chile have two local authorities: Mayor and Councilmen/women. Every municipality has one Mayor, but the number of Councilmen/women depends on the number of registered voters in the municipality. The method used to elect the Mayor varied throughout the years. In 1992, the latter was determined by an internal voting process done among the newly elected Councilmen and Councilwomen. In 1996 and 2000, the Mayor came out of a process that considered the number of valid votes of each Councilmen/women's electoral list and his/her's individual number of valid votes, among other criteria. As from 2004, the Mayor and Councilmen elections became two independent processes. Councilmen/women are elected through a D'Hont electoral system (similar to the proportional one used in legislative elections) and the Mayor is elected by simple majority. Both the length of Mayor and Councilmen/women in office is 4 years for the whole period of study.

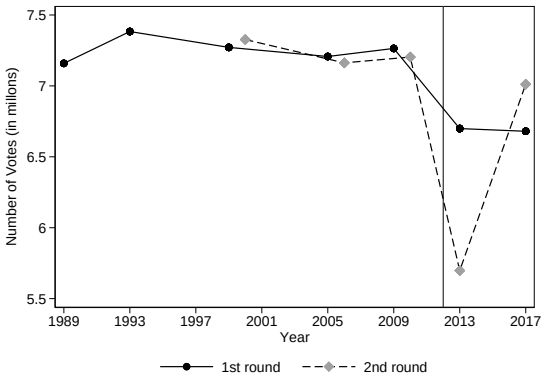
Finally, as for other institutional changes that do not concern certain types of elections, I focus my attention on the one that involves voter registration.[10] In early 2012, a voluntary voting law was passed in Congress making voter registration automatic for every Chilean older than 18 years old and any foreign resident living in Chile for over 5 years that had not been condemned to a sentence of over 3 years and a day, and at the same time making voting optional for this new electoral roll. This situation differed from the one existing prior to 2012, where registration was optional but voting was mandatory once registered. This provided an exogenous shock that is worth studying given its potential effect on either turnout or political coalition performance.

10.2 Restricting Samples

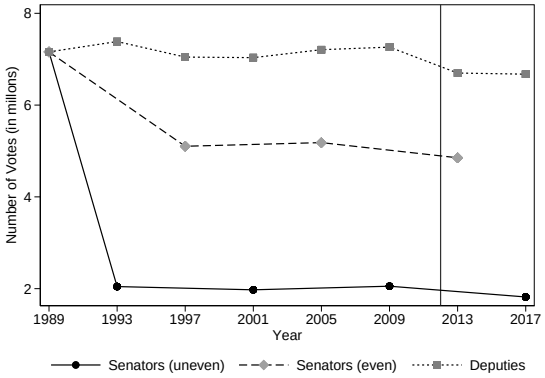
Since it is possible that some particular election results are driving my estimated parameters, I re-estimate equation (1) several times for local elections (since they are generally the ones with the most significant results) while omitting each election one at a time from the full sample, and see if my estimates change siggificantly. The results are shown in Table B.2. There we can see that excluding the first two local elections from my sample do not alter the full sample results significantly, however it seems that 2016's election is driving the estimations downwards, since omitting it from the sample rises turnout and outsider vote shares coefficients to over 0.1 p.p.. Nevertheless, and even though said election is affecting my previous results, its impact translates into lower bound for my estimates, where the coefficients I found before suffer from a sort of attenuation effect. Therefore, the implications on my conclusions are not significantly affected.

[10] Other changes include gender quotas, regulation of electoral expenses and abroad voting, among others.

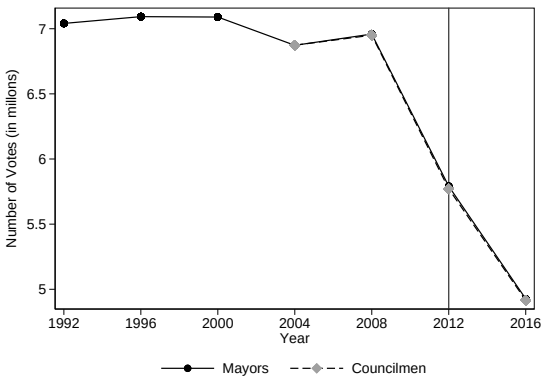
11 Appendix B



(a) Presidential (1989-2017)

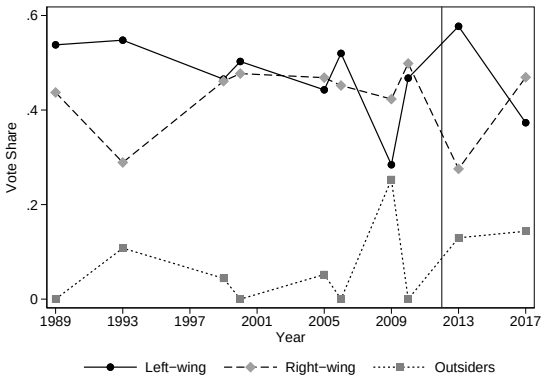


(b) Legislative (1989-2017)

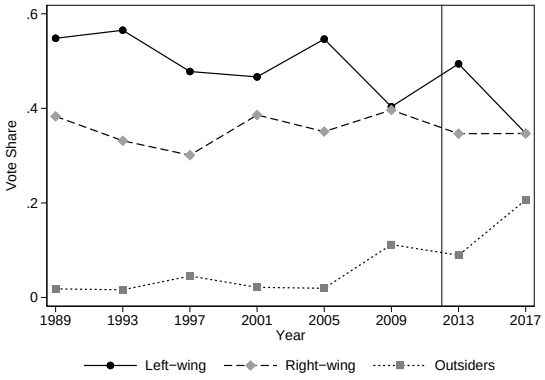


(c) Local (1992-2016)

