Mobile Internet Access and Political Outcomes: Evidence from South Africa*

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Abstract

I exploit variation over time and space in the arrival of 3G Internet in South Africa to estimate its impact on political participation, electoral competition, voters' preferences and protests. Combining granular coverage data with administrative records on municipal elections, I show that in 2016 mobile Internet availability caused a 2 pp increase in voter turnout and a 3 pp reduction in the vote share of the ruling party. The main opponents gained from mobile Internet arrival. The number of parties running for election and the number of protests increased. I conclude providing suggestive evidence that both information and coordination mechanisms could explain the observed results.

JEL codes: D72; D73; H83; L86; P16.

Keywords: Media; Mobile Internet; Municipal elections; Political outcomes.

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1 Introduction

Many developing countries have poor governance, often driven by low political participation and low electoral competition. International observers and reporters believed that the arrival of mobile Internet could provide new opportunities to solve some of the problems of the developing world. However, little is known on the impact of the Internet on political participation and electoral competition, especially in developing countries where the topic is particularly relevant. Existing literature primarily focused on developed economies finds that broadband Internet generally led to lower political participation, most likely due to the increase in entertainment and crowding out of news consumption. These effects could be drastically different in developing countries, where the traditional media sector is overall less competitive and the level of political information in the pre-Internet era used to be low. In this environment, Internet arrival can provide citizens with new sources of information about politics, help individuals to overcome collective action and coordination problems by reducing communication costs, and foster political change.

This paper studies whether the arrival of mobile Internet in South Africa promotes political participation and electoral competition, and affects voting behavior. Specifically, I focus on a period during which the country was experiencing corruption scandals and socio-economic turmoil, and look at the impact of 3G coverage on voter turnout and number of parties, as well as the allocation of the vote shares among the major parties. In contrast to findings for developed countries (Falck et al. 2014; Gavazza and Lizzeri 2009), I find that Internet arrival in fact increased people's political participation in South Africa.[1] I also find a positive effect on political competition, reflected in a larger number of parties running for elections. In turn, after more than two decades, the undisputed dominance of the incumbent party was damaged. All together, these results suggest that mobile Internet can have the potential to improve the quality of governance in developing countries.

Identifying the causal impact of mobile Internet access on political outcomes is challenging. Compared to the literature on radio and TV coverage,[2] in this case it is harder to exploit technological features of the transmitters to find an exogenous source of variation. Internet coverage is far from random, as it reflects private operators' decisions on where to install the technology (Buys et al., 2009). I address endogeneity issues related to Internet coverage adopting two complementary strategies: a Difference-in-Difference estimation and an Instrumental Variable approach. In the first case, I exploit variation over time and space in the expansion of 3G coverage along with the change in political outcomes across 35,000 partitions of voting districts between the 2006 and 2016 municipal elections. The second strategy exploits the variation in terrain ruggedness and its differential impact (pre- vs post-2005, i.e. the year in which 3G became available) on 3G coverage. In both cases, I rely on a granular measure of Internet

[1] Campante et al. (2018) show that in Italy broadband Internet positively affected turnout only after 10 years from its arrival.

[2] See Olken (2009), Enikolopov et al. (2011) , La Ferrara et al. (2012) and Durante et al. (2019), among others.

coverage and a newly-constructed dataset containing geo-referenced information at the voting (sub)district-year-level on political outcomes, protests, population density, luminosity as a proxy for GDP, and additional information on socio-demographic characteristics, infrastructure and geography.

In the most conservative specification, my findings show that a unitary increase in 3G coverage (i.e. from 0 to 100% of area covered) led to a 2 percentage point increment in voter turnout (approximately 4% of its value in 2006) in 2011 and 2016. At the same time, Internet coverage was detrimental for the popularity of the incumbent party (the African National Congress) whose vote share dropped by more than 3 percentage points in 2016. By contrast, other parties gained. Competition at ballots became tighter in localities more covered by 3G, as the number of parties running for elections in 3G-covered localities went up by 10% compared to 2006. Lastly, the number of protests against political institutions increased, suggesting an exacerbation of political discontent as a consequence of Internet arrival. The results are robust to different specifications and estimators, and various placebo exercises support the validity of the identifying assumptions.

I complement these findings with suggestive evidence on the possible mechanisms. Following Manacorda and Tesei (2020), I investigate the information and coordination potential of mobile Internet for local politics.[3] For voters, access to mobile Internet can significantly decrease the cost of obtaining information and, eventually, affect their voting behavior. In line with this hypothesis, I find a more detrimental impact of 3G coverage on the performance of the incumbent party in municipalities with worse administration of government finances and in localities more exposed to socio-economic turmoil. At the same time, for (potential) candidates, digital technologies could drastically reduce communication costs with voters, thus making barriers to entry into politics easier to overcome, especially for smaller groups that lack significant financial resources. In this respect, I find that mobile Internet coverage facilitated political turnover and enhanced political competition by fostering new-party formation.

My paper primarily contributes to the literature on political participation and competition in developing countries. Models of electoral participation suggest that more informed individuals are more likely to vote (Feddersen and Pesendorfer 1996; Matsusaka 1995). Other authors theoretically analyze information and political competition (Baron 1994; Grossman and Helpman 1996; Lindbeck and Weibull 1987; Lohmann 1998). Empirical exercises mainly focus on the role of awareness campaigns in local communities (Banerjee 2006; Goetz and Jenkins 2001; Jenkins and Goetz 1999; Paul 2002) and NGO activities to enhance individuals' public engagement (Boulding, 2010). However, empirical literature on the determinants of political competition and participation in the developing world is scarce, and this paper attempts to fill the existing gap.

My work is also close to the literature in the political economy of media that studies the impact of broadband Internet and digital ICTs on various forms of political participation and

[3]Unlike me, their focus is mainly on traditional 2G cellphone-related technologies (e.g., SMS) as their analysis covers a period in which 3G variation in the African context was extremely low. A similar study is also provided by Christensen and Garfias (2018).

mobilization in developed countries (Campante et al. 2018; Falck et al. 2014; Gavazza and Lizzeri 2009) and developing economies (Manacorda and Tesei 2020; Miner 2015). This paper contributes to the latter, bringing novel insights on voter turnout and electoral competition, as well as on the potential underlying mechanisms. In this respect, the paper also adds to the literature on the role of information in selecting better politicians, promoting political accountability and shaping public policies (Besley 2005; Besley and Burgess 2002; Besley and Prat 2006; Besley et al. 2005; Eisensee and Strömberg 2007; Ferraz and Finan 2008; Gentzkow et al. 2007; Olken 2007; Reinikka and Svensson 2005; Snyder Jr and Strömberg 2010; Strömberg 2004).

Finally, this paper also takes inspiration from the literature on digital media and their influence on politics (Allcott and Gentzkow 2017; Bond et al. 2012; Chen and Yang 2019; Enikolopov et al. 2018, 2020; Guriev et al. 2019; Petrova et al. 2021; Zhuravskaya et al. 2020) as well as the literature on traditional media and its impact on voting behavior (Casey 2015; Chiang and Knight 2011; DellaVigna and Kaplan 2007; DellaVigna et al. 2014; Enikolopov et al. 2011; Gentzkow et al. 2011, 2015)

The remainder of this paper is structured as follows. Section 2 describes the political scenario and the media landscape. Section 3 outlines the empirical strategy, while section 4 describes the data. Section 5 shows the main results and section 6 investigates the mechanisms. Finally, section 7 draws the conclusions.

2 Background

2.1 Political scenario

South Africa is the second largest economy and the most industrialized country of the African continent. However, poverty, unemployment and income inequality remain widespread. Government corruption, inefficient bureaucracy and political instability are among the top five challenges of doing business in the country.[4] Local and international observers argue that the search for a policy compromise within the African National Congress (ANC) - the country's dominant party - has often resulted in policy paralysis and the adoption of ineffective policies, hampering economic development.[5] Since the end of apartheid in 1994, the ANC has dominated South Africa's politics. It is the ruling party in eight of the nine provinces of the country, and in most of the municipal councils. Currently, its main challengers are the Democratic Alliance and the recently formed Economic Freedom Fighters (EFF).

Local government in South Africa consists of municipalities of various types. The largest metropolitan areas are governed by metropolitan municipalities, while the rest of the country is divided into local municipalities. In 2016, there were 8 metropolitan and 226 local municipalities. Their councils are elected by a system of mixed-member proportional representation

[4] Global Competitiveness Report 2015-2016. World Economic Forum.

[5] "ANC corruption is a major cause of South Africa's failure - and the polls will show it". The Guardian. May 8, 2019.

every 5 years. Table 1 depicts the overall results of the four major parties in the last municipal ballots, as well as voter turnout and the number of political parties running for election. The striking feature that emerges from the table is the gradual decline in the ANC vote share after 2006, which has been accompanied by an increase in popularity of the DA and the newly formed EFF. At the same time, both voters' participation and electoral competition intensified.

Table 1: South African municipal election results

Party name	2000	2006	2011	2016
African National Congress (ANC)	59.4%	64.8%	62%	54%
Democratic Alliance (DA)	22.1%	16.2%	23.9%	26.9%
Inkatha Freedom Party (IFP)	9.1%	7.5%	3.6%	4.3%
Economic Freedom Fighters (EFF)		Formed in 2013		8.2%
Voter turnout	48%	48%	57.5%	57.7%
N. of parties	81	97	122	206

Source: IEC of South Africa

South Africa's political scene has undergone a quite impressive transformation over the last 20 years. Possible explanations can be found in the increasing socio-economic and political discontent resulting from a series of administrative controversies and corruption scandals that directly involved the ANC party and the former President Zuma.[6] For instance, in 2012, at the Marikana platinum mine, rock drillers began a series of wildcat strikes seeking for a pay raise. In one of these occasions, the police opened fire on a group of strikers, killing 34 miners and wounding other 78.[7] The incident was considered to be the single most lethal use of force by the police against civilians since the apartheid era. Media repercussions were large, both at the national and international level. Opposition parties and leaders criticized the police and called for Zuma to resign because of the controversy over the shooting, meanwhile black people felt betrayed by "their" party.[8] Other scandals have emerged more recently. A major campaign issue during the 2016 election was corruption within the ANC, in particular President Zuma's relationship with the Gupta family[9] and funding for the construction of his home. Moreover, after the elections, the ANC was accused to spend almost $3.8 million on a covert campaign targeting opposition parties. In the first months of 2018, growing pressure on Zuma led him to resign as President of South Africa.

2.2 Media landscape

South Africa has a fragile media independence. In particular, "coverage of certain subjects involving the ruling ANC, government finances, or state-funded improvements to President

[6] For an overview, see "The trials of Jacob Zuma". BBC. December 15, 2017.

[7] "South Africa mine killings: Jacob Zuma announces inquiry". BBC News. August 17, 2012.

[8] "Marikana mine shootings revive bitter days of Soweto and Sharpeville". The Guardian. September 7, 2012.

[9] An Indian-South African business family which owns a business empire spanning computer equipment, media and mining.

Zuma's personal home are either off limits or provoke a hostile reaction from the authorities".[10] Similar restrictions are less likely to hold for new media, which are promoted by the spread of the Internet.

With respect to mobile Internet, the country has one of the most technologically advanced infrastructure on the African continent. The market is mainly dominated by three private Internet service providers (ISPs) with more or less homogeneous market shares. Internet users as percentage of the population went up from 5% in 2006 to almost 55% in 2016.[11] This growth was made possible thanks to a significant expansion of the 3G Internet infrastructure between 2006 and 2016, which is depicted in figure C.1. By contrast, 2G (GSM) coverage - used for calls and SMSs - has remained mostly stable over the same period.[12] In 2016, about 60% of the adult population owned a smartphone.[13] The cheapest price for 1GB of prepaid data was about $7, that was almost 1.5% of the average monthly per capita income, and no sharp change in data prices has occurred.[14] Fixed broadband Internet subscribers remain below 4%, and they mostly live in large cities where landline is available.

Previous literature (Falck et al. 2014; Gavazza et al. 2019; George 2008) has documented that broadband Internet arrival in developed economies partially crowded-out the use of traditional media in order to access information. Survey data from Afrobarometer show the situation for South Africa (figure C.2). Although access to information through the Internet more than doubled between 2011 and 2015, traditional media still remain the most popular way to get information. However, among regular Internet users only, the decline in newspapers readership is more visible. This might indicate that, to some extent, habits towards news consumption gradually shifted from printed papers to their online versions. Circulation numbers from the Audit Bureau of Circulations of South Africa lend support to this hypothesis (figure C.3).[15] Between 2010 and 2018, circulation dropped relatively more for national outlets (47%) than local newspapers (20%). This makes South Africa at odds with the evidence that the Internet has been detrimental especially for those media with a greater amount of local news content (Gavazza et al., 2019).[16] While hard copies sales decreased substantially, these outlets managed to boost readership in their online versions. In only three years (2016-2018), daily unique browsing for national and local newspapers increased by 65 and 34%, respectively.

Politicians themselves are also aware of the importance of mobile technologies to communicate with voters, and they have increased their presence in social media platforms over the last decade.[17] During the 2014 national election campaign, platforms such as Facebook, YouTube and Twitter were actively used (Malherbe, 2015). In that year, ANC, DA and EFF all together

[10] The country is also ranked 31st out of 180 on the World Press Freedom Index. http://www.rsf.org

[11] The World Bank.

[12] http://www.collinsbartholomew.com

[13] https://www.wearesocial.com

[14] This makes South Africa one of the country with the lowest tariffs in the Southern African Development Community.

[15] http://abc.org.za

[16] See also "Can local newspapers survive in the internet age?". BBC News. 11 May 2012.

[17] "Political parties and social media: Does it make a difference?" City Press. 29 April 2019. https://city-press.news24.com

had almost 300 thousand followers on their Twitter accounts.[18] In 2019, they reached nearly 2 million followers.[19]

3 Empirical strategy

3.1 Determinants of 3G coverage

The rollout of the 3G mobile network in South Africa started around 2005. At that time, existing antennas were already supporting the 2G (GSM) wireless communication technology, which enabled mobile phone calls and SMSs (Minges et al., 2008). 3G technology is an extension of GSM and is designed to offer faster data access speeds for mobile Internet. As described by Harris (2011) and exemplified in figure C.4, the primary job of a cell tower is to elevate antennas that transmit and receive radio-frequency signals from mobile devices. Wires run from the antenna to base station equipment (typically located at ground level), which is then connected through fiber optic cables to the backbone network. Three main differences exist between a 2G and a 3G mobile network infrastructure. First, more 3G antennas are needed to cover the same number of connections that one 2G repeater could support alone. Second, the equipment to be installed in the base station to support 3G services (UMTS) is different than the one used for 2G (EDGE). Third, 3G base stations need to be connected to the backbone national network infrastructure via fiber optic cables, which are usually installed underground. Therefore, supplanting 2G with 3G technology requires: (1) the installation of additional towers; (2) updating the technology in existing sites; (3) laying down fiber optic cables.

