Broadband connection and election in Brazil: what is role of the internet?

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Abstract

We investigate the relationship between broadband internet and election outcomes in Brazil (2008, 2010 and 2012). Using a robust identification strategy, a RDD applied to the roll out of Backhaul program, we explore jumps in internet velocity according to population size as identification strategy. Results indicate no relationship between internet and political outcomes – turnout, blank and null percentage votes and left parties vote share. Our findings diverge from some results reported before, usually applied to democracies with institutional backgrounds distinct of the one observed in Brazil, suggesting that this relationship may be context dependent.

Keywords: Internet, RDD, elections.

1 Introduction

The way how people get informed about politics has changed dramatically over the years. If in XIX century press was the main source of information, in the beginning of XX's radio took its place, surpassed by television in the middle of the same century. Today, a new type of media seems to be taking the lead: the internet.

Although the world wide web is a 25 years-old technology, broadband connection is an even recent event. Internet velocity capable of streaming videos became popular just in the XXI century. Social networks, like Facebook, YouTube and Twitter are relatively infant

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phenomenons[1], becoming popular globally only in the late of 2000's. Mobile broadband connections, thanks to 3G technology (followed by 4G) and massification of smartphones, helped internet to reach a greater number of users. New social medias, like WhatsApp, Instagram and Telegram are now everyday tools[2], with popularity increasing in an exponential fashion, being common even for business. A new wave, with 5G technology and the "internet of things" is coming to continue the revolution begun in the past century, with connections speed and quality increasing every day, with new possibilities of business.

Thus, information dissemination gained range and speed, reaching more people, almost instantaneously, nearly in any part of the world. Geographic barriers were broken and the amount of information are vast. Before these new possibilities, a question arises: how this new scenario affects social interaction? Furthermore, how do people are doing politics in this new environment? In particular, if people have tools to be more informed, do they increase their participation in elections? Could vote preferences change with introduction of this new technology? Or, on contrary, have this new possibilities of entertainment deviate people from political discussion? Is it possible that internet did not change politics at all?

These questions are not easy to be answered for several reasons. Availability of internet is not random and characteristics like income, schooling and geographic conditions may determine if an internet service provider will be accessible for individuals. Also, institutional and political backgrounds may possible influence internet-political relationship.

This is not a novel issue. Relationship between internet and politics has been focus of study in several fields, and this paper aims to contribute with this literature, studying internet impacts on politics in Brazil. Studying a single country, we have best tools to control possible confounders, and taking advantage of a specific rule for broadband roll out, where number of inhabitants determines the internet velocity of municipalities (the backhaul program), we have a robust identification strategy, that creates an ideal instrument to deal with internet endogeneity. Following Cattaneo *et al.* (2018), we use multiple cutoffs design to estimate effects.

Results suggests that, in general, broadband internet is not related to political outcome in Brazil. It seems that internet did not influence turnout, blank or null percentage votes and left parties vote share, in 2008, 2010 and 2012 elections, which covers national and local elections. The office considered (president, mayor or deputies) did not make difference in results. These finds are different from previous results reported in the literature, meaning that institutional background may play an important role in studies relating politics and

[1]Facebook was launched in 2004, YouTube in 2005 and Twitter in 2006.
[2]WhatsApp was launched in 2009, Instagram in 2010 and Telegram in 2013.

internet. Positive and negative relationship are reported for Germany, Italy and United Kingdom (Falck *et al.* 2014; Gavazza *et al.* 2015; Campante *et al.* 2017), all of them with distinct political institutional background compared with Brazilian's.

This paper is organized as follows: the first section presents the theoretical framework linking internet to political outcomes, while the next one reports the previous findings regarding its application. The third section reviews the Brazilian political background, followed by the section with empirical strategy, data bases and descriptive. The fifth section presents our results, with a final discussion in the sixth and last section.

2 Theoretical framework

There are some theories looking to explain why people vote (Downs 1957; Riker & Ordeshook 1968; Ferejohn & Fiorina 1974; Uhlaner 1989; Aldrich 1993). One approach is to treat as a microeconomic problem in the following way. In elections, individuals' problem is to choose the best candidate(s) according to their preferences. But, there is an asymmetry of information: there are many candidates (not considering uncontested elections), and voters are not fully informed about their abilities. Acquire information about them is costly, since they have to spend resources to consume information (e.g. from television, radio, newspaper, internet or another people), that may include money and time. Show up to cast the vote in the ballot also requires resources (transportation and time). More accurate decision requires more information, which demands more resources, i.e. is more costly. So, it can be viewed as a maximization problem from the microeconomics point of view, which can be solved by equalizing marginal costs and benefits. Benefits can be viewed as the policies the most preferred candidate will conduct, a civil duty or being party of the democratic process.

This problem changes over time with entrance of new technologies. For example, when radio, television and internet were not available, there were fewer options to people get informed about candidates. Also, there were available less leisure alternatives. With emergence of radio, then television and, finally, internet, these costs and substitution effects may have changed. A first natural question that someone could have is: did these new technologies affect the decision of voters? For newspaper, Gerber *et al.* (2009), Gentzkow *et al.* (2011) and Drago *et al.* (2014) report effects on elections participation. According to Strömberg (2004) and Horacio & Monteiro (2014), radio affects people perception about politics, while DellaVigna & Kaplan (2007), Enikolopov *et al.* (2011), Durante & Knight (2012), Gentzkow (2006) and Oberholzer-Gee & Waldfogel (2009) shows the impact of television (through news) on elections results.

How about the internet? Relationship between internet and politics has been investigated since the end of 1990's (Bimber 1998). The effect on information acquisition may be ambiguous depending on the hypothesis used: if internet makes available new possibilities of entertainment, people may substitute the time spent learning about politics with these new type of leisure; on the other hand, if internet bring to people new sources of politics information and channels of discussion, people may be pushed toward politics. Finally, the cost and the time needed to find candidates information or to find new possibilities of entertainment may have changed relative prices. Once someone has access to internet, it is possible to consume a variety of information with, in general, no additional cost. The same is valid to leisure. A last possibility is that the only thing substituted is the technology used to consume information and leisure, making no difference in resources allocation at all[3].

These changes may also take time to happen. Many types of media on internet depends on broadband connection (like video streaming), only available to the large public in the beginning of the XXI century. Moreover, all content we have today were not available with the launch of the internet. The same was true for television, where the diversity of programs and shows existing today took time to be developed and aired. Emergency of new technologies and its spread also affects relative prices both for information and leisure over time with this development.

While newspaper, radio and TV content production are more restricted and with barrier entries, internet have opened doors to virtually anyone produce information and media, interact with people and organize groups of common interest, everything at a lower cost. Thus, it is likely to exist a shift both in the demand and supply of information and entertainment with internet arrival. It can potentially alter the manner of how politics are made, since, with internet, politicians can reach more people, quickly and at lower costs when compared with other medias.

One situation this new scenario brings is the social media consumption of "fake news"[4] and its possible impact on elections. In the problem treated here, misleading information may have a market that deviate people from optimal choice (see Allcott & Gentzkow 2017 for a theoretical framework). Media capture by politicians put an additional flavor to this discussion (Besley & Prat 2006), where internet could break other types of media control or enhance an existing control.

[3]If there is no, or little, consumption of politics information with an older technology, it might be the case that, even with a new technology, there is no preference for this type of information, resulting in no, or limited, shifting in its demand.

[4]Fake news is a term the popular term to define, in general, the spread of misleading or false information like if it were real. See Lazer *et al.* (2018) for a brief discussion.

With this framework in mind, we analyse previous researches in the field in order to collect results and identification strategies, pointing resemblances and contrasts between them. Common outcomes between internet and politics relationship are voting turnout, election results, public polices and politician's accountability.

3 Literature

Sources from where people consume information and leisure are not exogenous. For example, if television or internet is expensive, only people with enough income can have access. If this kind of people have particular preferences regarding candidates, then there is a bias if relationship between internet and politic outcomes is treated as unconditional. The same is valid for another characteristics, like race, schooling, age or housing location.