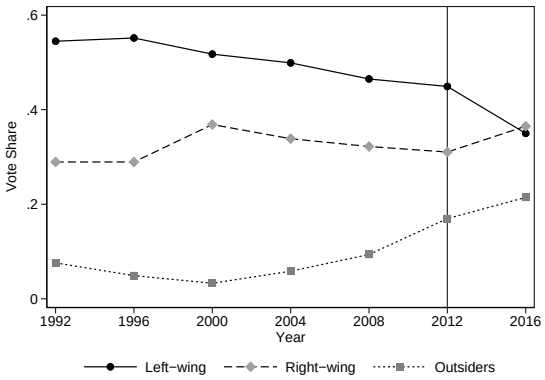
Figure B.1: Number of Votes by Election Type (vertical line denotes non-mandatory voting law)



(a) Presidential (1989-2017)



(b) Legislative (1989-2017)



(c) Local (1992-2016)

Figure B.2: Vote Shares by Election Type (vertical line denotes non-mandatory voting law)

Table B.1: Municipality Descriptive Statistics, by Year

Variable	Mean	SD	Min	Max	N
Year=1990					
Population	37,812	54,390	102	300,299	332
Age 18-34 (%)	30.94	2.12	26.5	36.2	72
Age 35-64 (%)	27.9	2.65	23.35	34.31	72
Age 65+ (%)	6.29	1.94	2.81	13.69	72
Urban (%)	83.73	26.14	0	100	72
Women (%)	51.41	2.21	45.52	58.76	72
Unemployment (%)	8.07	0.24	7.10	8.55	72
Income Poverty (%)	39.07	2.96	27.66	42.7	72
1st Income Quantile (%)	21.84	8.33	3.16	44.28	72
5th Income Quantile (%)	15.98	14.28	3.76	73.36	72
Secondary Education (%)	15.27	4.42	2.86	23.99	72
Tertiary Education (%)	4.8	4.88	0.34	26.28	72
Year=2003					
Population	43,978	67,596	40	490,059	346
Age 18-34 (%)	25.22	2.74	15.92	37.8	310
Age 35-64 (%)	33.63	2.61	25.31	42.08	310
Age 65+ (%)	9.27	2.71	1.78	19.82	310
Urban (%)	63.77	29.11	0	100	310
Women (%)	50.48	2.01	44.6	58.59	310
Unemployment (%)	8.68	0.58	6.26	10.76	310
Income Poverty (%)	23.24	2.17	18.55	27.13	310
1st Income Quantile (%)	33.74	14.75	0.78	76.64	310
5th Income Quantile (%)	9.92	10.43	0.72	80.36	310
Secondary Education (%)	16.33	5.02	4.86	31.38	310
Tertiary Education (%)	4.96	5.22	0.29	43.13	310
Year=2017					
Population	50,792	78,692	138	568,106	346
Age 18-34 (%)	23.2	3.86	8.71	45.89	324
Age 35-64 (%)	37.98	3.36	27.32	47.48	324
Age 65+ (%)	15.91	4.92	4.55	56.85	324
Urban (%)	63.33	28.34	0	100	324
Women (%)	51.68	2.66	43.28	62.14	324
Unemployment (%)	8.02	0.36	6.44	8.55	324
Income Poverty (%)	9.08	1.33	4.52	11.08	324
1st Income Quantile (%)	29.62	13.11	0.46	70.5	324
5th Income Quantile (%)	9.43	10.46	0	84.59	324
Secondary Education (%)	22.44	4.79	7.97	43.39	324
Tertiary Education (%)	9.25	6.01	0	42.35	324

Table B.2: Restricting Samples for The Effect of Mobile Internet in Local Elections

	Full Sample:	**Excluding Local Election of:**			
	(2001-2017)	(2004)	(2008)	(2012)	(2016)
Dependent Variable:					
A. Turnout (%)					
Antennas per	0.0530***	0.0610	0.0522***	0.0185	0.1036***
50.000 inhabitants	(0.0173)	(0.0401)	(0.0142)	(0.0224)	(0.0350)
B. Left-wing (%)					
Antennas per	-0.0239	-0.0288*	-0.0228	-0.0270*	-0.0170
50.000 inhabitants	(0.0176)	(0.0150)	(0.0183)	(0.0151)	(0.0151)
C. Right-wing (%)					
Antennas per	0.0085	0.0272	0.0062	0.0070	-0.0006
50.000 inhabitants	(0.0134)	(0.0191)	(0.0118)	(0.0120)	(0.0193)
D. Outsider (%)					
Antennas per	0.0655***	0.0555***	0.0689***	0.0341*	0.1186**
50.000 inhabitants	(0.0212)	(0.0208)	(0.0255)	(0.0174)	(0.0510)
E. Null/White (%)					
Antennas per	0.0029	0.0070	-0.0002	0.0043	0.0026
50.000 inhabitants	(0.0045)	(0.0071)	(0.0032)	(0.0060)	(0.0059)
Year and Municipality FE	X	X	X	X	X
Num. of Municipalities	337	337	337	337	337
Observations	2,696	2,022	2,022	2,022	2,022