In this paper I seek to identify the causal impact of 3G Internet on political outcomes. However, 3G coverage is far from random, and it reflects market-based calculations and profit optimization choices performed by the private ISPs. In particular, the decisions over the particular site in which the transmitter is installed is likely endogenous.[20] Buys et al. (2009) study the determinants of disparities in cell phone coverage in Sub-Saharan Africa and highlight that both demand and supply side factors play a role. Among other things, they show that places with larger market size, lower elevation and smoother terrain characteristics positively predict coverage. Following their approach, I analyze the determinants of 3G coverage in South Africa. Table B.1 shows that the share of land in a locality that is covered by 3G is positively associated with luminosity (income), urbanization, education, presence of a road, and past cellphone penetration, among other things. At the same time, terrain ruggedness, average population age, distance from main cities and to the fiber backbone network negatively predict 3G.

[18]See Malherbe (2015) for a qualitative assessment on how the South African political parties used Twitter, specifically, and the Internet in general, during the 2014 campaign period.

[19]"Political parties can't ignore social media power in election campaigning: Expert". SABC News. 18 February 2019. http://www.sabcnews.com

[20]To overcome endogeneity concerns, Manacorda and Tesei (2020) exploit the slower adoption of mobile technology in areas subject to a higher incidence of lightning strikes in the African continent. However, in my case using lightning strikes as an instrumental variable leads to the weak instrument problem.

3.2 Difference-in-Difference

The baseline empirical strategy of this paper is a Difference-in-Difference. To addresses potential endogeneity issues, this approach relies on the high-resolution features of the data and compares the within-district change over time in the outcomes, across districts experiencing a differential 3G expansion. The main specification I estimate is the following:

$$y_{it} = \beta_0\, 3\mathrm{G}_{it} + \beta_1\, 3\mathrm{G}_{it} \times \theta_{2011,t} + \beta_2\, 3\mathrm{G}_{it} \times \theta_{2016,t} + \mathbf{x}_{it}^{'}\beta_3 + (\mathbf{w}_i \times \theta_t)^{'}\beta_4 + \mu_i + \theta_t + \varepsilon_{it} \quad (1)$$

where i is the voting district, and t is the year, such that $t = 2006, 2011, 2016$. This approach uses the period 2006 to 2016 to carry out causal inference, and exploits the first two electoral rounds (2000-2006) to conduct placebo checks. 3G is the share of area covered by 3G signal in each voting district/year. θ_{2011} and θ_{2016} take value 1 when t is 2011 or 2016, respectively. Vector $\mathbf{x}$ contains time variant controls such as luminosity and population density, urbanization rate, average education, share of youths and average age. Vector $\mathbf{w}$ contains their values in 2000 as well as geographic controls (presence of mine, road, river, slope index, elevation, ruggedness, area, distance to closest city and to fiber backbone). I interact these covariates with year dummies, and also include a 5^{th}-order polynomial of a subset of them when explicitly indicated. Finally, μ and θ represent voting sub-district and year fixed effects, respectively.

Specification reported in equation 1 allows me to account for various sources of potential endogenity. In particular, voting district fixed effects account for time invariant unobserved factors that may affect the outcome and may also be correlated with 3G coverage. The year dummies capture instead the time trend in the outcomes that is common to all localities. I also include province linear time trends to control for unobserved and time-varying province-level characteristics. Finally, I allow demand and supply side factors to have different impacts on the outcome over time by interacting pre-determined controls with time dummies. I cluster standard errors at the level of the smallest (geographically) stable union of voting sub-districts to account for both cross-sectional and temporal correlation in the errors.[21]

Identifying assumption: In equation 1, coefficient β_0 captures the average difference in y between more and less covered localities at the baseline year, i.e. 2006. In order for β_1 and β_2 to consistently identify the average treatment effect of 3G coverage on the outcomes of interest, the parallel trend assumption must hold. In other words, in the absence of the 3G technology, outcomes in more and less covered localities should exhibit common trends. I will carry out a series of exercises to provide evidence in favor of this assumption.

3.3 Instrumental variable

The second approach relies on an IV estimation. In this case, I instrument 3G coverage with exogenous variation in (the log of) terrain ruggedness interacted with a dummy, which equals 1 if $year > 2005$. I rely on several technical reports and papers highlighting how the site where

[21] Details on the construction of the dataset are provided in section 4.

an antenna is built must be adjacent to a road for physical access, with availability of electrical power and telecommunications network connectivity (Aker and Mbiti 2010; GSMA 2015; Harris 2011, among others). When the rollout of the 3G started in South Africa, i.e. around 2005, phone companies had to verify that locations met these physical requirements before building antennas. At the same time, they had to expand the network to reach additional areas. *Ceteris paribus*, phone companies initially avoided localities with geographical characteristics associated with higher costs - namely, steeper slopes, and distance from a main road and major urban centers. Conditional on economic development, population density, distance from the closest main city and fiber optic backbone network, as well as other geographical and infrastructural controls, terrain ruggedness is the factor that best explains 3G coverage in a locality. This is visible in the exploratory analysis reported in table B.1. In particular, $log(ruggedness)$ matters for 3G penetration only after 2006. Therefore, I rely on the following 2SLS procedure:

$$\begin{aligned} 1^{st}\ Stage: \quad & 3\mathrm{G}_{it} = \pi_0[log(Ruggedness) \times \mathbb{1}(Year > 2005)]_{it} + \mathbf{z}_{it}'\pi_1 + \mu_i + \theta_t + u_{it} \\ 2^{nd}\ Stage: \quad & y_{it} = \gamma_0 \widehat{3\mathrm{G}_{it}} + \mathbf{z}_{it}'\gamma_1 + \mu_i + \theta_t + \varepsilon_{it} \end{aligned} \tag{2}$$

where $t = 2000, 2006, 2011, 2016$ and 3G is the share of area covered by 3G signal in each voting district/year. *Ruggedness* is measured by the standard deviation of elevation. Vector $\mathbf{z}$ contains the same controls as those in the Diff-in-Diff analysis, with the exception of the presence of mine/road/river, slope index and (log) elevation, which significantly reduce the predictive power of the instrument.

Identifying assumption: In order for the instrument to be valid, two conditions have to be satisfied. First, it has to be relevant. One can easily investigate relevance by looking at the *Wald F-statistic* from the 1^{st} stage. In particular, I will consider the *Kleibergen-Paap rk Wald F-statistic*. The second condition is exogeneity.[22] In this context, the identifying assumption requires that the correlation between ruggedness and any relevant omitted voting district's characteristics did not change around 2005, other than through the availability of 3G Internet. I will conduct an empirical exercise to assess the plausibility of this assumption.

4 Data

4.1 Dataset construction

The analysis exploits a newly-assembled dataset containing time-varying and geo-referenced information on political outcomes (vote share of the main parties, voter turnout, number of parties and protests), share of area covered by 3G, economic development (as measured by

[22]In this respect, terrain ruggedness has been shown to have positive indirect consequences on economic development in Africa, for instance because it afforded protection to those being raided during the slave trades (Nunn and Puga, 2012). However, their results also show no differential role of ruggedness for economic development among South African countries. Moreover, to mitigate concerns about potential endogeneity of the standalone ruggedness variable, I use its interaction with a time dummy.

luminosity at night), population density, urbanization and a variety of socio-demographic indicators (education, age, youth population and ethnicity) measured at the voting district level. In addition, each observation contains time constant information on average elevation (m), terrain ruggedness (m^2), average terrain slope, area (km^2), a dummy variable indicating the presence of a major road, a river and a mine, the distance (km) from the closest provincial capital or city with more than 1 million inhabitants, and the distance (km) from the closest fiber optic national backbone infrastructure. The construction of the dataset involves two steps.

Step 1. I create new geographical units of analysis. Data on political outcomes come at a very disaggregated level, i.e. the voting district. Districts are small geographical entities with no political significance, which contain voting stations. Each voting district has only one voting station. In 2000, the average municipality contained 57 voting districts. However, the boundaries and the number of these districts changed over time. The Municipal Demarcation Board of South Africa, which provided the demarcation data, is in charge of the determination of districts' boundaries for the elections.[23] The main driver of demarcation redeterminations is the increasing or decreasing number of voters. In 2000 there were 14,988 voting districts, 18,872 in 2006, 20,857 in 2011 and 22,612 in 2016. Hence, using the intersecting procedure explained in details in appendix A, I create about 43,000 geographically stable sub-districts per year. These new entities constitute my observational units.

Step 2. For each of these 43,000 units I calculate zonal statistics (mean/standard deviation) of the above mentioned variables using the GIS toolbox. Appendix A reports a detailed description of the variables and their source. The analysis is conducted after cleaning the dataset and considering only observations that are farther than 15 km from the closest provincial capital or city with more that 1 million inhabitants,[24] and such that their population density in 2000 was lower than the 95^{th} percentile. Excluding the major urban agglomerations mitigates potential confounding effects that may bias the results due to (1) the possible expansion of the landline broadband Internet, and (2) the presence of Wi-Fi connections.[25] However, for the sake of comparison, I also reports the results including all localities in the sample. Finally, to increase the precision of my measures, I neglect localities with no population and exclude the largest 1% in terms of area (km^2). Hence, out of a total of 43,014 observations, 8,026 are dropped.

4.2 Descriptive statistics

Table B.2 provides the descriptive statistics for the final sample. The main variables of interest are displayed for the years 2000, 2006, 2011 and 2016. Note that the table also reports the

[23]The Board is an independent authority. Its status is protected by section 3 of "The Local Government: Municipal Demarcation Act", 1998, and various judgments by the Constitutional Court. http://www.demarcation.org.za

[24]These are Bhisho, Bloemfontein, Cape Town, Durban, East London, Johannesburg, Kimberley, Nelspruit, Pietermaritzburg (Ulundi), Pietersburg (Polokwane), Port Elizabeth, Pretoria and Richards Bay.

[25]For instance, improvements in access to landline Internet connection in cities after 2006 increased employment in higher-skill occupations (Hjort and Poulsen, 2019). If these changes affect people's voting preferences, and landline connectivity is somehow correlated with 3G, then any estimates of the impact of 3G on political outcomes in cities would be biased.

statistics for socio-demographic and economic variables measured in 2001. Moreover, the mean total Gross Value Added (GVA) and GVA from mining and quarrying are measured in 2009, while data on total and irregular expenditure come at the municipality level (234 municipalities) and refer to the 2012-2015 period. Between 2006 and 2016, the ANC vote share dropped by 5 percentage points (pp), while voter turnout increased by 4 pp, on average. During the same period, the average share of area covered by 3G rose by 50 percentage points. Figure C.5 shows the spatial and temporal expansion of 3G over the entire country. The geographical entities in the picture correspond to the level at which standard errors are clustered in the regressions.

5 Main results

5.1 Voter turnout and incumbent party vote share

Table 2 reports the results on voter turnout and ANC share from the estimation of the Diff-in-Diff model described in equation 1. The coefficients of interest are those on the interaction terms (3G $\times$ 2016 (2011)). The table also reports the standalone coefficient on 3G, which captures average differences in the dependent variables between more and less covered localities at baseline (2006). For each outcome, a sensitivity analysis of the estimated coefficients across different specifications is reported in the table.

Column (1) of table 2 shows that a unitary increase in coverage - i.e. moving from 0 to 100% of the area covered by the 3G - is associated with a 9.5 percentage point (pp) growth in voter turnout in 2016. The magnitude of the point estimate drops to 2.5 pp when socio-economic controls are included, yet the coefficient remains statistically significant at the 5% confidence level. This suggests that omitting relevant socio-economic characteristics (which are likely correlated with both 3G coverage and political outcomes) could yield upward-biased estimates. However, adding additional geographic controls and a polynomial function of a subset of them does not significantly alter the estimates. To some extent, this is reassuring of the fact that observable socio-economic variables account for most of the potential endogeneity of 3G in explaining voter turnout. Moreover, the effect of 3G on turnout is positive and significant also in 2011. In the most conservative specification (columns 3-4) a unitary increase in 3G coverage leads to a 2.1 pp (1.6 pp) growth in turnout in 2016 (2011), which is approximately 4% (3%) of its mean in 2006.

To corroborate these findings, figure 1 depicts the average trends in the outcomes of interest for two subgroups of localities: those with most of their area covered by 3G in 2016 - i.e. 3G$\geq$ 50% - and those with less than 50% of their area covered. To inspect their trends in the pre-Internet era, I exclude localities that were covered by 3G in 2006 and re-scale the lines so that in 2006 the averages for the two subgroups exactly coincide. Moreover, to be consistent with the empirical analysis, I drop metropolitan areas and provincial capitals. The left panel of the figure supports the regression estimates: localities that are more exposed to 3G coverage exhibit higher voter turnout in 2011 and 2016, compared to localities with lower 3G penetration.

Importantly, turnout does not show significant diverging trends across the two subgroups before the arrival of 3G. This provides visual evidence in support of the parallel trend assumption.