Due to this endogeneity of internet supply and demand, geographical characteristics (e.g landscape or rainfall) or previous telecommunication infrastructure are common strategies taken to instrumentalize internet in order to link it to political outcomes. Campante *et al.* (2017) study the impact broadband diffusion on political participation for municipalities of Italy between 1996 and 2013 with this strategy. Miner (2015) take similar path for Malaysia, Czernich (2012) and Falck *et al.* (2014) for Germany, Gavazza *et al.* (2015) for UK, Jaber (2013) for USA and Menezes (2015) for Brazil. With slightly different approach, Lelkes *et al.* (2017) explore variation in state laws related to internet infrastructure to study influence of this technology on polarization in USA, while Poy & Schüller (2016) use similar strategy to analyse broadband effects on turnout and vote share in rural and sparse areas in Italy.

For Italy, Campante *et al.* (2017) report a negative effect on turnout in elections following high speed internet implantation (2008), changing its direction for later elections (2013). An interesting result reported in Italian case is that internet affected ideological groups distinctly, according to vote share results, paving the way for organization of new political groups, formed in online platforms. Poy & Schüller (2016) echoes these results, linking high speed internet (ADSL2+) to increases in turnout in 2008 and 2013 Italian elections, as well transitory increases in vote share of some parties (center-left and right-fringe).

In Malaysian case, Miner (2015) reports important effects of internet in 2008 election results (vote share of opposition parties), but not in turnout and limited effects in turnover. It is interesting to note that the political background for the Malaysian case is different from the Italian one, although the identification strategy is similar.

A negative effect of internet on turnout is reported by Falck *et al.* (2014) for Germany.

The mechanism is related to an increase in leisure consumption that crowds out television entertainment. The impact reported is heterogeneous: west Germany was affect, while in east Germany no effect was observed, while effects on vote shares were not observed in neither places. On the other hand, Czernich (2012) found positive effects on participation in German 2002-2005 election.

Gavazza *et al.* (2015) report for UK negative effects of internet on turnout in 2006-2010 elections, with stronger results for less-educated and younger voters. Furthermore, incumbents seems to take advantage, diminishing election competitiveness. Taking a step further, the UK study suggests effects on public policies, lowering public expenses and taxes in areas with higher internet access (with similar heterogeneity effects reported for turnout).

In Brazilian case, Menezes (2015) shows that internet is associated with increases in vote share of small candidates in 2010 elections, but no relation with turnout nor with no candidates votes (blank votes). This is an important result once the winner of last Brazilian presidential election (2018) won with a very limited advertisement time on radio and television in the first round.

For USA, results presented by Lelkes *et al.* (2017) seems to bring light to mechanisms underlying the effects of internet one politics outcomes. States with less restrictive laws (and more likely to have broadband coverage) induces people to be exposed to partisan information and be more extreme in partisan preferences. This mechanism is compatible with results presented in Jaber (2013), who reports a positive impact on turnout, donations to political campaigns and democrats vote share in 2008 presidential elections. In an early study, with weaker identification strategy, Tolbert & McNeal (2003) suggests that, in 1996 and 2000 presidential election, individuals with internet and online elections news reading are more likely to vote.

It is important to note that countries have distinct political regimes, which could potentially affect results reported. Minard & Landriault (2015) bring this to discussion analysing how maturity of democracy regimes in Asia responds to internet availability. Immature regimes seems to be more affect by internet than solid democracies according to 2006 cross-country analysis. Hence, the cross country variation suggests that there are institutional factors playing action on internet-politics relationship, which puts caution to external validity of results.

To sum up, it is clear that there are different results for different countries (even inside the same country), with possible changing effects over the time. Also, the majority of studies are concentrated in 2000 decade elections, focusing on the begging of the broadband internet.

Few studies report results for elections held in 2010 decade, when smartphone revolution and social media gained strength. Even more, there are no studies about the effects of mobile broadband and smartphones on elections.

In this paper we will address just fixed line broadband roll out, studying the Brazilian case, one of the largest democracies in the world. Unfortunately, mobile broadband technology roll out (3G and 4G) will not be investigated, since information at municipality level is not available. As pointed before, peculiarities of each country seems to be determinant for results, which demands closer analysis of the political system in order to compare our results with those presented before.

4 Brazilian's political background

Brazil is a Federal Republic, with three layers of government: central (or Federal), states and municipalities. It is a young presidential democracy, with bicameral legislative system (Chamber of Deputies and Senate), holding election every four years. President is elected by direct vote since 1989 in national elections, being elected together with national congress, state governors and state assemblies (1994 onward). Local elections, for municipal mayors and local legislators are also held every four years, since 1996[5].

In Brazil, voting is mandatory to literate citizens aged 18 to 69. For people aged 16 to 17 and 70 and over voting is optional. Voters absent in election must justify or pay a small fine. If they fail to justify three consecutive pools, some rights are lost (issue or renew passports and national identification, are ineligible for public education, public service and some government social programs). This set raises the question if this rule changes incentives to acquire information about politicians.

An important aspect of Brazilian suffrage regards campaign advertisement. There are national, free of charges and mandatory programs during campaign time, booth aired daily in radio and television, broadcasting the same content in all regions of the country. There is a fixed amount of time for electoral advertisement in these channels, 2/3 distributed according to current party presence in legislatures and 1/3 among candidates, and only this

[5]Brazilian dictatorship ended in 1985, with general election in 1986, except for president (elected indirectly in the previous year). Before 1985, all other elections (except for president) had direct vote, but under military rules. In 1988, a new constitution was promulgated and in 1989 the president was elected by direct vote again, after 29 years. In 1990, there were elections for state governors, state assemblies and national congress. In 1992, municipal mayors and local assembly members were elected. By 1994 onward, national elections (president, state governors, state assembly and national congress) happens every four year, while local elections (municipal mayor and municipal assembly) happens every four years, since 1996. Thus, Brazil has elections every two years since 1994.

time is allowed to be used in these channels. Ads on newspaper are also restricted, even though being a less important media compared to TV and radio. Internet is exception, where candidates can use it, almost freely, to reach voters, since 2009, except for anonymously or paid advertisement (which includes social medias like Twitter, Facebook, Instagram and YouTube).

According to Downs (1957), low probability to be pivotal in elections explain the "rational ignorance" of voters and low preference to turn out. On the other hand, mandatory vote could change these incentives, making people more inclined to vote (Lijphart 1997). Leon *et al.* (2014) finds that, for Brazilian case, mandatory voting seems not change people incentives to be more informed in voting decision. It seems the case that providing more information about candidates (Banerjee *et al.* 2011), hence lowering the costs for collect information, is more effective than compulsory voting system.

Following Fujiwara *et al.* (2016), we also consider possible persistent habits on voting pattern, incorporating raining information in election days in each municipality.

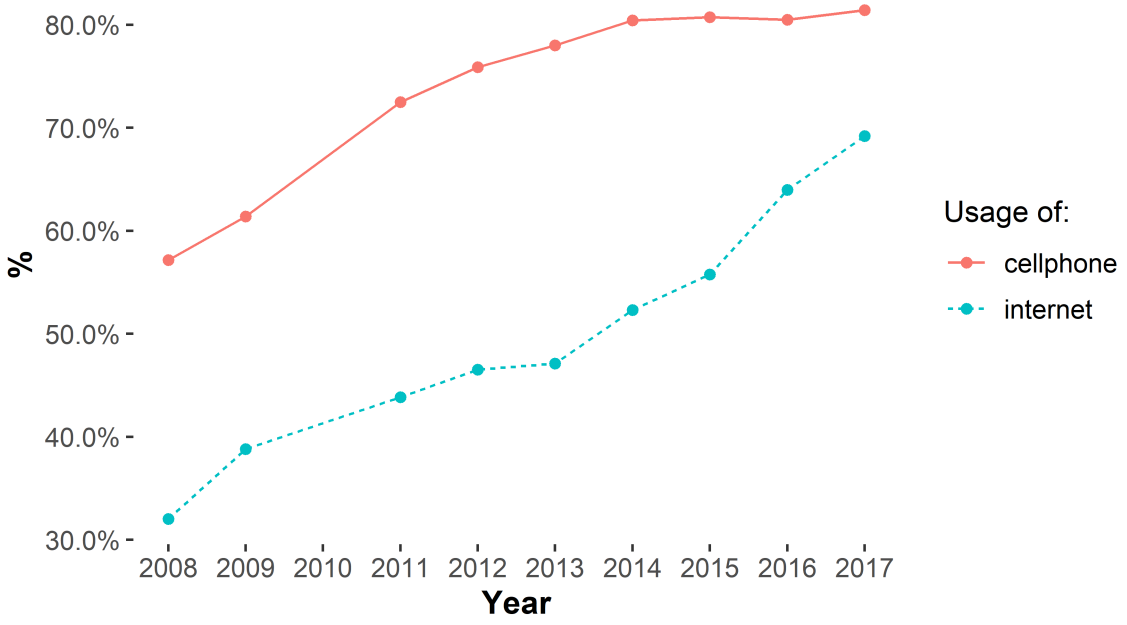
5 Empirical strategy and data bases

In this section we describe in detail the empirical strategy, relied on the Backhaul program rules, and the databases that support the analysis.