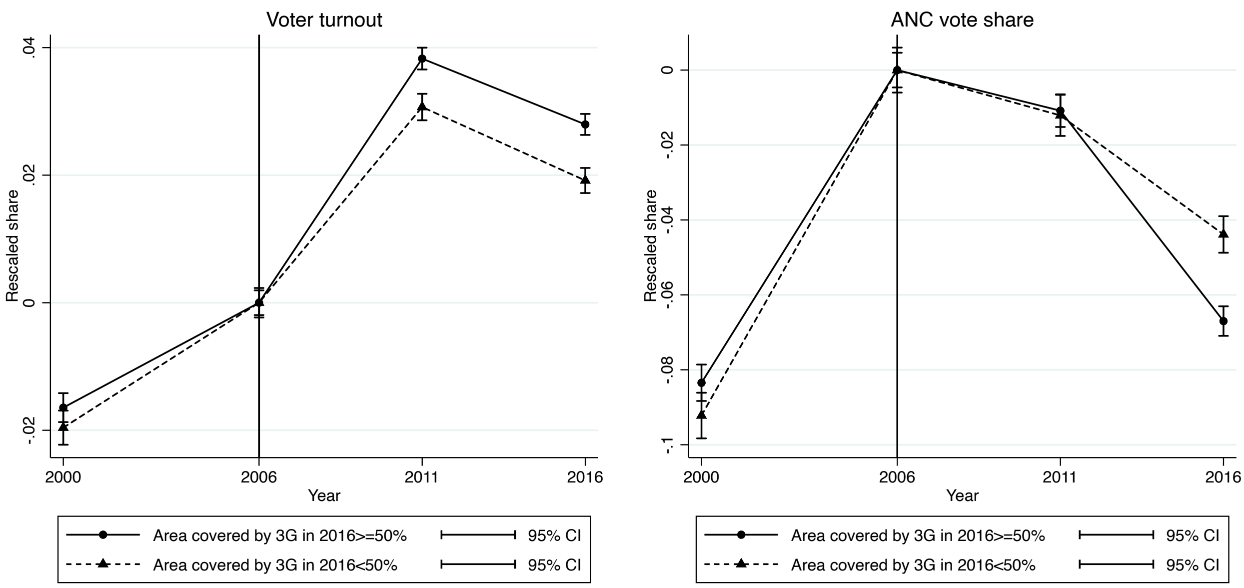
Table 2: Diff-in-Diff estimates of the impact of 3G on turnout and ANC vote share

OLS; years 2006 to 2016; whole sample

	Turnout				ANC share			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
3G*Year 2016	0.094***	0.025**	0.021**	0.021**	-0.097***	-0.035***	-0.031**	-0.035***
	(0.007)	(0.011)	(0.010)	(0.010)	(0.014)	(0.012)	(0.013)	(0.013)
3G*Year 2011	0.095***	0.021**	0.016**	0.016**	-0.023***	-0.006	-0.011	-0.013
	(0.006)	(0.008)	(0.008)	(0.008)	(0.007)	(0.010)	(0.010)	(0.010)
3G	-0.084***	-0.028***	-0.021**	-0.021**	0.035***	-0.003	0.002	0.004
	(0.006)	(0.009)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
Voting Dist FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Province trends	✓	✓	✓	✓	✓	✓	✓	✓
Socio-economic		✓	✓	✓		✓	✓	✓
Geographic			✓	✓			✓	✓
Polynomial				✓				✓
Mean in 2006	0.529	0.529	0.529	0.529	0.683	0.684	0.684	0.684
Observations	104595	103925	103925	103925	104571	103901	103901	103901
Adj. R-squared	0.456	0.507	0.514	0.514	0.736	0.753	0.756	0.757

Notes - Provincial capitals and larger cities are excluded. Standard errors in parentheses clustered at the smallest stable aggregation of voting districts. Socio-economic variables include contemporaneous information on (log) luminosity and (log) population density, urbanization rate, years of schooling, ethnicity, age and share of youth, as well as their 2000 values interacted with year dummies. Geographic variables include presence of mine, road, river, slope index, (log) elevation, (log) ruggedness, (log) area, (log) distance to closest city and (log) distance to fiber backbone interacted with year dummies. Polynomial is a 5^{th} order polynomial function of (log) elevation, (log) ruggedness, and (log) population density interacted with year dummies. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Figure 1: Trends in voter turnout and ANC vote share by 3G coverage



Notes: Provincial capitals and larger cities are excluded, as well as localities that were covered by 3G in 2006. Lines are re-scaled so that in 2006 the averages for the two subgroups exactly coincide and are equal to 0.

Columns (5-8) of table 2 look at the vote share of the incumbent party. Similar to voter turnout, the coefficients of interests are sensitive to the inclusion of socio-economic variables, yet they remain stable after the addition of geographic controls and the polynomial function. The most conservative specification (column 7) suggests that a unitary increase in 3G coverage causes a 3.1 pp (4.5%) drop in the ANC vote share in 2016, while the impact in 2011 is still negative but not statistically significant. The right panel of figure 1 provides supporting evidence for these estimates. Differently from turnout, the effect of 3G on the incumbent party is observable only in 2016. A potential reason, which is discussed more in details later, is that many administrative controversies and corruption scandals involving the ANC party emerged after 2011, and the availability of 3G exacerbated the socio-economic and political discontent resulting from them. Finally, similarly to turnout and in line with the parallel-trend assumption, the figure shows no diverging trends between the two subgroups of localities before 2006.

I complement these findings estimating model 2 via 2SLS. Table 3 shows the results. For each outcome, the first pair of columns reports OLS coefficients while the last pair provides the 2SLS estimates, with and without control variables. This analysis takes all four electoral waves into account (from 2000 to 2016) so to exploit the differential impact - around 2005 - that terrain ruggedness has on political outcomes through the arrival of the 3G technology. Coefficients on the instrumental variable from the 1^{st} stage regressions and the Wald F-statistics are also reported.

Table 3: IV estimates of the impact of 3G on turnout and ANC vote share

OLS and 2SLS; years 2000 to 2016; whole sample

	Turnout				ANC share			
	(1) OLS	(2) OLS	(3) 2SLS	(4) 2SLS	(5) OLS	(6) OLS	(7) 2SLS	(8) 2SLS
3G	0.014***	0.006**	0.075***	0.061**	-0.051***	-0.030***	-0.168***	-0.237***
	(0.003)	(0.003)	(0.019)	(0.028)	(0.007)	(0.006)	(0.042)	(0.058)
Voting Dist FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Controls		✓		✓		✓		✓
Mean in 2000	0.51	0.51	0.51	0.51	0.60	0.60	0.60	0.60
log(ruggedness)*Post			-0.09	-0.08			-0.09	-0.08
1st stage F-stat			137.2	171.1			136.8	170.8
Observations	139227	138335	139227	139227	139161	138269	139161	139161
Adj. R-squared	0.333	0.384	0.048	0.122	0.693	0.721	0.036	0.018

Notes - Provincial capitals and larger cities are excluded. Standard errors in parentheses clustered at the smallest stable aggregation of voting districts. Controls include contemporaneous information on (log) luminosity and (log) population density, urbanization rate, years of schooling, ethnicity, age and share of youth, as well as (log) area, (log) distance to closest city and (log) distance to fiber backbone interacted with year dummies. Coefficient on the instrumental variable from the first stage regression and the respective Kleibergen-Paap rk Wald F-statistic are reported. Post is a dummy which equals 1 if Year>2005. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

The 2SLS estimates are generally larger in magnitude than the OLS ones, in the order of 3 to 6 times. Columns (1-2) show an overall positive and significant relationship between 3G and turnout, ranging between 0.6 and 1.4 pp, depending on the specification. By contrast, the IV approach (columns 3-4) suggests that a unitary increase in 3G coverage leads to a 6-to-7.5

pp rise in voter turnout, a much larger estimated impact than what the OLS predicts. Similar patterns hold for the vote share of the incumbent party. Columns (5-6) point out a negative impact of 3G on the ANC vote share, in the order of -3 pp in the most conservative case. The 2SLS estimation yields larger coefficients, ranging between -17 and -24 pp.

To put the Diff-in-Diff and IV estimates into perspective and reconcile their magnitudes, consider that average mobile Internet penetration increased by 50 pp in the 2006-2016 period, while voter turnout increased by 4pp and the ANC share dropped by 5 pp (table B.2). The Diff-in-Diff estimates then imply that the expansion in 3G Internet coverage accounted for about one fourth of the increase in voter turnout and one third of the vote swing against the ANC. By contrast, the 2SLS coefficients suggest that the rise in 3G coverage accounted for three fourths of the increase in turnout and the entire loss in the ANC share during the same period. Hence, the Diff-in-Diff approach yields considerably more conservative effects. Moreover, while the signs of the OLS and 2SLS coefficients in table 3 are always internally consistent, their magnitudes differ substantially across estimators, with OLS estimates closer to the Diff-in-Diff results than the 2SLS ones.[26] This divergence may raise some concerns about the validity of the identifying assumptions of the IV approach. While it is easier to prove that the instrument is relevant - the Wald F-statistic is always above 130 -, defending its exogeneity is a more complex task, which will be discussed later. Hence, because the Diff-in-Diff results tend to be overall more conservative than the IV estimates and the identifying assumption (parallel trend) is easier to defend, I consider the Diff-in-Diff analysis as the benchmark specification.

5.2 Other political outcomes

I now describe the results for the vote share of the Democratic Alliance (DA) - the ANC's main political opponent - as well as the aggregate vote share of all remaining parties, the number of parties running for election and the number of protests against political institutions.

Table 4 shows that the arrival of 3G benefits the Democratic Alliance, whose vote share rises by almost 2.2 and 2.7 percentage points in 2011 and 2016, respectively, which is about 22 and 27% of the mean in 2006. By contrast, the effect of 3G on the aggregate share of other parties is much smaller and not statistically significant. Column (3) investigates the effects of the 3G technology on the number of parties running for election as a proxy for political competition. The coefficients of interest suggest that mobile Internet coverage intensifies competition, leading to an increase of about 8 and 10% in the number of parties in 2011 and 2016, with respect to their mean in 2006. The result suggests that the new technology may lower entry costs into politics, eventually promoting the proliferation of new parties or helping existing parties to run in new districts. Finally, column (4) analyzes the effect of 3G availability on protests against a typically political entity as a proxy for social and political discontent. The coefficients indicate that in 2011 and 2016, 3G coverage causes the number of protests to rise by 15 and 30

[26] The fact that 2SLS estimates are larger than OLS ones is common in the literature. There might be several explanation for this. 1) OLS is biased, 2) the instrument is not exogenous and so 2SLS results are biased, 3) there is measurement error in the independent variable, 4) ATE and LATE do not coincide.

times their baseline value in 2006. Figure 2 depicts the patterns for the last two outcomes and provides visual evidence on their parallel trends across more and less covered localities before 3G became available. Finally, IV estimates are reported in the appendix table B.3. The 2SLS coefficients are generally larger and, in contrast to the Diff-in-Diff results, they show that the DA did not benefit from 3G coverage, while smaller parties did.

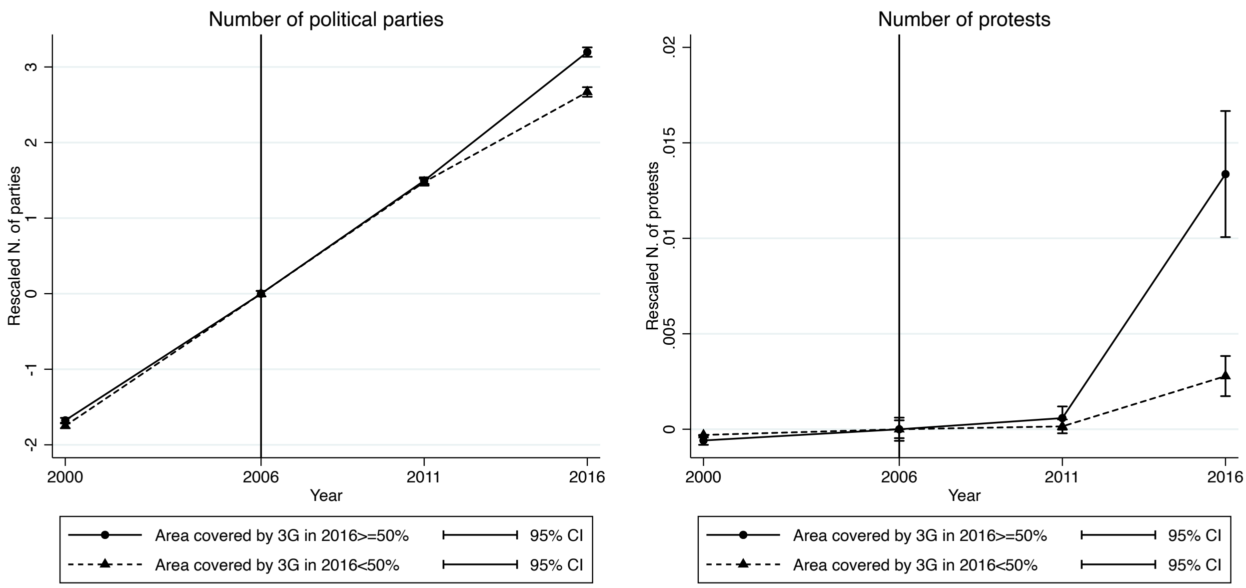
Table 4: Diff-in-Diff estimates of the impact of 3G on other political outcomes

OLS; years 2006 to 2016; whole sample

	DA share	Other parties share	N. of parties	N. of protests
	(1)	(2)	(3)	(4)
3G*Year 2016	0.027***	0.004	0.689**	0.033***
	(0.007)	(0.013)	(0.293)	(0.010)
3G*Year 2011	0.022***	-0.010	0.553**	0.015**
	(0.006)	(0.009)	(0.248)	(0.006)
3G	-0.020***	0.020**	-0.318	-0.031***
	(0.006)	(0.009)	(0.251)	(0.011)
Voting Dist FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
Province trends	✓	✓	✓	✓
Socio-economic	✓	✓	✓	✓
Geographic	✓	✓	✓	✓
Mean in 2006	0.099	0.203	6.559	0.001
Observations	99033	103321	103925	104292
Adj. R-squared	0.847	0.717	0.853	0.132

Notes - Provincial capitals and larger cities are excluded. Standard errors in parentheses clustered at the smallest stable aggregation of voting districts. Socio-economic variables include contemporaneous information on (log) luminosity and (log) population density, urbanization rate, years of schooling, ethnicity, age and share of youth, as well as their 2000 values interacted with year dummies. Geographic variables include presence of mine, road, river, slope index, (log) elevation, (log) ruggedness, (log) area, (log) distance to closest city and (log) distance to fiber backbone interacted with year dummies. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Figure 2: Trends in number of parties and protests by 3G coverage



Notes: Provincial capitals and larger cities are excluded, as well as localities that were covered by 3G in 2006. Lines are re-scaled so that in 2006 the averages for the two subgroups exactly coincide and are equal to 0.

Overall, my findings on the decline in ANC share and the simultaneous gain by the opponents are in line with those obtained by Miner (2015) on the decrease in popularity of the ruling party in Malaysia. However, in contrast to Miner (2015), I find empirical support for the hypothesis that Internet coverage may in fact promote political participation in developing countries. In this respect, my findings partially reconcile with the theory by Campante et al. (2018), suggesting that in the long-run the Internet can become a political tool to reach out and recruit new individuals by newly formed parties. More generally, my results on voter turnout are at odds with what established literature (Falck et al. 2014; Gavazza et al. 2019) has found in developed countries.[27] Finally, my estimates on political competition and protests reconcile with the findings of Manacorda and Tesei (2020), who show that traditional cellphone technologies are instrumental to mass mobilization during economic downturns in Africa.

5.3 Robustness checks

I test the robustness of the baseline estimates to different estimators, clustering and observational units. First, I corroborate my Diff-in-Diff findings using a Propensity Score Matching estimation. Results from this approach are shown in appendix table B.4. Magnitudes of the estimated average treatment effects (ATE) are generally aligned but more attenuated than those from the Diff-in-Diff analysis, yet they remain statistically significant. Second, I check the sensitivity of the standard errors to a different level of clustering. Particularly, I use municipal boundaries to cluster the errors and report the results in table B.5. With the exception of the results on the number of parties, coefficients for all other outcomes remain statistically significant.

Then, I attempt to alleviate concerns about endogenous changes in boundaries and potential measurement error from the construction of the units of analysis. In fact, one potential issue is that 3G coverage may be correlated with strategic re-demarcation interventions, which, in turn, affect political outcomes. To investigate this, first, I replicate the baseline estimation only for those localities whose demarcations remained fairly stable over time. Particularly, I restrict the attention to those voting districts that experienced at maximum 3 changes in their borders between 2000 and 2016.[28] These represent around 8% of the sample. Results from Panel A of table B.6 show that all estimated coefficients are larger than those from the baseline analysis. This points out that places where boundary modifications occurred more frequently - i.e. those where concerns on endogeneity are higher - are not biasing the results upwards. Second, I replicate the estimation using larger observational units. In particular, I aggregate voting districts until their boundaries remain unchanged over time and use these aggregations as units of observations.[29] Panel B of table B.6 shows that when these wider units are employed, estimated coefficients are consistently larger than those from the baseline analysis. Finally,

[27] An exception is Rotesi (2019), who finds a positive impact of Twitter penetration on turnout in the US.

[28] I choose this threshold in order to have sufficient power (observations) for the tests. However, restricting the attention to districts that did not experience any change yields even larger coefficients.

[29] These are the same units that have been used to cluster the standard errors in the baseline specification.

table B.7 shows the results on the sample including provincial capitals and larger cities. In this case, coefficients of interest are very similar to baseline estimates.

5.4 Validation of identifying assumptions

I perform a number of exercises to check the plausibility of the assumptions underlying the identification strategies. The graphical inspection of pre-trends for turnout and ANC vote share reported in figure 1 provides some reassurance on the validity of the parallel trend assumption for these outcomes during 2000-2006. More formally, I conduct placebo regressions. In particular, I regress all electoral outcomes in the years before the expansion of the mobile technology (2000-2006) on the leads of 3G coverage (2006-2016). If the parallel trend assumption holds, then one should find no effects of lead 3G on political variables. Table B.8 provides evidence in favor of this assumption: for all the outcomes, coefficients on lead 3G interacted with the time dummy are never statistically different from zero. This evidence mitigates concerns on the presence of divergent pre-trends in political outcomes across covered and not covered localities.

Then, I perform a test following the procedure developed by Altonji et al. (2005). This strategy is useful in cases in which doubt remains about the exogeneity of the treatment variable. The approach involves two steps. First, I regress 3G coverage on a bunch of potentially relevant predictors (economic, socio-demographic and geographic variables) and then I calculate its fitted values. Second, I regress political outcomes between 2006 and 2016 on the predicted 3G coverage and its interaction with time dummies to assess the extent to which its plausibly endogenous component may affect these outcomes. Table B.9 shows the results from the second step.[30] The coefficients on predicted 3G interacted with time dummies have opposite signs with respect to those from the baseline analysis. Hence, the procedure suggests that the component of 3G coverage explained by the observables is not driving the baseline estimates, alleviating the concern that omitted variables could bias the results in the baseline specification.

Finally, I conduct a placebo exercise to assess the plausibility of the exogeneity of the instrument in the IV estimation. In particular, a reasonable claim is that ruggedness interacted with time may affect political outcomes through different channels, other than 3G coverage. To investigate this, I consider localities with no 3G in 2006, and regress the outcomes of interest between 2000 and 2006 on $log(Ruggedness) * 2006$. For the exogeneity assumption to be valid, the coefficient should not be statistically different from zero. Table B.10 provides mixed evidence on the exogeneity of the instrument. While ruggedness does not predict changes in the parties vote shares and the number of protests, it is significantly and negatively correlated with voter turnout and the number of parties running for elections. These facts raise some concerns on the validity of the IV estimation, and provide further reasons to believe that the Diff-in-Diff approach should be preferred in this context.

[30] The output of the first step is shown in table B.1.

6 Mechanisms

To provide suggestive evidence on the potential mechanisms, I follow Manacorda and Tesei (2020) and attempt to investigate the role of information and coordination as possible drivers of the observed outcomes. Empirically, I exploit additional administrative and survey data, and rely on a triple-difference estimation where, depending on the channel under investigation, specific variables will be interacted with 3G coverage. In particular, I estimate the following regression:

$$\begin{aligned} y_{it} = \; & \beta_0 \, 3\mathrm{G}_{it} + \beta_1 \, 3\mathrm{G}_{it} \times \theta_t + \mathbf{x}_{it}'\beta_2 + (\mathbf{w}_i \times \theta_t)'\beta_3 + \\ & \beta_4 \, 3\mathrm{G}_{it} \times \theta_t \times E_i + \beta_5 \, 3\mathrm{G}_{it} \times E_i + \beta_6 \theta_t \times E_i + \mu_i + \theta_t + \varepsilon_{it} \end{aligned} \tag{3}$$

where the notation used in section 3.2 applies, 3G is the share of area of voting district i covered by 3G and E is a time invariant variable that represents the level of exposure of i to certain socio-economic conditions, depending on the specific channel analyzed. Note that standalone E is omitted from equation 3 because of the inclusion of voting district fixed effects. The main coefficient of interest is β_4, the one associated to the triple-interaction term.

6.1 Information

In order to investigate the information role of mobile Internet, I exploit the spatial variation in the probability of being exposed to the various administrative controversies described in section 2.1. Specifically, I take advantage of two sources of variation. First, I use differences in irregular expenditure across municipalities as a proxy for the quality of the administration of the municipal finances. In places where this expenditure is higher, voters have more reasons for political grievance as they attribute it to mismanagement of public funds (Dlomo, 2017). Second, I use variation in the economic relevance of the mining industry as a proxy for the exposure to mining strikes and the subsequent socio-economic turmoil. Localities where mining plays a significant economic role were more likely to be affected by the long-lasting negative consequences of the strikes. In both cases, most of the times the ANC party was considered accountable for the inappropriate administration. Hence, if mobile Internet is used as a source of information, one should expect the 3G technology to play a bigger role in eroding its popularity in places more exposed to these events.

Empirically, I consider equation 3 and replace E with the exposure to either mismanagement of public funds or mining strikes, alternatively.[31] In the first case, E is the sum of irregular and unauthorized audited municipal expenditure per capita over the 2012-2015 period. In the second case, E is the per capita gross value added (GVA) from mining and quarrying, for each voting district. I also include the per capita aggregate municipal expenditure and GVA as

[31] In this case I focus only on the 2011 and 2016 electoral waves. In fact, data on municipal expenditure are available for years after 2011, and information on the gross value added (GVA) from the mining sector is measured in 2009. At the same time, it is true that mining accidents and scandals occurred much more frequently after 2011. Therefore, in equation 3, θ_t is a dummy which equals 1 if the year is 2016, meaning that the baseline is set in 2011.

controls, respectively. A negative and significant β_4 when y is the ANC share would provide suggestive evidence in favor of the information channel.

Table 5 shows the results. Column (1) of panel A suggests that, among localities with a higher level of irregular expenditure, a unitary increase in coverage causes an additional reduction in the votes for the ANC party of almost 1 percentage point.[32] At the same time, columns (2-3) show that the main gainers from the poor financial administration when 3G is present are smaller and newly formed parties as opposed to the DA, whose vote share is not significantly affected. Finally, while columns (4) and (6) indicate that political participation and protests do not change, column (5) shows that political competition intensifies, as the number of parties running for election increases further.

Table 5: The information channel

Panel A: Diff-in-Diff-in-Diff, years 2011 to 2016; whole sample

	ANC share (1)	DA share (2)	Other parties (3)	Turnout (4)	N. of parties (5)	N. of protests (6)
Irregular Exp*3G*2016	-0.009***	-0.001	0.009**	0.001	0.231**	0.003
	(0.003)	(0.002)	(0.004)	(0.001)	(0.114)	(0.003)
Total Exp*3G*2016	0.011	0.009*	-0.014	-0.008*	-0.100	-0.019**
	(0.011)	(0.005)	(0.011)	(0.005)	(0.324)	(0.009)
Voting Dist FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Province trends	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Observations	69,488	67,658	68,730	69,528	69,528	69,528
Adj. R-squared	0.793	0.903	0.705	0.602	0.870	0.211

Notes - Provincial capitals and larger cities are excluded. Standard errors in parentheses clustered at municipality level. Irregular Exp is the log of total irregular and unauthorized municipal expenditure per capita from 2012 to 2015. Total Exp is the log of income and capital municipal expenditure per capita from 2012 to 2015. All other interactions are included but not reported for conciseness. Controls of column (4) of table 2 are included here. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Panel B: Diff-in-Diff-in-Diff, years 2011 to 2016, whole sample

	ANC share (1)	DA share (2)	Other parties (3)	Turnout (4)	N. of parties (5)	N. of protests (6)
Mining GVA*3G*2016	-0.030***	0.022*	0.007	-0.021*	-0.178	0.012
	(0.011)	(0.013)	(0.010)	(0.011)	(0.328)	(0.014)
GVA*3G*2016	0.001	0.001	-0.002**	-0.002**	0.024	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.017)	(0.002)
Voting Dist FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Province trends	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Observations	69,488	67,658	68,730	69,528	69,528	69,528
Adj. R-squared	0.792	0.903	0.704	0.603	0.866	0.211

Notes - Provincial capitals and larger cities are excluded. Standard errors in parentheses clustered at the smallest stable aggregation of voting districts. Mining is the per capita Gross Value Added from mining and quarrying of the locality. GVA is the per capita Gross Value Added from all sectors. All other interactions are included but not reported for conciseness. Controls of column (4) of table 2 are included here. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

[32] If one exclusively focuses on municipalities where the ANC was ruling (which are anyway the majority) the magnitude of the coefficient does not significantly vary. Results available upon request.

Panel B of table 5 looks at the interaction of 3G with variation in per-capita GVA from mining.[33] Column (1) shows that in localities where the mining industry is more prominent, a unitary increase in 3G coverage causes an additional 3pp reduction in the ANC vote share. Differently from the case of municipal financial irregularities, socio-economic turmoil following the mining strikes favor the second biggest party, i.e. the DA, whose vote share increases by an additional 2.2 pp in mining sites more covered by 3G. This may suggest that individuals are more likely to trust consolidated parties when they face economic downturn, while they prefer new or smaller political entities when mismanagement of public funds is seen as a major problem. Finally, the number of parties and protests remains unchanged, yet overall disaffection towards politics grows, as voter turnout further decreases by 2 pp in localities exposed to mining activities when 3G is present.

In line with the findings by Ferraz and Finan (2008), the above analysis suggests that a segment of the population is informed through mobile Internet about the unsatisfactory administration of public funds and socio-economic issues. Exposure to these facts makes individuals more likely to change their political opinions and subsequent behavior at ballots. The incumbent party is consistently damaged, while different opponents gain depending on the source of the event. Similarly, political participation and electoral competition react differently.

I complement this analysis with descriptive evidence from survey data and information on online activity from Google Trends. First, I use individuals' answers from the 2015 Afrobarometer survey to show how opinions towards the President, the ruling party and the political process differ between Internet users non-users. One limitation is that self-reported Internet usage at the individual level is likely to be correlated with unobserved individual characteristics that directly affect political opinions. To partially address this concern, I combine individuals' exact location from the survey[34] with information on whether the respondent is covered by 3G or not, and instrument self-reported Internet usage with 3G signal reception.[35] I run regressions both in reduced-form and implementing the 2SLS estimation. In both cases, I control for a variety of socio-economic individual-level covariates and province fixed effects.

Table 6 shows that general affection towards politics is not influenced by Internet usage, while ANC affection is negatively associated with it. Moreover, Internet users are less likely to vote for the ANC and more likely to distrust the ruling party. They are also more likely to think that most of the people in the President's office are involved in corruption, that opposition parties are silenced by the incumbent and that elections are unfair. Figure C.7 combines different survey waves to show that divergence in opinions (on trust and corruption) across individuals covered by 3G and not enlarges over time. This is consistent with the fact that many corruption scandals in politics emerged in more recent years and a share of individuals could be exposed to them through mobile Internet.[36]

[33] Figure C.6 shows the geographical dispersion of mining employment and GVA over the country in 2009.

[34] In particular, I use GPS coordinates that I obtained from Afrobarometer upon request.

[35] Although 3G coverage is not exogenous, the variation that this variable provides at the individual level is preferable than self-reported measures of usage or access, as done by Guriev et al. (2019).

[36] Additional evidence from Afrobarometer reported in table B.11 points out that frequent internet usage is indeed positively correlated with a more intense access to information online and through social media platforms.