5.1 Communication usage

As a glimpse of Brazilian communication consumption, Figure 1 presents internet and cell phone usage from 2008 to 2017.

Figure 1: Internet and cell phone usage in Brazil, % of 16+ years-old population, 2008-2009 and 2011-2017



Source: National Household Survey (PNAD e PNADc)
Obs1.: Usage of internet in the last 3 months (survey date month as reference)
Obs2.: Cell phone ownership for personal use
Obs.3: No value for 2010 (Census year)

In 2008, 30% of Brazilians (16 years-old or above, i.e. population in voting age) declared to have used internet at least once in the last three months (September as reference), while almost 60% declared cell phone ownership for personal usage. In order to increase these figures, the government carried out a national plan in the begging of 2008. In 2011, these figures rose to 44% and 73%, respectively, indicating an increasing communication market in Brazil. Even in 2017, there is room remaining for internet and cell phone expansion in the country.

Hence, this expressive change in communication consumption may have changed how Brazilians face politics, possibly increasing opportunities for information acquisition and social interaction about this matter, or, on the other hand, widening leisure alternatives.

5.2 Backhaul Program (National Broadband Plan)

In April 2008, the presidential Decree 6,424 changed the former National Plan of Goals for Public Switched Telephone (PST) Network Universalization, adding broadband infrastructure as mandatory (in exchange of the PST obligation). The infrastructure mentioned in the

Decree was the Backhaul, a requirement for internet implementation in the country. Backhauls are necessary in order to connect them to the Telephone Companies' Backbones. The plan put as target that, at least, 40% of municipalities should have the necessary infrastructure by the end of 2008, 80% by the end of 2009 and 100% by the end of 2010. Also, minimal internet velocities were set, increasing with population size (Table 1).

Table 1: Backhaul Plan – setup

Population Size	N# municipalities	%	Velocity (Mbps)
Up to 20,000	3,077	90	8
From 20,001 to 40,000	268	8	16
From 40,001 to 60,000	63	2	32
Above 60,001	31	1	64
Total	3,439	100	

Source: Anatel, 2010.

According to the National Agency of Telecommunication (Anatel[6]) (Anatel 2010), the majority of municipalities to be covered by Backhaul program were up to 20,0000 inhabitants, which is more than half of total municipalities of Brazil[7]. The minimal required velocity (8 Mbps[8]) guarantee improvement in navigation quality, allowing, for example, streaming (music and videos).

Out of 5,570 municipalities, by 2015, only 85 remained uncovered (Table 2) and 2,125 (38%) already had broadband infrastructure before the program, mainly larger cities. We notice that the program focused on small cities, with average population under 15,000.

[6] *Agência Nacional de Telecomunicações* in Portuguese.

[7] Today, Brazil has 5,570 municipalities. By the time when the program was created, six municipalities did not exist yet.

[8] Megabit per second.

Table 2: Backhaul deployment by coverage status, 2015

Situation	# Munic	Avg Velocity	Avg Pop.
Covered	3,360	11	14,403
Covered before	2,125		67,151
Uncovered	85		35,372
Total	5,570	11	34,072

Municipalities by backhaul status

According to program schedule, 100% of Brazilians' municipalities should has backhaul infrastructure in 2010. However, by this year 72% of the goal was achieved. Table 3 presents the roll out of the program by year.

Table 3: Backhaul deployment by year

Backhaul year	# Munic	Avg. Velocity	Avg Pop.
2008	1,384	13	16,911
2009	1,388	10	13,340
2010	495	9	9,026
2011	27	2	12,134
2012	7	14	25,531
2013	41	4	20,238
2014	17		38,490
2015	1		13,293
Total	3,360	11	14,403

number

Source: Anatel.

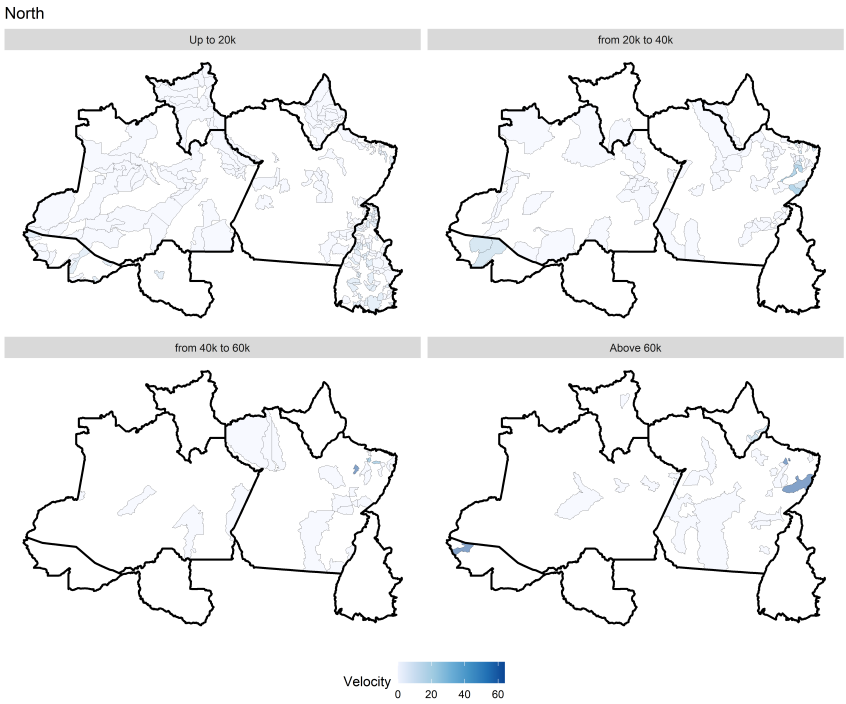
Obs.: No velocity information for 2014 and 2015.

The main point of our identification strategy relies on the velocity discontinuity, which is further analysed in Figures 2 to 6, by region[9]. North and Northeast regions are poorer, while South and Southeast are richer[10], making a common practice disaggregated analysis in Brazil.

[9]Since Brazil is a continental country with important regional inequalities, regional visualization improve analysis.

[10]For example, the state of São Paulo was responsible for almost 1/3 of Brazilian GDP in 2017. Per capita household income of the richest state (Federal District) was 3.84 times greater than the poorest (Alagoas),

Figure 2: Internet velocity in backhaul program by municipality population, North region



according to 2014 National Household Survey (IBGE/PNAD). Brazilian Gini index for the same year was 0.517.

Figure 3: Internet velocity in backhaul program by municipality population, Northeast region

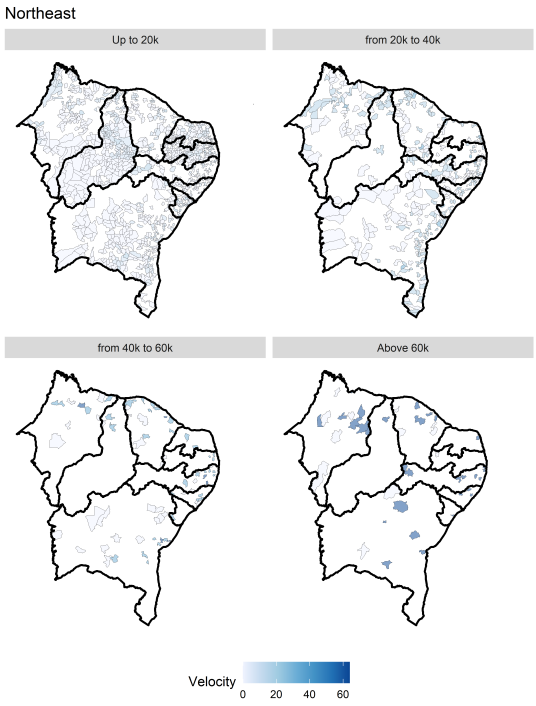


Figure 4: Internet velocity in backhaul program by municipality population, Southeast region