Table 6: Internet use and political opinions (Afrobarometer, 2015)

	Any party affection			ANC affection			Vote for ANC		
	OLS	OLS	2SLS	OLS	OLS	2SLS	OLS	OLS	2SLS
Internet user	-0.04		-0.31	-0.09**		-0.55*	-0.10***		-0.63**
	(0.02)		(0.27)	(0.04)		(0.31)	(0.04)		(0.32)
Covered by 3G		-0.04			-0.06*			-0.08**	
		(0.03)			(0.03)			(0.03)	
Wald F-stat			19.4			18.3			19.0
Observations	2349	2349	2349	2349	2349	2349	2360	2360	2360
	Distrust president			**Distrust ANC**			**Disapprove president**		
	OLS	OLS	2SLS	OLS	OLS	2SLS	OLS	OLS	2SLS
Internet user	0.07**		0.30	0.07		0.57*	0.11***		0.52
	(0.03)		(0.33)	(0.04)		(0.30)	(0.03)		(0.36)
Covered by 3G		0.04			0.07*			0.05	
		(0.04)			(0.04)			(0.04)	
Wald F-stat			19.5			19.3			17.7
Observations	2345	2345	2345	2339	2339	2339	2313	2313	2313
	President is corrupt			**Opposition is silenced**			**Elections are unfair**		
	OLS	OLS	2SLS	OLS	OLS	2SLS	OLS	OLS	2SLS
Internet user	0.05*		0.77**	0.04		0.91***	0.01		0.51**
	(0.03)		(0.30)	(0.04)		(0.34)	(0.03)		(0.25)
Covered by 3G		0.08**			0.09**			0.06**	
		(0.04)			(0.04)			(0.03)	
Wald F-stat			19.1			17.6			19.2
Observations	2313	2313	2313	2166	2166	2166	2196	2196	2196

Notes - Standard errors in parentheses clustered at the village level. Internet user is a dummy which takes value 1 if the respondent reported to use the Internet for any purpose at least a few times a month. Covered by 3G is a dummy which takes value 1 if the respondent's GPS location was reached by 3G signal at the beginning of 2015. In the 2SLS estimation this variable is used to instrument Internet usage. The Kleibergen-Paap rk Wald F statistic is reported. All regressions include province fixed effects as well as individual-level controls for TV, radio and newspaper use to access information, occupational status, age, education, religion, distance from closest provincial capital/major city. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Finally, I follow Gonzales et al. (2019) and exploit trends in search terms such as "news" and "corruption" relative to a set of similarly common words in the Google search engine to provide evidence on how online news consumption increased over the last 20 years. Figure C.8 shows that online searches for the general term "news" increased over time, especially after the municipal elections that took place in 2011. At the same time, Google queries for the specific word "corruption" became more frequent in certain periods around the 2014 national elections and in some of the subsequent months, reflecting the upsurge in political scandals involving the ANC party. All together, these findings provide additional evidence in support of the information channel.

6.2 Coordination

Another channel through which the Internet could affect politics operates through its capability of fostering communication and increasing coordination among users. In particular, the arrival of the Internet has significantly reduced communication costs between candidates and voters, thus making barriers to entry into politics easier to overcome, especially for parties that lack financial resources.[37] In this respect, one should expect to find a higher number of newly formed parties running in places where 3G is present.[38]

To empirically investigate this, I construct new dependent variables that allow me to distinguish whether the increase in political competition discussed in section 5.2 is driven by new parties or old coalitions running in new places. To do so, I consider a party to be new in years 2006 to 2016 if it did not run in any voting districts during the 2000 municipal election and replicate the Diff-in-Diff and IV estimations. Table 7 presents the results. Columns (1-3) show a positive impact of mobile Internet on the number of new parties running for elections, in the order of about 1 new entrant in the most conservative specification. By contrast, columns (4-6) indicate that old parties are less likely to stand for elections in places more covered by 3G. Figure C.9 corroborates the Diff-in-Diff estimates and offer visual evidence in support of the parallel trend assumption. These results suggests that, by reducing coordination and communication costs, the mobile technology can facilitate political turnover in developing countries, a finding that is in line with the results of Campante et al. (2018) for Italy.

Table 7: The coordination channel

Diff-in-Diff (2006 to 2016), OLS and 2SLS (2000 to 2016), whole sample

	N. of new parties			N. of old parties		
	(1) Diff-in-Diff	(2) OLS	(3) 2SLS	(4) Diff-in-Diff	(5) OLS	(6) 2SLS
3G*2016	1.076***			-0.387**		
	(0.293)			(0.166)		
3G*2011	0.898***			-0.345*		
	(0.188)			(0.197)		
3G	-0.672***	0.973***	3.758***	0.354**	-0.291***	-0.665
	(0.232)	(0.115)	(0.604)	(0.161)	(0.088)	(0.493)
Voting Dist FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Province trends	✓			✓		
Controls	✓	✓	✓	✓	✓	✓
1st stage Wald F-stat			179.0			179.0
Observations	103925	139227	139227	103925	139227	139227
Adj. R-squared	0.793	0.715	0.612	0.777	0.793	0.187

Notes - Provincial capitals and larger cities are excluded. Standard errors in parentheses clustered at the smallest stable aggregation of voting districts. Controls of table 4 are included in columns (1) and (4), while controls of table B.3 are included in columns (2-3) and (5-6). For every voting district-year, new and old parties are defined with respect to those parties existing in year 2000. A party is considered to be new if it did not run in any districts during the 2000 municipal elections. In columns (3) and (6) the instrumental variable is (log) ruggedness*Post, where the latter is a dummy which equals 1 if Year>2005. The associated Kleibergen-Paap rk Wald F-statistic is reported. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Finally, I investigate the heterogeneity of these results across different local conditions that may facilitate the formation of new political parties. For instance, when deciding whether to

[37] Petrova et al. (2021) show that joining Twitter helps politicians in the US raise political donations.

[38] For instance, as discussed by Malherbe (2015), during the 2014 national election campaign, the newly formed party EFF had a much more integrated and deliberate online communication strategy than the ANC. The EFF was also active when it came to building online communities, which are an essential novel tool for political mobilization.

step in or not, entrants may take into account the historical level of political engagement of a locality or the adoption of traditional technologies such as cellphones. Moreover, potential entrants expect higher returns from running in places where the reputation of established parties is questioned by the local community. If there are strategic complementarities between these factors and mobile Internet, then online mobilization and communication campaigns should be more effective in these places, eventually enhancing new party formation even further.

To test this, I use a triple difference estimation as described in equation 3, where E now reflects pre-determined (i.e. measured in 2000) specific local circumstances that may favor new party formation. These are voter turnout, cellphone penetration, the share of votes to ANC opponents, as well as a measure of individuals' ethnic affinity with the ANC leader Jacob Zuma as a proxy for political grievance.[39] Table 8 provides the results.

Table 8: Heterogeneous results on party formation

Diff-in-Diff-in-Diff, years 2006 to 2016, whole sample

	N. of new parties				N. of old parties			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High turnout*3G*2016	0.68**				-0.22			
	(0.28)				(0.14)			
High turnout*2016	-0.32**				0.08			
	(0.14)				(0.06)			
High cellphone*3G*2016		0.42**				-0.10		
		(0.19)				(0.13)		
High cellphone*2016		-0.18				0.03		
		(0.12)				(0.06)		
%Anti-ANC*3G*2016			4.69***				-1.19***	
			(0.56)				(0.36)	
%Anti-ANC*2016			-3.01***				0.26	
			(0.40)				(0.24)	
Zulu*3G*2016				3.26***				-1.76***
				(0.97)				(0.37)
Zulu*2016				-2.04***				0.22
				(0.41)				(0.20)
Voting Dist FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Province trends	✓	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Observations	103,086	103,925	102,960	103,925	103,086	103,925	102,960	103,925
Adj. R-squared	0.80	0.79	0.81	0.80	0.78	0.78	0.78	0.78

Notes - Provincial capitals and larger cities are excluded. Standard errors in parentheses clustered at the smallest stable aggregation of voting districts. High turnout is a dummy variable which equals 1 if the voting district's turnout in 2000 was above the median. High cellphone is a dummy variable which equals 1 if the cellphone penetration in the district in 2000 was above the median. %Anti-ANC is the aggregate share of ANC opponents in 2000. Zulu is a dummy which equals 1 if Zulu is the main ethnic group of the voting district. All other interactions are included but not reported for conciseness. Controls of table 4 are included here. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Columns (1-2) point out that in places where political participation and cellphone penetra-

[39] Zuma belongs to the Zulu ethnicity. During his political career, the leader extensively exploited his Zulu traditions to mobilize voters and gain local support. However, more recently he took advantage of his ethnic origins to cover-up poor personal choices, indiscretions and wrong behavior ("Jacob Zuma President of South Africa". Encyclopædia Britannica. Last update: 19 March 2018).

tion rates are historically larger (above the median in 2000), 3G availability plays an important role in encouraging new parties to stand for elections. Interestingly, interacting 3G coverage with cellphone penetration allows to disentangle the role of new media (e.g., social networks) vs. traditional ICTs (e.g., SMSs) in facilitating coordination and communication.[40] Results in column (2) suggest that, in the absence of 3G, standard cellphone availability is not sufficient to trigger new party formation. By contrast, columns (5-6) indicate that the number of established parties is not affected by these circumstances. Moreover, columns (3-4) show that new parties are more likely to run for elections if mobile Internet is available in places where the support for the ANC is lower. In fact, coefficients on the interaction of 3G with the share of anti-ANC votes and the Zulu ethnicity indicator are positive and statistically significant. Finally, columns (7-8) show that opposite results hold for established coalitions, which are more likely to abandon the political arena when mobile coverage is present and they are more likely to face unfavorable circumstances. Overall, these results provide suggestive evidence on the role of the 3G technology in reducing communication and coordination costs especially in places where the political context is more favorable to new party formation.

6.3 Additional channels

Other mechanisms could be in place. For instance, one may argue that 3G access can impact on political outcomes through the availability of new monitoring technologies at the voting stations and their effect on vote buying. Although I cannot completely rule out this hypothesis, self-reported voting intentions described in table 6 showed that ANC support was much smaller among Internet users. This fact should partially invalidate the proposed channels because voting intentions are independent from possible monitoring at the voting stations.

Another possibility is that the rise of mobile Internet might result in better investigative journalism. This, in turn, may spill over to other traditional media outlets and affect their quality also in localities with low Internet coverage. Insufficient data availability do not allow me to assess whether the overall quality of TV news programs or newspapers improved over time. However, descriptive evidence from surveys might help. If traditional media benefited from improved investigative journalism, then opinions towards the President across traditional media users and non-users should diverge over time also as a result of higher quality. Figure C.10 shows patterns of political opinions (on trust and corruption) for TV and newspapers users and non-users in localities not covered by 3G. Individuals' opinions do not exhibit significantly divergent trends over time, providing no evidence to support the hypothesized channel.

Finally, mobile Internet could affect economic development, for instance through better labor market matching or agglomeration economies and, in turn, this could explain changes in voting behavior. My data do not allow to directly test for this channel.[41] However, because of labor mobility, better economic outcomes in certain localities would attract more workers,

[40] In fact, cellphone penetration is measured in 2000, when no smartphone was available.

[41] Indeed, luminosity is missing for recent years and I linearly extrapolated the information for 2016 to use it as a control variable.

thus resulting in larger population. By contrast, results form table B.12 provide no evidence on the impact of 3G on population density. This might indicate that any change in economic development due to mobile Internet arrival is not substantial, thus partially invalidating the proposed channel.[42]

7 Conclusions

In this paper I analyzed the impact of mobile Internet coverage on political outcomes looking at the South African municipal election results over the 2000-2016 period. I mitigated concerns on potential endogeneity exploiting a newly constructed high-resolution dataset along with two alternative empirical approaches, a Diff-in-Diff and an IV estimation.

My findings demonstrated that the arrival of fast mobile Internet in South Africa led to a decline in the popularity of the incumbent party, and the simultaneous gain of its rivals. These results were accompanied by increased political participation and electoral competition. In fact, 3G coverage positively affected voter turnout and lowered entry costs into politics, as the number of parties running for election increased. Furthermore, 3G-covered localities experienced an upsurge in the number of riots and protests against political institutions. These findings are robust to various model specifications and different estimators.

The overall effect of mobile Internet on political outcomes could be the consequence of increased discontent towards politics amplified by the exposure to online information, as well as the result of better coordination facilitated by lower communication costs. Thus, I complemented the main results with suggestive evidence on these proposed mechanisms. This analysis revealed that (1) the mobile technology provided voters with additional information and this led to a change in their political behavior; (2) the presence of 3G in a locality facilitated political turnover by lowering entry costs into politics for new political parties, as it most likely decreased communication costs with their potential voters.

My paper indicates that mobile Internet might be an effective tool to monitor politicians' performance and promote political accountability and participation in developing countries. More generally, the increasing availability of 3G and 4G technologies suggest that the potential for digital ICTs to foster electoral competition and improve the democratic process in the developing world might be sustained in the long term. Taken together, the observed results offer an optimistic assessment of the possibility of political change through digital media in countries with historically fragile traditional media independence. However, understanding how politicians react to the new technology and whether they become more reactive to the voters' demands remains unclear and is left for future work.

[42] Alternatively, individuals might still live in low-coverage regions but commute for working in 3G-covered and more developed areas. However, this would most likely imply that my estimates represent a lower bound of the true effect.

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Appendix

A Data

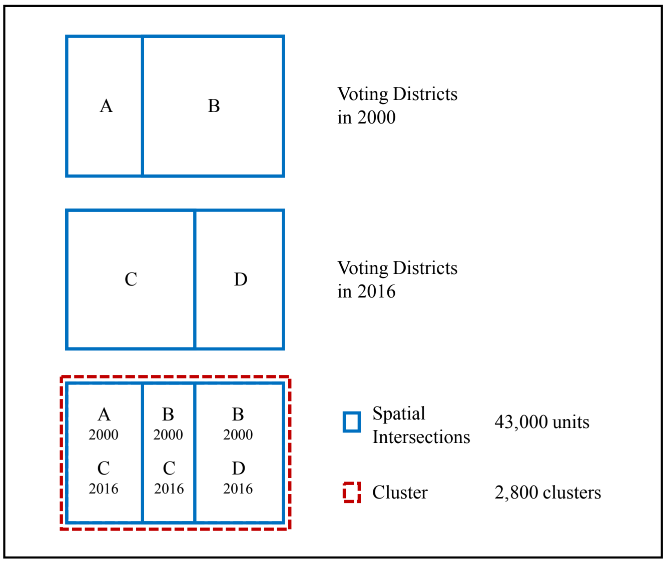
Construction of observational units

The goal of this procedure is to create stable (geographically and time invariant) units of observation. This has two purposes: first, it allows comparability of electoral outcomes over time; second, it solves the problem of endogenous change in the district boundaries. There are to possible ways of creating new units of observations.

The first method focuses on the union of all neighboring districts whose boundaries change over time: I use an algorithm that combine neighboring and mutable voting districts until their spacial union reaches a stable aggregation. The output provides new entities that represent the smallest aggregations of districts whose borders are constant between 2000 and 2016. These are approximately 3,800 clusters, much less than the initial number of voting districts.

The second method, instead, is based on the intersection of initial districts. The procedure is exemplified in figure A.1. The spatial intersection of two initial voting districts whose common border changes over time gives birth to three new entities. For each entity/year I assign the political outcome of the voting district from which it originated, for the respective year. This procedure creates about 43,000 observations per year.