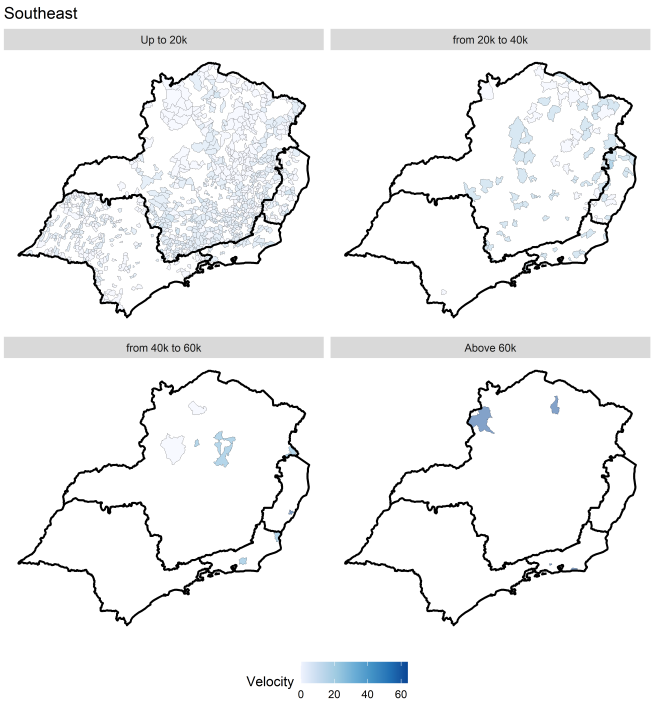


Figure 5: Internet velocity in backhaul program by municipality population, South region

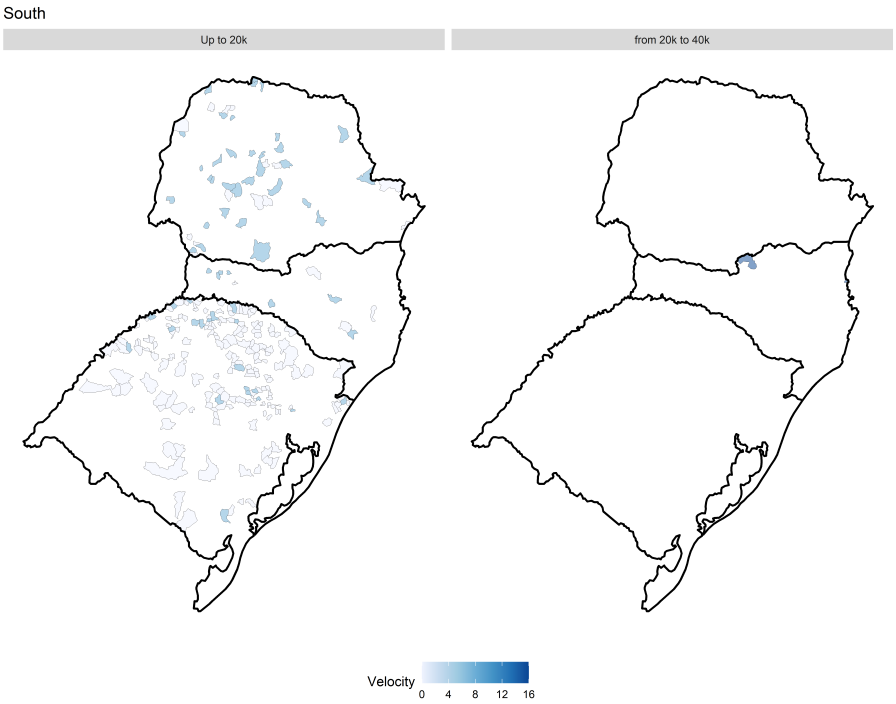


Figure 6: Internet velocity in backhaul program by municipality population, Center-West region

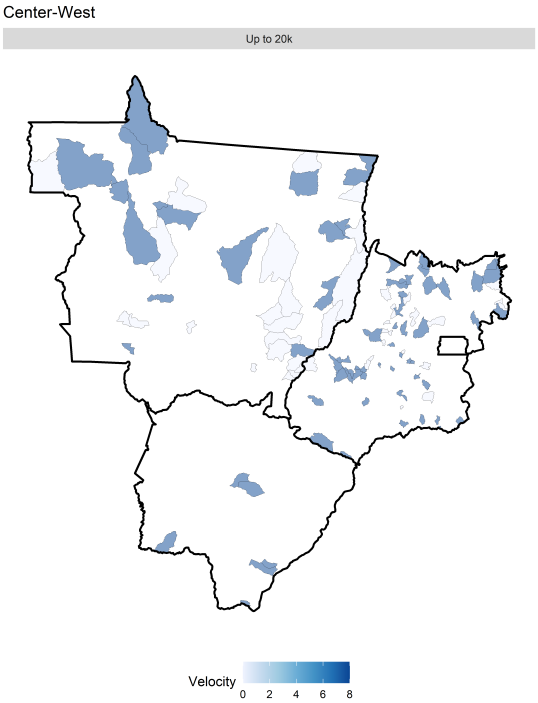


Figure 7: Discontinuity in Backhaul program velocity by population cut-offs: 20,000; 40,000; 60,000

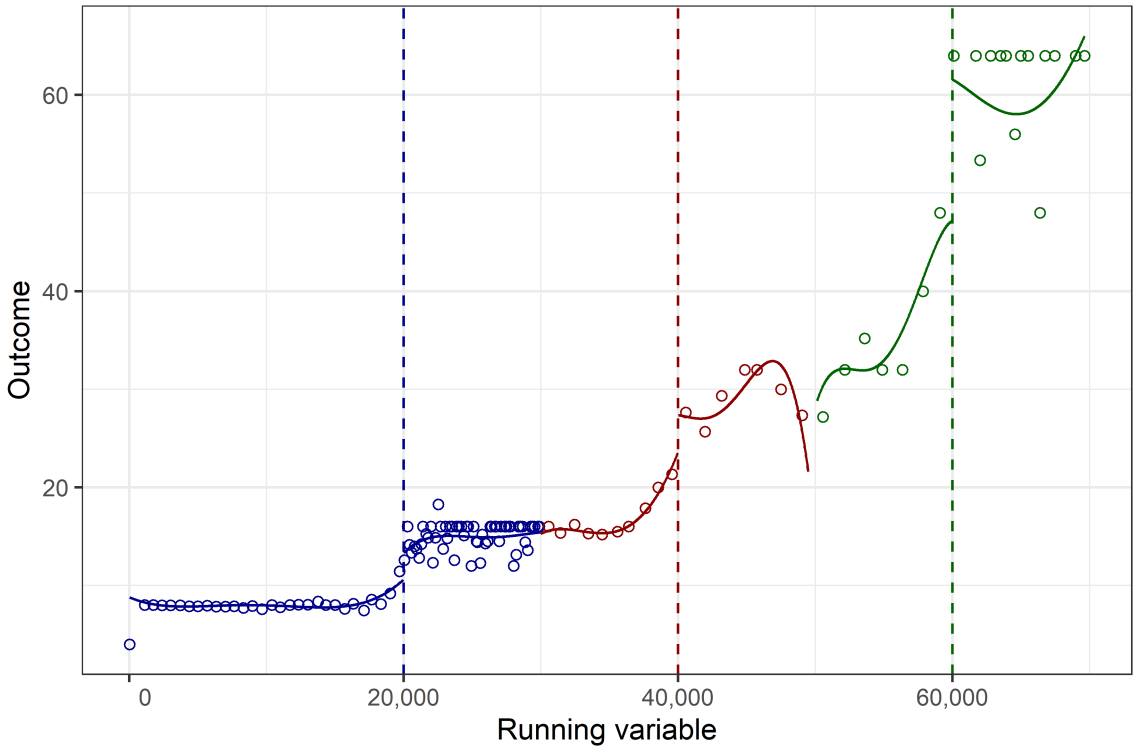


Figure 7 shows a clear jump in velocity cut-offs for the entire period. The jump around cut-offs are clear, where municipalities just below the population size established in the program face lower internet velocities. The first cut-off must be preferable due to sample size, as well as pooled weighted estimations, which will also be presented.