Figure A.1: Construction of observational units



The two methodologies produce two distinct datasets, whose number and size of the observational units largely differ. The first method has the advantage of measuring the political outcome more accurately, as it is simply the sum of the outcome in the initial districts. However, the dimension of the new entities is critical. Most of them are large in size and, in turn, Internet coverage ends up being imprecisely measured. In particular, for each large observation, it becomes impossible to distinguish who is covered and who is not. To some extent, in this case the granularity of my measure of 3G coverage becomes useless and misleading. Therefore, to better take advantage of the high-resolution of the data, I decide to focus on the second procedure. The 43,000 observations/year have much smaller dimensions, hence it becomes possible to precisely attribute average Internet penetration to each of them. Then, to account for correlation in the errors induced by the intersecting procedure, I cluster the standard errors at the level of the smallest stable aggregation, as exemplified by the dashed line in figure A.1.

The procedure provides larger, hence more conservative, standard errors. At the same time, in order to alleviate the suspect of endogenous change in the borders, I replicate the baseline estimation only for those districts whose boundaries remained almost constant over time. For the sake of comparison, I also replicate the analysis using as units of observations the aggregations of voting districts (i.e. those produced by the first method described above). In both cases, estimated coefficients are larger or similar in magnitude to those from the baseline analysis.

Variables description and sources

Variables: Turnout, Vote shares, Vote margins, Number of parties, Population
Source: Independent Electoral Commission[43]
Description: Voting data contains information on the total number of registered voters, the number of those who actually voted, and the number of votes each party got in each voting district for all municipal elections (2000, 2006, 2011, 2016). I used the number of registered voters as a proxy for population for each voting district.

Variable: Mobile Internet coverage
Source: Collins Mobile Coverage Explorer[44]
Description: The dataset comes in GIS vector format and for each country provides 2G, 3G and 4G coverage, separately: each pixel has value 1 if covered, 0 otherwise. In South Africa the geographical precision varies from year to year, with a maximum pixel size of 1km by 1km (up to almost 200m by 200m in the most recent version). I exploit only 3G coverage data since there is practically no variation in 2G or 4G technologies between 2007 and 2015: almost all places had 2G already before 2007, almost no place had 4G in 2015 (nor before). To proxy coverage in 2016 I use Internet coverage in 2015, as this depicts the situation up to December of that year. Similarly, I use coverage in 2007 to proxy for internet penetration in 2006. Measurement error associated to this approximations should be small. On the one hand, municipal elections in 2016 were held on the 3rd of August. The assumption is that 3G coverage did not change abruptly in the months right before elections. If it did, my estimate would represent a lower-bound for the actual effect, as coverage likely expands over time. On the other hand, in the initial years (2007-2009), changes in penetration were extremely marginal. Therefore, is it reasonable to assume that infrastructure status between 2006 and 2007 does not differ significantly.

Variable: Luminosity
Source: National Centers for Environmental Information[45]
Description: Each pixel (1 square kilometer) in the luminosity data is assigned a digital number (DN) representing its luminosity. The DNs are integers that range from 0 to 63. The higher this number, the greater is the economic activity in the pixel. The reader may look at Pinkovskiy and Sala-i Martin (2016) for a recent application of this dataset as a proxy for GDP in Africa. Unfortunately, the last available year for the data is 2013. Hence, I predicted night-light for 2015/16. I exploited linear extrapolation by assuming for each observation a constant growth rate between 2011 and 2015, using the observed growth experienced between 2011 and 2013.

Variable: Number of protests
Source: PRIO/Uppsala Armed Conflict Location and Event (ACLED)[46]

[43] http://www.elections.org.za
[44] http://www.collinsbartholomew.com/mobile-coverage-maps/mobile-coverage-explorer/
[45] http://www.ngdc.noaa.gov/eog/dmsp/downloadV4composites.html
[46] http://www.acleddata.com

Description: The dataset provides information on a variety of characteristics for any kind of conflict event. I restrict the attention to unilateral actions perpetrated by rioters/protesters. This category of events includes demonstrations against a typically political entity, such as a government institution. The event is coded as involving protesters when it is non-violent, and as involving rioters if the demonstrators employ violence. However, I disregard this distinction: I merge the two categories and refer to them as protests. Moreover, I consider only events that took place in the election years and in the preceding one. So, for instance, for year 2000 I use events that happened in 1999 and 2000. Finally, for each locality/year, I compute the total sum of protests.

Variables: Age, Urbanization rate, Years of schooling, Phone/TV/Radio ownership
Source: 2000 and 2011 Census[47]
Description: Information comes at a very disaggregated unit of analysis, called Small Area level: in 2001 and 2011 there were approximately 56,000 and 85,000 of such Small Areas, respectively. I use zonal statistics to compute the average quantity of the variables of interest for each observational unit/year. Since information on 2006 and 2016 does not exist, I interpolate and extrapolate the quantities, respectively, so to create a balanced panel for each locality. Note that I use the 2001 census wave as a proxy for socio-economic characteristics in year 2000.

Variables: Total expenditure, Irregular expenditure
Source: Department of National Treasury[48]
Description: Total expenditure is the sum of municipal income and capital expenditure. For income, I use the Statement of Financial Performance: how a municipality has spent money and received income; for capital, I use expenditure on purchase, repair and renewal of capital assets. I use the sum of irregular and unauthorized expenditure at the municipality level to proxy for the quality of local governance. These are specific amounts from audited financial results, recorded in the notes to the annual financial statements of each municipality. Data are available from 2012 to 2015. For each variable/municipality I construct aggregate measures by summing up the quantities over the years.

Variables: Various geographic information
Data on elevation and ruggedness (as measured by the standard deviation of the elevation) at high resolution come from the Global Multi-resolution Terrain Elevation Data 2010. The dataset is hosted by the Earth Resources Observation and Science (EROS).[49] Moreover, shapefiles containing information on major cities, main roads and waterways come from Open Street Map.[50] Data on mining presence come from the Mineral Resources Data System (MRDS).[51] Information on Gross Value Added from mining and quarrying in 2009 comes from the economic sector maps provided by Quantec and accessible online on the Geospatial Analysis Platform.[52] I follow Hjort and Poulsen (2019) to retrieve information on the terrestrial national fiber backbone infrastructure.[53] Finally, the terrain slope index is borrowed from Nunn and Puga (2012) and geographic data on major ethnic groups come from the GREG database.[54]

[47] http://www.statssa.gov.za
[48] https://www.municipaldata.treasury.gov.za
[49] https://www.topotools.cr.usgs.gov/gmted_viewer/
[50] https://www.openstreetmap.org
[51] https://www.mrdata.usgs.gov/mrds/
[52] https://www.gap.csir.co.za/download-maps-and-data
[53] https://www.africabandwidthmaps.com and https://afterfiber.nsrc.org
[54] https://www.icr.ethz.ch/data/greg/

B Tables

Table B.1: Determinants of 3G coverage

OLS; years 2000 to 2016; whole sample

	3G (share of area covered)	
log(Pop. Density)	0.006**	(0.002)
log(Nightlight)	0.010*	(0.006)
Urbanization	0.062***	(0.015)
Schooling	0.013***	(0.004)
Age	-0.004***	(0.001)
Youths share	-0.014	(0.061)
Mining*2006	0.008	(0.029)
Mining*2011	0.060**	(0.024)
Mining*2016	0.001	(0.020)
Road*2006	0.027***	(0.010)
Road*2011	0.023**	(0.011)
Road*2016	0.034***	(0.012)
Waterway*2006	0.020*	(0.011)
Waterway*2011	0.029**	(0.011)
Waterway*2016	-0.002	(0.017)
log(Elevation)*2006	0.007	(0.007)
log(Elevation)*2011	-0.006	(0.008)
log(Elevation)*2016	0.010	(0.008)
log(Ruggedness)*2006	-0.008**	(0.003)
log(Ruggedness)*2011	-0.014***	(0.005)
log(Ruggedness)*2016	-0.027***	(0.005)
Slope*2006	0.002*	(0.001)
Slope*2011	-0.002	(0.002)
Slope*2016	-0.009***	(0.002)
log(Distance to city)*2006	-0.048***	(0.012)
log(Distance to city)*2011	-0.036**	(0.014)
log(Distance to city)*2016	0.019	(0.015)
log(Area)*2006	0.014**	(0.005)
log(Area)*2011	0.025***	(0.006)
log(Area)*2016	0.005	(0.009)
log(Distance to fiber)*2006	0.007	(0.007)
log(Distance to fiber)*2011	-0.030***	(0.009)
log(Distance to fiber)*2016	-0.006	(0.010)
Phone (in 2000)*2006	0.272***	(0.064)
Phone (in 2000)*2011	0.237***	(0.051)
Phone (in 2000)*2016	0.023	(0.061)
Cellphone (in 2000)*2006	0.118***	(0.037)
Cellphone (in 2000)*2011	0.051	(0.047)
Cellphone (in 2000)*2016	0.160**	(0.068)
ANC share (in 2000)*2006	-0.070***	(0.016)
ANC share (in 2000)*2011	-0.031*	(0.019)
ANC share (in 2000)*2016	0.146***	(0.031)
Voting Dist FE	✓	
Year FE	✓	
Socio-economic trend	✓	
Observations	137,472	
Adj. R-squared	0.667	

Notes - Provincial capitals and larger cities are excluded. Standard errors in parentheses clustered at the smallest stable aggregation of voting districts. Socio-economic variables measured in 2000 and interacted with time dummies are included. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table B.2: Descriptive statistics: final sample

Variabe	Year	Obs	Mean	Median	Std. Dev.	Min	Max
3G (share of area covered)	2000	34988	0.00	0	0	0	0
3G (share of area covered)	2006	34988	0.10	0	0.29	0	1
3G (share of area covered)	2011	34988	0.22	0	0.38	0	1
3G (share of area covered)	2016	34988	0.60	0.71	0.41	0	1
ANC share	2000	34590	0.60	0.70	0.29	0	1
ANC share	2006	34615	0.68	0.80	0.28	0	1
ANC share	2011	34986	0.68	0.78	0.26	0	1
ANC share	2016	34970	0.63	0.69	0.24	0	1
DA share	2000	27789	0.15	0.04	0.23	0	1
DA share	2006	31187	0.10	0.02	0.19	0	1
DA share	2011	34071	0.13	0.03	0.22	0	1
DA share	2016	34970	0.14	0.03	0.23	0	1
Other parties share	2000	33071	0.26	0.13	0.28	0	1
Other parties share	2006	34437	0.20	0.10	0.24	0	1
Other parties share	2011	34604	0.17	0.09	0.21	0	.99
Other parties share	2016	34970	0.21	0.16	0.17	0	1
Turnout	2000	34632	0.51	0.51	0.15	0	1
Turnout	2006	34619	0.53	0.53	0.13	0	1
Turnout	2011	34988	0.57	0.58	0.12	0	1
Turnout	2016	34988	0.57	0.57	0.11	0	1
N. of parties	2000	34632	4.56	4	2.54	2	14
N. of parties	2006	34619	6.57	6	3.78	2	23
N. of parties	2011	34988	7.96	7	4.23	2	33
N. of parties	2016	34988	9.92	9	5.48	3	36
N. of protests	2000	34988	0.000	0	0.02	0	2
N. of protests	2006	34988	0.001	0	0.04	0	4
N. of protests	2011	34988	0.003	0	0.07	0	6
N. of protests	2016	34988	0.019	0	0.36	0	27
Luminosity	2000	34988	9.09	2.65	15.09	0	63
Pop. density	2000	34988	725.35	275.20	1001.46	.002	4797
Urbanization rate	2001	34988	0.12	0	0.30	0	1
Years of schooling	2001	34988	4.95	4.75	1.79	0	16
Age	2001	34988	26.28	25.80	5.55	0	82.5
Youth share (14<age<30)	2001	34988	0.27	0.27	0.08	0	1
Zulu main ethnic group		34764	0.21	0	0.41	0	1
Phone (share of households)	2001	34988	0.11	0.04	0.16	0	1
Cellphone (share of households)	2001	34988	0.20	0.16	0.16	0	1
TV (share of households)	2011	34988	0.45	0.45	0.28	0	1
Radio (share of households)	2011	34988	0.52	0.57	0.24	0	1
GVA from mining (Millions, Rpc)	2009	34988	0.04	0.00	0.40	0	28
Total GVA (Millions, Rpc)	2009	34988	0.47	0.08	1.86	0	110
Irregular expenditure (Rpc)	2011-2014	234	3961	1510	13701	0	204008
Total expenditure (Rpc)	2011-2014	234	18416	15866	15079	2257	100333
Elevation (m)		34988	921.62	976.08	469.29	0	2546
Ruggedness (m^2)		34988	38.79	23	45.39	0	551
Area (km^2)		34988	20.14	2.58	61.52	.25	654
Distance to city (km)		34988	123.05	112.13	74.61	15	646
Distance to fiber (km)		34988	11.24	7.68	12.37	0	218
Road (yes/no)		34988	0.11	0	0.31	0	1
River (yes/no)		34988	0.04	0	0.20	0	1
Mine (yes/no)		34988	0.01	0	0.10	0	1

Notes - Population is proxied by the number of registered voters. GVA is gross value added, Rpc stands for Rounds per capita.