5.3 Descriptive statistics

Despite these clear discontinuities, a set of covariates were collected, in order to control for any further confounders that might remain. Lack of information at municipal level is one of the weakness in Brazilian researches at this territory level. Census occurs only every ten years, remaining just few administrative data in the between years, some of them with low quality (mainly for small cities). Even tough, considering that this is the only source of the main socioeconomic variables, we use information from the last two censuses (2000 and 2010), organized by Brazilian Institute of Statistics and Geography (IBGE). Also from IBGE, we collect total population estimates and GDP. Considering that direct cash transfers are important in Brazil, we collect data from the two major programs: Bolsa Família (PBF) and Benefício de Prestação Continuada for elders (BPC), booth organized by Ministry of

Citizenship[11]. In addition, we collect the mass of wages (formal labour market) from RAIS database, organized by Ministry of Economy[12]. We also collected information from National Institute of Meteorology, to control for rain and temperature in election day, following Fujiwara *et al.* (2016). Municipalities were joined by the nearest distance between the center of the city and the closest meteorological station.

In addition, we collected data from Ministry of Health regarding homicide and suicide, but, due to poor quality of data (missing values), we had to discard them. Public finance data were collected too, but discarded due to missing problem and for being highly correlated with other covariates (like GDP and population). In fact, some of covariates were discarded due to high correlation (for example electricity, car and computer ownership). Finally, we collected fiscal data, from Ministry of Economy, regarding public expenses (current expenses and investments), but again due to missing data and high correlation with other covariates (like GDP and mass of wages) these variables were dropped too.

Outcomes are election results, organized by Superior Election Court (TSE)[13]. We will analyze 2008, 2010 and 2012 elections, covering two municipal and one national suffrage. The main outcomes we will analyze are: turnout, percentage of blank or null votes[14] and vote shares, for left wing, center or right wing parties (following Power & Zucco Jr (2012) and the party index from Brazilian Legislative Survey[15]. Left wing parties are those up to quantile 0.25 of the party index, center parties are those between 0.25 and 0.75 and right wing parties are those above).

Descriptive statistics are separated by year (2008, 2010 and 2012), considering 2000 Census data for 2008 statistics and 2010 Census for 2010 and 2012. All the other variables refers to the respective year.

[11]PBF is one of the biggest conditional cash transfer program in the world. The target are families under the extreme poverty and poverty lines (in 2020, families earning up to R$ 89 by person, or U$ 15, by month are considered extremely poor, while families above that amount and up to R$ 178, or U$ 31, are considered poor), focused one children. As counter part, school attendance and vaccination are required. PBF reaches around 14 million families in Brazil in 2020. On the other hand, BPC is a program for elderly and handicapped. The poor population in this profile (people aged 65 or over and all handicapped) are eligible for a minimum wage paycheck.

[12]In Brazil, every formal company have to fill the Annual Relation of Social Information (RAIS), with the profile of all workers they had in the calendar year, including wages.

[13]*Tribunal Superior Eleitoral* in Portuguese.

[14]In Brazilian election, people may put a blank vote, which are not computed for any candidate and is not considered for official results, as well null votes. The difference consists in the way the registration of these votes are made: the blank vote is available as a button in the electronic ballot, while the null vote occurs when someone enters an invalid candidate number into the ballot and confirms the vote.

[15]Version 7, available in https://dataverse.harvard.edu/dataverse/bls;jsessionid=992eedb7e954a17ef718c7078cf5?widget=dataverse%40harvard&q=&types=dataverses%3Afiles%3Adatasets&sort=dateSort&order=desc&page=3

Table 4: Descriptive Statistics, 2008

Variable	Obs.	Average	Std.Dev.	Min	Max
Avg. Temperature	3,432	24.57	3.88	11.31	31.75
Black	3,432	0.56	0.22	0.00	0.99
BPC	3,432	0.00	0.01	0.00	0.08
College	3,432	0.01	0.01	0.00	0.05
Formal Wages	3,432	0.01	0.01	0.00	0.19
GDP	3,432	101,592.10	276,401.56	4,926.00	6,522,232.00
Married	3,432	0.29	0.09	0.04	0.52
Median Income	3,432	594.33	221.06	189.63	1,748.38
PBF	3,432	0.03	0.02	0.00	0.09
Pop. over 60 years	3,432	0.10	0.03	0.02	0.22
Population	3,432	13,414.58	16,747.05	795.00	393,569.00
Radio	3,432	0.79	0.13	0.22	1.00
Rain (elect. day)	3,432	3.03	9.22	0.00	86.70
Rural	3,432	0.49	0.21	0.00	1.00
Television	3,432	0.69	0.20	0.03	1.00
Working Pop.	3,432	0.41	0.08	0.14	0.80

Source: IBGE, Inmet, ME and MC.

Table 5: Descriptive Statistics, 2010

Variable	Obs.	Average	Std.Dev.	Min	Max
Avg. Temperature	3,433	25.03	4.15	11.28	32.22
Black	3,433	0.60	0.21	0.01	0.93
BPC	3,433	0.01	0.01	0.00	0.08
College	3,433	0.02	0.01	0.00	0.09
Formal Wages	3,433	0.01	0.01	0.00	0.15
GDP	3,433	128,197.85	400,966.27	7,218.00	14,985,170.00
Married	3,433	0.29	0.09	0.05	0.59
Median Income	3,433	885.36	316.00	300.00	2,900.00
PBF	3,433	0.03	0.02	0.00	0.09
Pop. over 60 years	3,433	0.12	0.03	0.03	0.29
Population	3,433	14,671.51	20,161.23	805.00	471,980.00
Radio	3,433	0.75	0.14	0.13	1.00
Rain (elect. day)	3,433	1.37	6.34	0.00	149.20
Rural	3,433	0.43	0.20	0.00	0.96
Television	3,433	0.90	0.09	0.18	1.00
Working Pop.	3,433	0.43	0.08	0.14	0.82

Source: IBGE, Inmet, ME and MC

Table 6: Descriptive Statistics, 2012

Variable	Obs.	Average	Std.Dev.	Min	Max
Avg. Temperature	3,433	24.75	3.67	14.47	32.23
Black	3,433	0.60	0.21	0.01	0.93
BPC	3,433	0.01	0.01	-0.02	0.10
College	3,433	0.02	0.01	0.00	0.09
Formal Wages	3,433	0.01	0.01	-0.55	0.14
GDP	3,433	165,772.00	523,791.75	-19,046.00	19,080,395.00
Married	3,433	0.29	0.09	0.05	0.59
Median Income	3,433	594.33	221.06	189.63	1,748.38
PBF	3,433	0.03	0.02	-0.15	0.12
Pop. over 60 years	3,433	0.12	0.03	0.03	0.29
Population	3,433	14,683.79	20,166.74	805.00	471,980.00
Radio	3,433	0.75	0.14	0.13	1.00
Rain (elect. day)	3,433	0.44	2.53	0.00	40.40
Rural	3,433	0.43	0.20	0.00	0.96
Television	3,433	0.90	0.09	0.18	1.00
Working Pop.	3,433	0.43	0.08	0.14	0.82

Source: IBGE, Inmet, ME and MC

All three tables show a high heterogeneity in Brazil. Regional inequalities, as pointed before, are particularly important and should be considered in standard error estimates. It is very likely that municipalities in the northeast and in the south regions show different behavior that may possibly affect error distributions, that should be addressed by, for example, clustered standard errors, strategy we adopt here.

In order to clarify identification validity, Table 7 presents a simple t-test for 20,000 population with a 5,000 people (adhoc) cutoff. Since this is the cutoff with larger sample size, results should be more robust.

Table 7: Covariates t-test for 20,000 cut-off, 2008, 2010 and 2012

Variable	t 2008	p value 2008	t 2010	p value 2010	t 2012	p value 2012
Turnout	-1.328	0.185	-2.116	0.035	-0.717	0.474
Population	-14.296	0.000	-18.773	0.000	-35.089	0.000
Median Income	0.565	0.572	-3.665	0.000	-1.727	0.085
Pop. over 60 years	-0.342	0.733	0.260	0.795	0.697	0.486
Rural	2.105	0.036	3.538	0.000	2.387	0.018
Black	-1.196	0.232	1.549	0.122	0.610	0.542
Radio	-0.742	0.459	-1.117	0.265	-0.095	0.924
Television	-1.626	0.105	-2.022	0.044	-1.402	0.162
College	0.727	0.468	-2.257	0.025	-1.448	0.149
Married	0.385	0.700	-0.125	0.901	0.392	0.695
Working Pop.	-1.005	0.315	-3.374	0.001	-1.075	0.283
Rain (elect. day)	0.029	0.977	0.537	0.592	0.626	0.532
Avg. Temperature	0.321	0.748	1.206	0.229	0.472	0.637
PBF	1.199	0.231	3.726	0.000	2.364	0.019
BPC	-2.587	0.010	-2.589	0.010	-1.367	0.173
GDP	-0.273	0.785	-2.323	0.021	-1.840	0.067
Formal Wages	-2.818	0.005	-1.866	0.063	-1.500	0.135
Velocity	-4.637	0.000	-13.315	0.000	-12.914	0.000

Source: IBGE, Inmet, ME and MC

Obs.: Null hypotheses is no difference.

Results for 2008 year in Table 7 (which, indeed, refers to 2000 census for socioeconomic variables) show that there were no significant differences for most of the characteristics between municipalities just above and just below the cut-off, except for the population (and velocity), as expected. Some results, however, do not hold in 2010 and 2012, years with values collected from 2010 census and, hence, closer to the years of analysis. Some covariates,

like formal wages and BPC seems to be different across municipalities, while other covariates changes its significance in 2010 and 2012 samples. Overall, Table 7 results suggests that our identification strategy should work, if controlled for some covariates, and even more if applied to a narrow cutoff (which will be the case).

6 Results

We begin our analysis of results looking the effects of broadband in participation. Considering that there are two rounds for two types of offices, mayor and president, and some municipalities might not have a second round, we focus only in the first one, using, hence, the larger sample size as possible. All the three cut-offs are considered (20,000, 40,000 and 60,000), with optimal bandwidth chosen following Imbens & Kalyanaraman (2012). Regressions are performed in R software, with rdd package[16] and rdmulti package[17], for pooled regression with multiple cutoffs, following Cattaneo *et al.* (2018).

Results in Table 8 suggest no relationship between broadband internet and participation in elections. For all regressions, considering the three cutoffs, and pooled results, only two showed significant relationship. Since participation in elections is mandatory in Brazil, and turnout is relatively high (around 80%), there is no much room to improve this situation. These results are in line with Menezes (2015) for Brazil, as well as results reported by Miner (2015) for Malaysia, but differs from results reported in USA and European countries (Jaber 2013; Falck *et al.* 2014; Gavazza *et al.* 2015; Campante *et al.* 2017). Another way to look to this relationship is the difference in turnout between elections, presented in Table 9.

[16]Drew Dimmery (2016). rdd: Regression Discontinuity Estimation. R package version 0.57. https://CRAN.R-project.org/package=rdd

[17]Matias D. Cattaneo, Rocio Titiunik and Gonzalo Vazquez-Bare (2020). rdmulti: Analysis of RD Designs with Multiple Cutoffs or Scores. R package version 0.5. https://CRAN.R-project.org/package=rdmulti

Table 8: RDD regression results for turnout. Election years: 2008, 2010 and 2012. Brazil

Year	Cutoff	Type	Bw	Obs.	Estimates	SE	p.value	Weight
2008	20000	With covariates	3,309	382	0.000	0.001	0.732	0.813
		Without covariates	3,309	382	0.001	0.002	0.508	0.813
	40000	With covariates	3,202	58	0.006	0.005	0.267	0.136
		Without covariates	3,202	58	0.002	0.001	0.001	0.136
	60000	With covariates	9,219	66	-0.001	0.001	0.300	0.051
		Without covariates	9,219	66	-0.004	0.004	0.332	0.051
	Pooled	With covariates	6,123	883	0.001	0.000	0.790	1.000
		Without covariates	5,890	839	0.000	0.000	0.633	1.000
2010	20000	With covariates	2,939	352	-0.004	0.006	0.438	0.815
		Without covariates	2,939	352	0.007	0.007	0.267	0.815
	40000	With covariates	3,769	79	0.010	0.028	0.711	0.138
		Without covariates	3,769	79	-0.001	0.004	0.880	0.138
	60000	With covariates	7,547	58	0.009	0.009	0.313	0.047
		Without covariates	7,547	58	0.003	0.003	0.216	0.047
	Pooled	With covariates	4,032	568	-0.018	0.004	0.903	1.000
		Without covariates	3,225	464	-0.011	0.001	0.841	1.000
2012	20000	With covariates	2,205	232	0.021	0.007	0.003	0.793
		Without covariates	2,205	232	0.211	1.573	0.893	0.793
	40000	With covariates	3,687	76	0.003	0.002	0.203	0.162
		Without covariates	3,687	76	-0.005	0.008	0.569	0.162
	60000	With covariates	7,564	65	-0.006	0.006	0.370	0.045
		Without covariates	7,564	65	-0.001	0.001	0.191	0.045
	Pooled	With covariates	2,764	395	-0.005	0.000	0.362	1.000
		Without covariates	2,797	401	-0.006	0.000	0.431	1.000

Standard Errors are clustered by regions
Turnout for first round
Bw=bandwidth
LATE estimates.

Results suggests that broadband did not changed turnout rate between elections in Brazil. It is an interesting result since a new possibility of leisure, at least apparently, did not reduce people participation in elections. However, in another backgrounds, where participation in

elections are not mandatory, results may be different (like in Germany and UK, showed by Falck *et al.* (2014) and Gavazza *et al.* (2015), respectively).

Table 9: RDD regression results for difference in turnout. Election years: 2008, 2010 and 2012

Year	Cutoff	Type	Bw	Obs.	Estimates	SE	p.value	Weight
2008	20000	With covariates	3,646	355	-0.002	0.001	0.099	0.915
		Without covariates	3,646	355	-0.005	0.007	0.508	0.915
	40000	With covariates	3,210	53	-0.001	0.003	0.639	0.164
		Without covariates	3,210	53	0.001	0.001	0.246	0.164
	60000	With covariates	10,832	70	0.000	0.000	0.276	0.054
		Without covariates	10,832	70	-0.004	0.002	0.092	0.054
	Pooled	With covariates	7,851	1,019	0.002	0.000	0.416	1.000
		Without covariates	7,958	1,035	0.002	0.000	0.432	1.000
2010	20000	With covariates	3,787	436	-0.001	0.003	0.612	0.796
		Without covariates	3,787	436	0.003	0.002	0.097	0.796
	40000	With covariates	3,170	63	0.005	0.014	0.748	0.150
		Without covariates	3,170	63	0.001	0.006	0.894	0.150
	60000	With covariates	6,268	46	-0.003	0.001	0.000	0.054
		Without covariates	6,268	46	0.005	0.005	0.350	0.054
	Pooled	With covariates	5,807	856	0.006	0.000	0.579	1.000
		Without covariates	4,814	681	0.011	0.004	0.553	1.000
2012	20000	With covariates	4,305	459	0.002	0.001	0.039	0.831
		Without covariates	4,305	459	0.003	0.002	0.111	0.831
	40000	With covariates	3,650	68	0.009	0.008	0.229	0.154
		Without covariates	3,650	68	0.005	0.037	0.899	0.154
	60000	With covariates	8,716	77	-0.006	0.012	0.616	0.058
		Without covariates	8,716	77	-0.004	0.004	0.403	0.058
	Pooled	With covariates	4,111	539	-0.002	0.000	0.871	1.000
		Without covariates	4,030	531	-0.002	0.000	0.932	1.000

Standard Errors are clustered by regions

Turnout for first round

Bw=bandwidth

LATE estimates.

The next outcome regards to the percentage of blank or null votes (Table 10). Again, there is little support in favor of the influence of broadband internet in blank or null votes (a *proxy* for "absence of engagement with political process", since these votes can be seen as a "whatever vote"). So, results so far suggests that broadband did not encourage or discourage people to turnout neither people to place more directed votes in elections (again in accordance to Menezes (2015) results).