Table B.3: IV estimates of the impact of 3G on other political outcomes

OLS and 2SLS; years 2000 to 2016; whole sample

	DA share			Other parties share		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	2SLS	2SLS	OLS	2SLS	2SLS
3G	0.003	-0.028	-0.028	0.056***	0.206***	0.196***
	(0.003)	(0.018)	(0.019)	(0.007)	(0.042)	(0.042)
Voting Dist FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Controls			✓			✓
Mean in 2000	0.15	0.15	0.15	0.26	0.26	0.26
log(ruggedness)*Post		-0.11	-0.10		-0.10	-0.09
1st stage F-stat		142.2	146.4		132.0	133.3
Observations	127489	127489	127489	137069	137069	137069
Adj. R-squared	0.801	0.038	0.041	0.684	-0.007	0.017
	N. of parties			N. of protests		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	2SLS	2SLS	OLS	2SLS	2SLS
3G	0.923***	3.622***	3.347***	0.003*	0.034***	0.020**
	(0.157)	(0.592)	(0.570)	(0.002)	(0.009)	(0.009)
Voting Dist FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Controls			✓			✓
Mean in 2000	4.56	4.56	4.56	0.00	0.00	0.00
log(ruggedness)*Post		-0.09	-0.09		-0.09	-0.09
1st stage F-stat		137.2	141.8		139.1	144.2
Observations	139227	139227	139227	139952	139952	139952
Adj. R-squared	0.816	0.522	0.539	0.088	0.001	0.004

Notes - Provincial capitals and larger cities are excluded. Standard errors in parentheses clustered at the smallest stable aggregation of voting districts. Controls include contemporaneous information on (log) luminosity and (log) population density, urbanization rate, years of schooling, ethnicity, age and share of youth, as well as (log) area, (log) distance to closest city and (log) distance to fiber backbone interacted with year dummies. Coefficient on the instrumental variable from the first stage regression and the respective Kleibergen-Paap rk Wald F-statistic are reported. Post is a dummy which equals 1 if Year>2005. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table B.4: Average Treatment Effects of 3G on political outcomes

Propensity Score Matching; years 2006 to 2016; whole sample

	ANC share	DA share	Other parties	Turnout	N. of parties	N. of protests
	(1)	(2)	(3)	(4)	(5)	(6)
ATE in 2016						
Covered vs. Not	-0.014***	0.006**	0.006	0.007*	0.246**	0.015***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.107)	(0.002)
ATE in 2011						
Covered vs. Not	-0.033***	0.015***	0.019***	0.006	-0.058	0.002**
	(0.010)	(0.004)	(0.007)	(0.006)	(0.064)	(0.001)
Observations	34219	30424	33698	34224	34224	34368

Notes - Provincial capitals and larger cities are excluded. Robust Abadie-Imbens standard errors in parentheses. A locality is considered Covered in a given year if the share of area covered by 3G≥0.5 in that year. In all columns the propensity of being covered is estimated using (log) luminosity, (log) population density, urbanization rate, years of schooling, ethnicity, age, share of youth and ANC vote share all measured in 2000; as well as an indicator variable for the presence of a road, (log) elevation, (log) ruggedness, (log) area and (log) distance to closest city.* Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table B.5: Diff-in-Diff estimates with standard errors clustered at municipality level

OLS; years 2006 to 2016; whole sample						
	ANC share	DA share	Other parties	Turnout	N. of parties	N. of protests
	(1)	(2)	(3)	(4)	(5)	(6)
3G*Year 2016	-0.031*	0.027**	0.004	0.021*	0.689	0.033***
	(0.018)	(0.011)	(0.019)	(0.011)	(0.661)	(0.011)
3G*Year 2011	-0.011	0.022**	-0.010	0.016	0.553	0.015**
	(0.015)	(0.010)	(0.015)	(0.011)	(0.585)	(0.006)
3G	0.002	-0.020*	0.020	-0.021**	-0.318	-0.031***
	(0.014)	(0.011)	(0.015)	(0.009)	(0.612)	(0.012)
Voting Dist FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Province trends	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Observations	103,901	99,562	103,344	103,925	103,925	104,292
Adj. R-squared	0.756	0.847	0.717	0.514	0.853	0.132

Notes - Provincial capitals and larger cities are excluded. Standard errors in parentheses clustered at the municipality level. Controls in all columns include: contemporaneous information on (log) luminosity and (log) population density, urbanization rate, years of schooling, ethnicity, age and share of youth, as well as their 2000 values interacted with year dummies, indicators variables for the presence of mine, road and river, slope index, (log) elevation, (log) ruggedness, (log) area, (log) distance to closest city and (log) distance to fiber backbone interacted with year dummies. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table B.6: Sensitivity of the Diff-in-Diff estimates to different observational units

Panel A: Results using voting districts with mostly stable demarcations; OLS; years 2006 to 2016

	ANC share	DA share	Other parties	Turnout	N. of parties	N. of protests
	(1)	(2)	(3)	(4)	(5)	(6)
3G*Year 2016	-0.043**	0.027*	0.010	0.022**	2.001***	0.116*
	(0.019)	(0.014)	(0.016)	(0.010)	(0.428)	(0.066)
3G*Year 2011	0.026	0.031**	-0.055***	0.010	0.716**	0.063**
	(0.017)	(0.012)	(0.014)	(0.011)	(0.334)	(0.026)
3G	-0.023	-0.025*	0.055***	-0.013	-1.341***	-0.108*
	(0.016)	(0.013)	(0.013)	(0.009)	(0.329)	(0.059)
Voting Dist FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Province trends	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Observations	8236	8064	8218	8236	8236	8256
Adj. R-squared	0.819	0.917	0.757	0.621	0.902	0.167

Notes - The sample includes only localities that experienced at maximum 3 changes in their demarcations between 2000-2016. These are almost 8% of the initial sample. Standard errors in parentheses clustered at the smallest stable aggregation of voting districts. Controls are the same of table B.5. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Panel B: Results using aggregations of voting districts; OLS; years 2006 to 2016

	ANC share	DA share	Other parties	Turnout	N. of parties	N. of riots
	(1)	(2)	(3)	(4)	(5)	(6)
3G*Year 2016	-0.139***	0.095***	0.039	0.050***	3.883***	0.473**
	(0.036)	(0.030)	(0.034)	(0.016)	(1.431)	(0.229)
3G*Year 2011	-0.055*	0.089***	-0.036	0.036**	2.008	0.236**
	(0.029)	(0.033)	(0.033)	(0.015)	(1.381)	(0.109)
3G	0.048	-0.074**	0.033	-0.043***	-3.226**	-0.359*
	(0.029)	(0.032)	(0.029)	(0.015)	(1.359)	(0.184)
Voting Dist FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Province trends	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Observations	8831	8831	8831	8831	8831	8868
Adj. R-squared	0.837	0.923	0.774	0.720	0.904	0.288

Notes - The units of observations are the smallest aggregations of voting districts whose boundaries do not change over time. These units have been used to cluster the standard errors in the baseline specification. Provincial capitals and larger cities are excluded. Standard errors in parentheses clustered at municipality level. Controls are the same of table B.5. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table B.7: Diff-in-Diff estimates including provincial capitals and larger cities

OLS; years 2006 to 2016; whole sample including provincial capitals and larger cities

	ANC share	DA share	Other parties	Turnout	N. of parties	N. of protests
	(1)	(2)	(3)	(4)	(5)	(6)
3G*Year 2016	-0.031**	0.034***	-0.003	0.018*	0.863***	0.057**
	(0.012)	(0.006)	(0.012)	(0.009)	(0.279)	(0.023)
3G*Year 2011	-0.012	0.027***	-0.014*	0.013*	0.627**	0.037***
	(0.009)	(0.005)	(0.008)	(0.007)	(0.263)	(0.012)
3G	0.005	-0.027***	0.024***	-0.018**	-0.559**	-0.051***
	(0.009)	(0.005)	(0.008)	(0.008)	(0.246)	(0.020)
Voting Dist FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Province trends	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Mean in 2006	0.682	0.113	0.191	0.525	7.191	0.002
Observations	127584	122026	126915	127617	127617	128100
Adj. R-squared	0.778	0.870	0.702	0.524	0.889	0.294

Notes - Standard errors in parentheses clustered at the smallest stable aggregation of voting districts. Controls are the same of table B.5. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table B.8: Diff-in-Diff Placebo regressions

OLS; years 2000 to 2006; whole sample

	ANC share	DA share	Other parties	Turnout	N. of parties	N. of protests
	(1)	(2)	(3)	(4)	(5)	(6)
Lead 3G*2006	-0.004	0.003	0.005	-0.014	0.302	-0.003
	(0.015)	(0.007)	(0.014)	(0.010)	(0.225)	(0.002)
Lead 3G	-0.019	0.011	0.006	0.003	-0.338*	0.002
	(0.012)	(0.007)	(0.011)	(0.008)	(0.197)	(0.002)
Voting Dist FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Province trends	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Observations	68,440	54,256	65,156	68,532	68,532	69,528
Adj. R-squared	0.793	0.804	0.827	0.378	0.905	0.001

Notes - Provincial capitals and larger cities are excluded. To compute Lead 3G, I assign the value of 3G coverage in 2006 to year 2000, and the value of 3G coverage in 2016 to year 2006. Standard errors in parentheses clustered at the smallest stable aggregation of voting districts. Controls of column (4) of table 2 are included here. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table B.9: Diff-in-Diff using the Altonji, Elder and Taber (2005) procedure

OLS; years 2006 to 2016; whole sample						
	ANC share	DA share	Other parties	Turnout	N. of parties	N. of protests
	(1)	(2)	(3)	(4)	(5)	(6)
Predicted 3G*2016	0.231***	-0.353***	0.094*	-0.573***	-1.294	-0.295***
	(0.046)	(0.029)	(0.049)	(0.031)	(1.189)	(0.048)
Predicted 3G*2011	0.458***	-0.284***	-0.189***	-0.499***	-5.007***	-0.260***
	(0.052)	(0.033)	(0.060)	(0.031)	(1.235)	(0.042)
Predicted 3G	-0.349***	0.268***	0.122**	0.518***	0.466	0.187***
	(0.051)	(0.027)	(0.049)	(0.030)	(1.019)	(0.030)
Voting Dist FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Province trends	✓	✓	✓	✓	✓	✓
Observations	103,901	99,033	103,321	103,925	103,925	104,292
Adj. R-squared	0.734	0.840	0.688	0.468	0.834	0.129

Notes - Provincial capitals and larger cities are excluded. Standard errors in parentheses clustered at the smallest stable aggregation of voting districts. Predicted 3G is the linear prediction of the share of area covered by 3G in each district. The regression output of the linear prediction is reported in table B.1. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table B.10: IV Placebo regressions

OLS; years 2000 to 2006; only localities with no 3G coverage in 2006						
	ANC share	DA share	Other parties	Turnout	(log) N. of parties	N. of protests
	(1)	(2)	(3)	(4)	(5)	(6)
log(Ruggedness)*2006	-0.001	-0.003	0.002	-0.004*	-0.112***	-0.000
	(0.003)	(0.002)	(0.004)	(0.002)	(0.032)	(0.000)
Voting Dist FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Observations	59,354	45,356	56,150	59,442	59,442	60,428
Adj. R-squared	0.782	0.721	0.829	0.341	0.849	0.000

Notes - Provincial capitals and larger cities are excluded. Standard errors in parentheses clustered at the smallest stable aggregation of voting districts. Localities covered by 3G in 2006 are excluded from the analysis. Controls are the same of table B.3. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table B.11: Internet use and information acquisition (Afrobarometer, 2015)

Panel A: Extensive margin - whole sample

	Y=1 if respondent regularly accesses to information through:				
	Internet	Social media	Newspapers	Television	Radio
Internet user	0.605***	0.548***	0.212***	0.056***	0.039*
	(0.022)	(0.029)	(0.030)	(0.017)	(0.024)
Observations	2357	2358	2362	2364	2364

Notes - Standard errors in parentheses clustered at the village level. Province fixed effects included in all regressions. Controls include occupational status, age, education, religion, distance from closest provincial capital/major city. The dependent variables take value 1 if the respondent reported to use the respective media to access information at least a few times a month. Internet user is a dummy which takes value 1 if the respondent reported to use the Internet for any purpose at least a few times a month.* Significant at 10%, ** significant at 5%, and *** significant at 1%.

Panel B: Intensive margin - only respondents who use the Internet at least a few times a week

	Y = N. of days per month the respondent accesses to information through:				
	Internet	Social media	Newspapers	Television	Radio
Use Internet everyday = 1 (vs. a few times a week = 0)	7.879***	7.061***	1.025	-0.777*	-0.490
	(0.681)	(0.844)	(0.937)	(0.462)	(0.758)
Observations	1108	1109	1109	1109	1109

Notes - Standard errors in parentheses clustered at the village level. Province fixed effects included in all regressions. Controls include occupational status, age, education, religion, distance from closest provincial capital/major city. The dependent variables count the number of days in a month the respondent reported to use the respective media to access information. These are computed from the categorical variables as follows: Everyday = 28 days, A few times a week = 12 days, A few times a month = 4 days, Less than once a month = 1 day, Never = 0 days. The main independent variable is a dummy which takes value 1 if the respondent reported to use the Internet for any purpose everyday, and 0 if she uses the Internet only a few times a week.* Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table B.12: Internet coverage and population density

Dependent variable is: log(population density)

	Diff-in-Diff: 2006-2016	OLS: 2000-2016	2SLS: 2000-2016
	(1)	(2)	(3)
3G*Year 2016	0.032		
	(0.030)		
3G*Year 2011	-0.000		
	(0.028)		
3G	-0.023	-0.008	0.086
	(0.027)	(0.012)	(0.102)
Years of coverage			
Voting Dist FE	✓	✓	✓
Year FE	✓	✓	✓
Province trends	✓		
Controls	✓	✓	✓
1st stage Wald F-stat			183.2
Observations	104292	139056	139952
Adj. R-squared	0.951	0.931	0.018

Notes - Provincial capitals and larger cities are excluded. Standard errors in parentheses clustered at the smallest stable aggregation of voting districts. Controls of table B.5 are included in column (1), while controls of table B.3 are included in columns (2-3), with the exception of population density, which is the dependent variable. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

C Figures

Figure C.1: Mobile internet coverage 2007-2015 (Raw data from Collins Bartholomew)