Table 10: RDD regression results for blank of null votes. Election years: 2008, 2010 and 2012

Year	Cutoff	Type	Bw	Obs.	Estimates	SE	p.value	Weight
2008	20000	With covariates	3,517	209	0.011	0.010	0.313	0.783
		Without covariates	3,517	209	-0.014	0.052	0.789	0.783
	40000	With covariates	3,192	41	0.014	0.032	0.659	0.164
		Without covariates	3,192	41	0.000	0.004	0.984	0.164
	60000	With covariates	12,732	56	-0.007	0.010	0.515	0.052
		Without covariates	12,732	56	0.002	0.007	0.827	0.052
	Pooled	With covariates	5,677	444	-0.001	0.000	0.779	1.000
		Without covariates	4,972	383	0.000	0.000	0.877	1.000
2010	20000	With covariates	3,341	389	0.004	0.002	0.088	0.802
		Without covariates	3,341	389	-0.004	0.002	0.011	0.802
	40000	With covariates	3,682	74	-0.001	0.002	0.652	0.148
		Without covariates	3,682	74	0.000	0.005	0.962	0.148
	60000	With covariates	8,379	65	0.000	0.000	0.833	0.050
		Without covariates	8,379	65	0.000	0.001	0.845	0.050
	Pooled	With covariates	5,812	858	-0.005	0.000	0.409	1.000
		Without covariates	4,262	595	0.066	2.042	0.696	1.000
2012	20000	With covariates	2,438	158	-1.035	37.615	0.978	0.774
		Without covariates	2,438	158	-0.018	0.024	0.458	0.774
	40000	With covariates	2,533	40	0.007	0.006	0.199	0.163
		Without covariates	2,533	40	0.010	0.008	0.205	0.163
	60000	With covariates	12,289	72	0.213	5.159	0.967	0.063
		Without covariates	12,289	72	-0.119	1.433	0.934	0.063
	Pooled	With covariates	3,449	298	0.001	0.000	0.846	1.000
		Without covariates	3,522	301	0.001	0.000	0.872	1.000

Standard Errors are clustered by regions.

For mayor elections (2008 and 2012) and presidential election (2010).

Bw=bandwidth.

LATE estimates.

No huge changes are observed when we look to the differences in these percentages between elections (Table 11).

Table 11: RDD regression results for blank of null votes. Election years: 2008, 2010 and 2012

Year	Cutoff	Type	Bw	Obs.	Estimates	SE	p.value	Weight
2008	20000	With covariates	4,043	119	0.012	0.008	0.138	0.755
		Without covariates	4,043	119	-0.104	0.899	0.908	0.755
	40000	With covariates	3,774	32	0.005	0.004	0.166	0.188
		Without covariates	3,774	32	0.001	0.001	0.079	0.188
	60000	With covariates	25,181	82	-0.001	0.001	0.567	0.057
		Without covariates	25,181	82	-0.001	0.001	0.322	0.057
	Pooled	With covariates	4,759	197	0.002	0.000	0.574	1.000
		Without covariates	6,735	298	0.001	0.000	0.766	1.000
2010	20000	With covariates	3,727	428	0.002	0.002	0.196	0.798
		Without covariates	3,727	428	0.001	0.002	0.508	0.798
	40000	With covariates	3,433	67	-0.001	0.003	0.771	0.149
		Without covariates	3,433	67	-0.002	0.007	0.745	0.149
	60000	With covariates	9,434	70	0.001	0.000	0.002	0.053
		Without covariates	9,434	70	0.000	0.000	0.000	0.053
	Pooled	With covariates	7,162	1,065	0.001	0.000	0.257	1.000
		Without covariates	5,313	774	0.005	0.000	0.268	1.000
2012	20000	With covariates	2,796	138	0.062	0.088	0.483	0.763
		Without covariates	2,796	138	-0.553	7.706	0.943	0.763
	40000	With covariates	2,292	31	0.007	0.005	0.201	0.175
		Without covariates	2,292	31	0.011	0.005	0.047	0.175
	60000	With covariates	15,940	79	-0.080	0.647	0.901	0.062
		Without covariates	15,940	79	-0.025	0.048	0.604	0.062
	Pooled	With covariates	8,236	613	-0.011	0.001	0.574	1.000
		Without covariates	6,215	452	0.005	0.001	0.701	1.000

Standard Errors are clustered by regions.

For mayor elections (2008 and 2012) and presidential election (2010).

Bw=bandwidth.

LATE estimates.

In last presidential elections (2018), polarization was dramatic in Brazil. Left versus Right debate was at the center of the presidential run, with the last four times presidential

winner party (the left wing Workers Party – PT) being the main target. In fact, 2014 elections was one of the closest seen in Brazil, when Mrs. Rouseff defeated Mr. Neves (from central right Brazilian Social Democracy Party – PSDB) with only 51.64% of the valid votes in the second round. Internet may had a important role in this scenario, since, back in 2010, Mr. Lula da Silva, the first president of Workers Party, had 80% of presidency approval, the highest value ever recorded.[18]

Hence, a closer look at the relationship between broadband and vote share of left parties since 2008 might shed light into this turnaround in Brazil. As pointed before, vote shares were classified as left, center or right based on Power & Zucco Jr (2012) party index. Table 12 presents this organization.

Table 12: Party classification based on party index

Left	Center	Right
PSTU	PDT	PRN
PSOL	PV	PFL
PC do B	PCB	DEM
PT	PPS	PDS
PSB	PSDB	PPR
PCO	PMDB	PDC
	PTB	PPB
	PSD	PP
	PL	PMN
	PRONA	PSL
	PR	
	PSC	
	PRB	

Division of parties based on quantiles of party index (0.25, 0.75, 1)

Parties out of party index were allocated based on party description available on their internet page.

The party index has some aggregation of parties as "others", so another classification criterion was necessary. Parties web pages were consulted to analyse their history and beliefs in order to designate parties to the groups. This methodology may arise questions if some parties labeled as right are actually centrists. To avoid this issue, we focus on left parties vote shares, since their classification are more direct and mostly based on the party index.

[18] A news about these figures are available in: http://g1.globo.com/politica/noticia/2010/12/popularidade-de-lula-bate-recorde-e-chega-87-diz-ibope.html

Results suggests, once again, that there is no clear relationship between broadband internet and the vote received by left wing parties in elections for mayors and president (Table 13). So, unlike results reported by previous studies, there is little evidence of important effects of internet on vote shares, at least when fixed broadband is considered (Jaber 2013; Falck *et al.* 2014; Gavazza *et al.* 2015; Campante *et al.* 2017).

Table 13: RDD regression for left wing parties vote share. Election years: 2008, 2010 and 2012

Year	Cutoff	Type	Bw	Obs.	Estimates	SE	p.value	Weight
2008	20000	With covariates	3,487	207	-0.037	0.033	0.262	0.785
		Without covariates	3,487	207	-0.118	0.309	0.703	0.785
	40000	With covariates	3,501	47	0.018	0.080	0.818	0.157
		Without covariates	3,501	47	0.003	0.015	0.833	0.157
	60000	With covariates	14,881	67	0.013	0.020	0.533	0.058
		Without covariates	14,881	67	0.001	0.004	0.758	0.058
	Pooled	With covariates	4,770	365	0.012	0.000	0.311	1.000
		Without covariates	5,583	433	0.012	0.000	0.246	1.000
2010	20000	With covariates	3,076	362	0.009	0.003	0.006	0.792
		Without covariates	3,076	362	-0.061	0.016	0.000	0.792
	40000	With covariates	3,774	79	-0.016	0.024	0.496	0.154
		Without covariates	3,774	79	0.012	0.045	0.780	0.154
	60000	With covariates	6,870	52	0.043	0.033	0.193	0.054
		Without covariates	6,870	52	-0.010	0.013	0.440	0.054
	Pooled	With covariates	4,541	639	0.398	11.434	0.715	1.000
		Without covariates	4,953	703	-0.197	0.590	0.427	1.000
2012	20000	With covariates	3,799	244	-0.011	0.014	0.437	0.778
		Without covariates	3,799	244	-0.099	0.239	0.678	0.778
	40000	With covariates	3,051	45	-0.001	0.014	0.946	0.157
		Without covariates	3,051	45	0.019	0.030	0.514	0.157
	60000	With covariates	13,630	79	-0.290	5.656	0.959	0.066
		Without covariates	13,630	79	-0.081	0.332	0.807	0.066
	Pooled	With covariates	3,811	314	0.018	0.000	0.493	1.000
		Without covariates	4,230	351	0.021	0.001	0.589	1.000

Standard Errors are clustered by regions.

For mayor elections (2008 and 2012) and presidential election (2010).

Left wing parties: PSTU, PSOL, PC do B, PT, PSB and PCO.

Bw=bandwidth.

LATE estimates.

A limitation of RDD models is the bandwidth choice, that could influence results.

It is possible that a narrower or wider bandwidth give different results, since fewer or more observations will be part of regressions (trade off between randomness and precision). Considering this possibility, Table 14 presents only significant results using also half or double bandwidths.

Table 14: RDD regression with alternative bandwidths. Election years: 2008, 2010 and 2012

Year	Model	Cutoff	Type	Bw	Obs.	Estimates	SE	p.value	Outcome
2008	Double-BW	20000	With covariates	6,974	461	-0.096	0.010	0.000	Left Vote Share
	LATE	40000	Without covariates	3,202	58	0.002	0.001	0.001	Turnout
	Double-BW	40000	Without covariates	6,404	128	0.005	0.001	0.001	Turnout
	Half-BW	60000	With covariates	6,366	30	-0.001	0.000	0.000	Blank and Null
	Double-BW	60000	With covariates	29,761	197	-0.003	0.001	0.003	Left Vote Share
	Half-BW	60000	With covariates	4,610	29	-0.001	0.000	0.007	Turnout
	Double-BW	60000	With covariates	18,438	137	-0.001	0.000	0.000	Turnout
	Double-BW	60000	Without covariates	18,438	138	-0.003	0.001	0.019	Turnout
2010	LATE	20000	With covariates	3,341	389	0.004	0.002	0.088	Blank and Null
	Double-BW	20000	With covariates	6,681	793	0.001	0.001	0.019	Blank and Null
	LATE	20000	With covariates	3,076	362	0.009	0.003	0.006	Left Vote Share
	LATE	20000	Without covariates	3,341	389	-0.004	0.002	0.011	Blank and Null
	Double-BW	20000	Without covariates	6,681	793	-0.002	0.001	0.018	Blank and Null
	LATE	20000	Without covariates	3,076	362	-0.061	0.016	0.000	Left Vote Share
	Half-BW	20000	Without covariates	1,538	184	-0.083	0.027	0.002	Left Vote Share
	Double-BW	20000	Without covariates	6,153	736	-0.025	0.009	0.004	Left Vote Share
	Half-BW	20000	Without covariates	1,470	176	0.027	0.010	0.006	Turnout
	Double-BW	20000	Without covariates	5,879	709	0.004	0.002	0.100	Turnout
	Half-BW	60000	With covariates	3,435	25	0.004	0.000	0.000	Left Vote Share
	Half-BW	60000	With covariates	3,774	25	0.000	0.000	0.001	Turnout
2012	LATE	20000	With covariates	2,205	232	0.021	0.007	0.003	Turnout
	Double-BW	20000	With covariates	4,410	487	0.008	0.004	0.032	Turnout
	Half-BW	20000	Without covariates	1,219	74	-0.005	0.002	0.013	Blank and Null
	Half-BW	20000	Without covariates	1,899	117	0.057	0.027	0.037	Left Vote Share
	Half-BW	20000	Without covariates	1,103	115	-0.019	0.008	0.019	Turnout
	Double-BW	40000	With covariates	5,066	69	0.007	0.002	0.002	Blank and Null
	Half-BW	40000	Without covariates	1,266	22	0.013	0.003	0.000	Blank and Null
	Double-BW	60000	With covariates	24,579	159	-0.008	0.004	0.062	Blank and Null
	Half-BW	60000	With covariates	3,782	27	-0.006	0.003	0.029	Turnout
	Double-BW	60000	Without covariates	24,579	159	-0.007	0.002	0.001	Blank and Null
	Double-BW	60000	Without covariates	27,259	191	-0.006	0.002	0.007	Left Vote Share

Standard Errors are clustered by regions.
For mayor elections (2008 and 2012) and presidential election (2010).
Left wing parties: PSTU, PSOL, PC do B, PT, PSB and PCO.
Bw=bandwidth.
LATE estimates.

With bandwidth doubled, a significant and negative effect of broadband are observed for left wing vote share in 2008 (for the first and last cutoffs). However, results are only significant with covariates, a possible consequence due to the loss of randomness when the distance from the cut-off increases. Turnout seems to be positively related to broadband around 40,000 cut-off, while negatively related around 60,000, this last one more robust to covariates and changes in the cut-off. This is an interesting result, suggesting that cities with different sizes may respond differently to the internet.

In 2010, negative relationship between broadband and left wing vote shares seems to persist around 20,000 cutoff, although there is an ambiguity in a specification with covariates, changing its sign in LATE regression from positive to negative when covariates are omitted. Considering that around the 60,000 cut-off results are positive with covariate, these figures should be looked with even more caution. Turnout shows a positive relationship only with half bandwidth, for 20,000 and 40,000 cutoffs, which don't seems to be a very robust results because they are sensitive to covariates. Black and null percentage votes are only significant for 20,000 cutoff, being highly sensitive to covariates. Booth LATE and doubled bandwidth regression show a change in sign when covariates are considered, putting in check the results.

Finally, left wing vote share is positively related in the first cut-off and negatively related in the last one, but only without covariates. Turnout shows a change of sign in the 20,000 cutoff when the bandwidth is narrowed, making any conclusion problematic. Finally, blank and null votes shows distinct behavior according to the cut-off, being negatively related to broad band in the first and the last one, while positively related in the middle.

Putting all these results together, it is hard to conclude that the backhaul program, and, hence, broadband availability, made difference in 2008, 2010 and 2012 elections in terms of turnout, left wing vote share and percentage of blank or null votes, at least when presidential and mayor offices, and only the first round, area considered.[19] It may possible that other offices present a different result. However, results (not reported) are similar, with significance only for a negative relationship between broadband and left wing vote share in municipal chamber office election (*vereador*), only for the first cut-off. One more time, significant results are sparse, which means that it is hard to point a consistent pattern linking broadband internet availability to election outcomes. Finally, all polled regressions, a general result regardless the cut-off, were not significant, reinforcing this conclusion.

[19]These are the natural scenarios to be first investigated because they are the more important offices in each election.

7 Discussion and conclusions

Relationship between broadband and elections outcome does not seems be relevant in Brazil, at least when fixed broadband are considered, neither for local or national elections. Despite our robust identification strategy, we did not find strong relationship between broadband availability, measured by the jumps of internet velocity in the backhaul program roll out, and election outcomes (turnout, percentage of blank and null votes and left parties vote share), in line with finds reported by Menezes (2015), with a different approach, giving robustness to our finds.

However, these results are different from those reported in some part of the literature, mostly concentrated in European countries and USA (Jaber 2013; Falck *et al.* 2014; Gavazza *et al.* 2015; Campante *et al.* 2017), which could indicate that the background may be important in this kind of analysis. First of all, vote is mandatory in Brazil, which is not necessarily true in other countries. Second, the political system in Brazil is presidentialist, in a federation republic, which means that people may behavior differently than in a parliamentarian system. Third, national congress deputies are elected by proportional vote, while senators are elected by direct vote, situation that may differ across countries. A fourth source of variation in political background regards to the difference between unitary and federal systems, that sets different rules to be played in the "political game".

Aside the political background, there is a qualification of internet usage that is not addressed in our analysis. First of all, social networks have grown in Brazil after 2010. WhatsApp, one of the most popular social network in Brazil today, was created only in 2009, the very same year internet campaign was regulated. Is it possible that, today, mobile broadband and social medias usage in smartphones are more important for communication and mobilization than older social medias and connection made at home, through desktop or laptop computers. Unfortunately, there is not available in Brazil the roll out of 3G and 4G technology implementation at municipality level, only at Direct Dialling codes (DDDs)[20], which makes impossible to determine when the technology begun to operate in every city[21].

Nonetheless, our paper contributes to bring into discussion that internet and political outcomes should be viewed in a wider perspective, meaning that some relationship may be circumstantial to idiosyncrasies of the countries. Also, further investigation, like the role of the new social medias and mobile broadband, are necessary to shed light in this discussion, even because internet and social medias are still evolving.

[20]The DDD codes are numbers that divides Brazil in 67 areas.

[21]We contact the Regulation Agency of Telecommunication – Anatel – requesting mobile internet implementation at municipality level. Unfortunately, there is no such data base available.

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