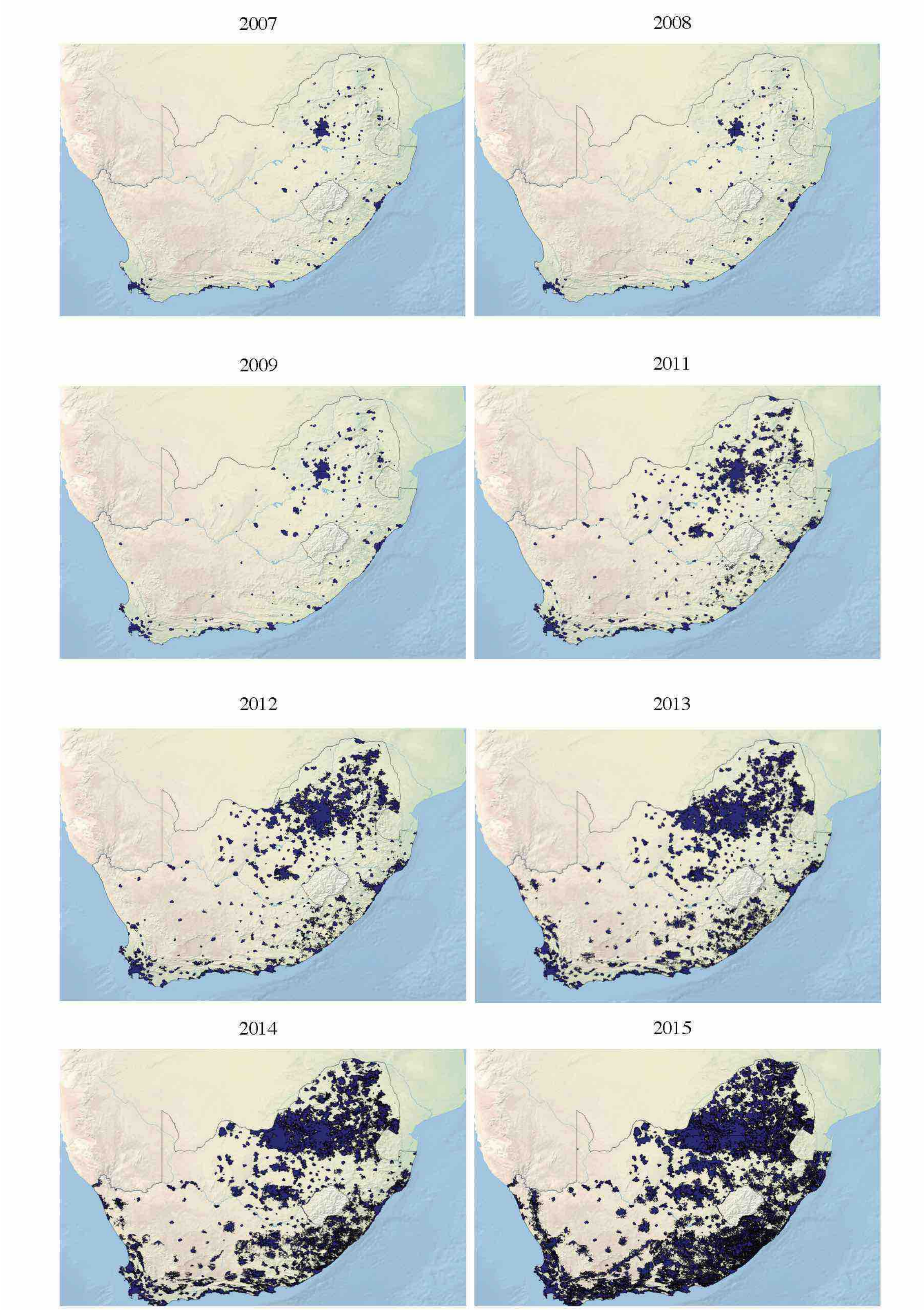
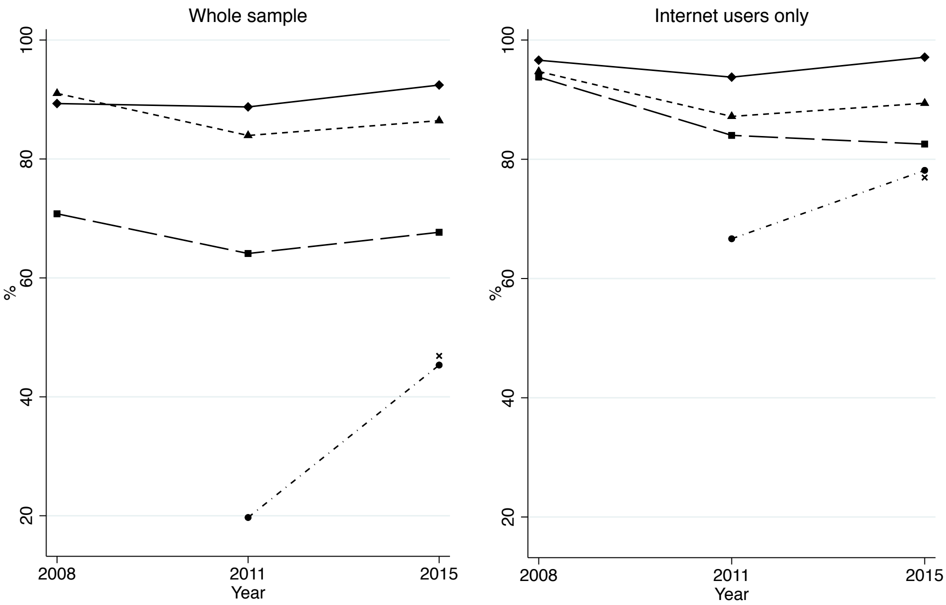
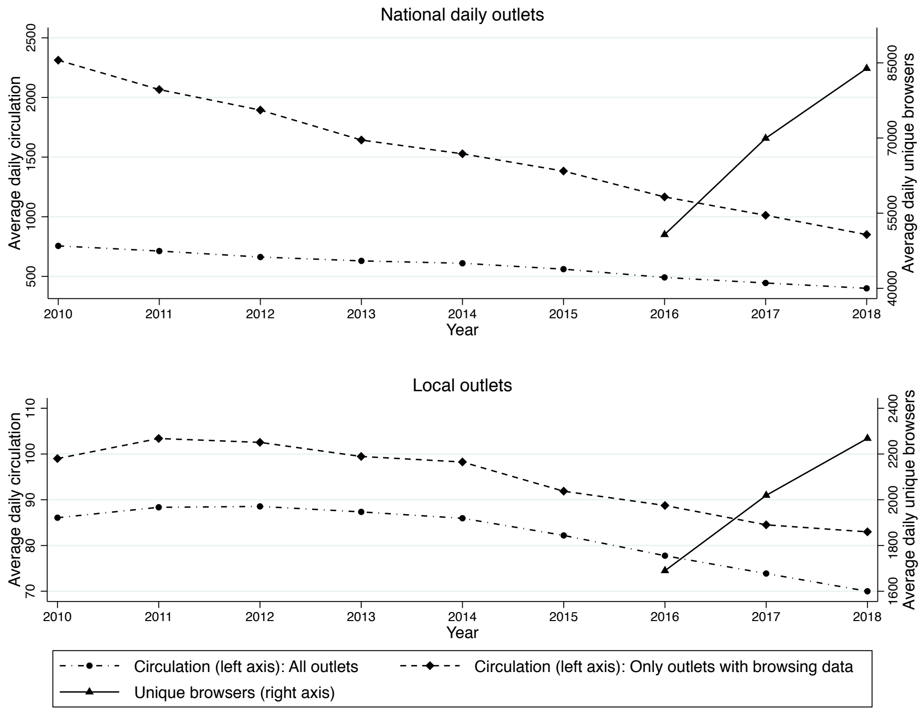


Figure C.2: Access to information by type of media



Notes: Author's own calculations based on Afrobarometer. The figure shows the share of people who reported to use each type of media to access information at least a few times a month. This is shown for the entire sample, and for a subsample of Internet users only.

Figure C.3: National and local newspapers circulation



Notes: Author's own calculations based on data from the Audit Bureau of Circulations of South Africa. Average daily circulation in a year is computed from quarterly information as follows. For each quarter, I divide the total number of printed copies sold by the total number of days in the quarter, irrespectively of the frequency of publication. I then take the average of the resulting number over the year.

Figure C.4: Mobile phone technology

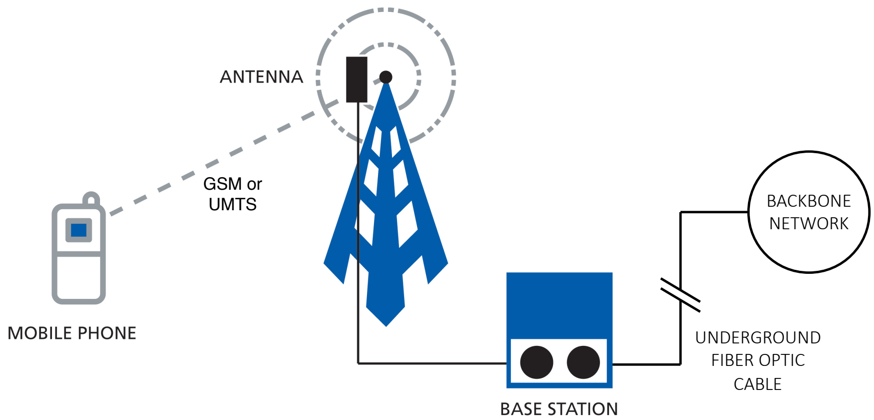


Figure C.5: Share of area covered by 3G

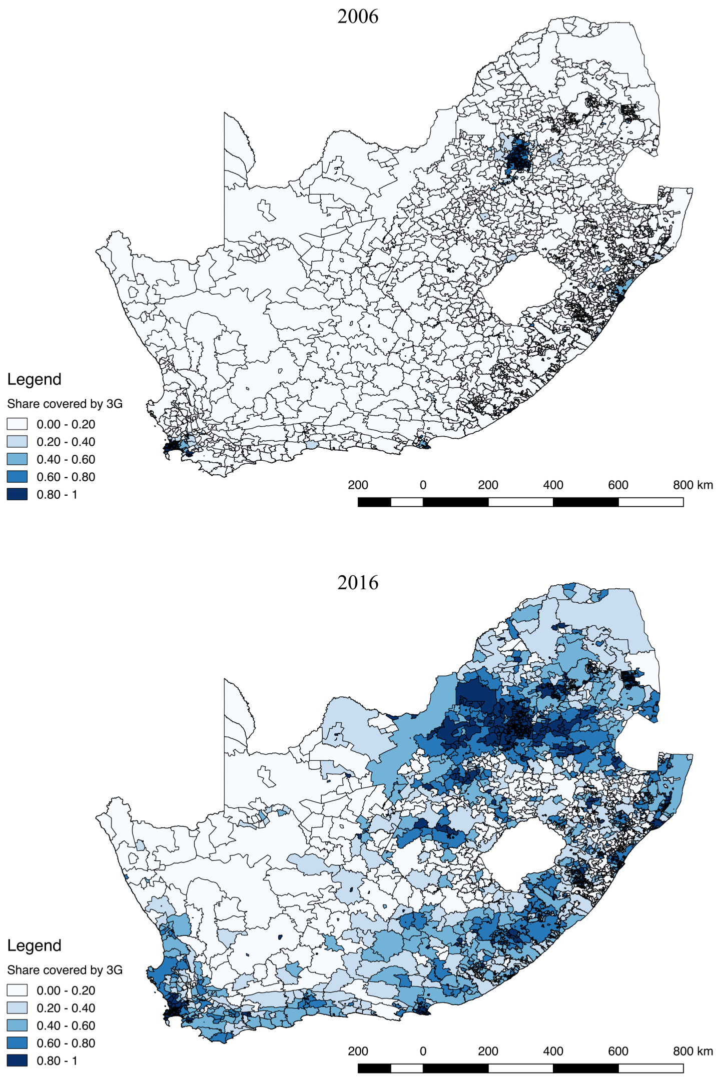
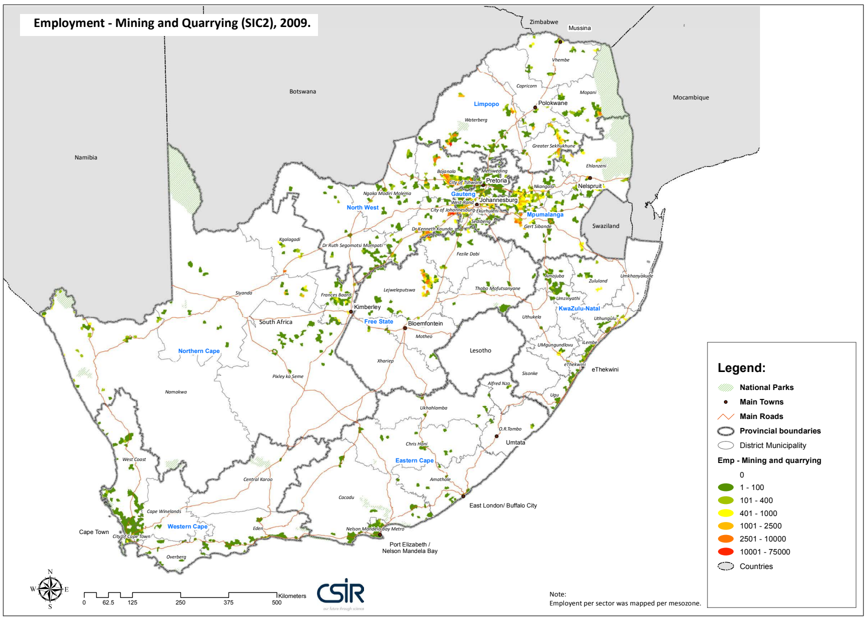


Figure C.6: Economic relevance of the mining industry (2009)



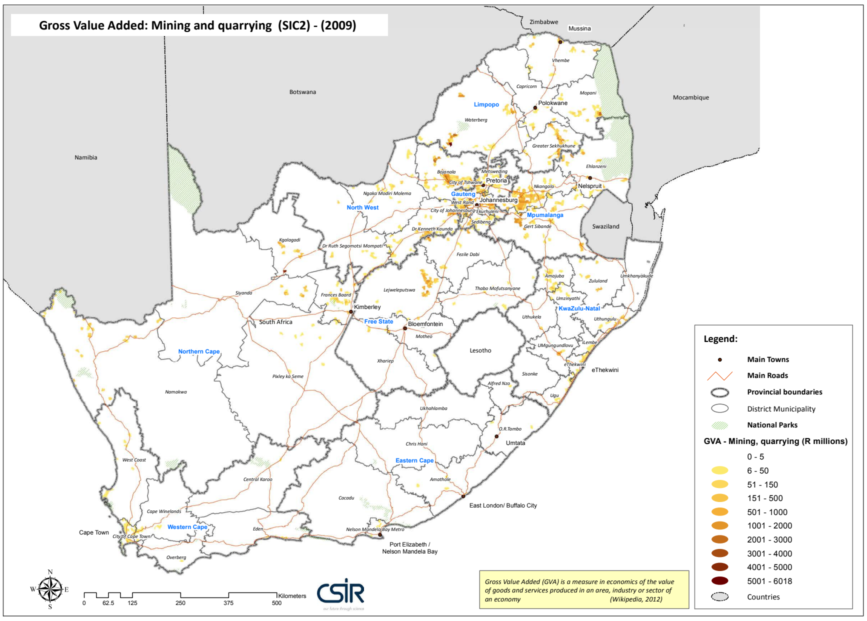


Figure C.7: 3G coverage and political opinions over time (Afrobarometer)

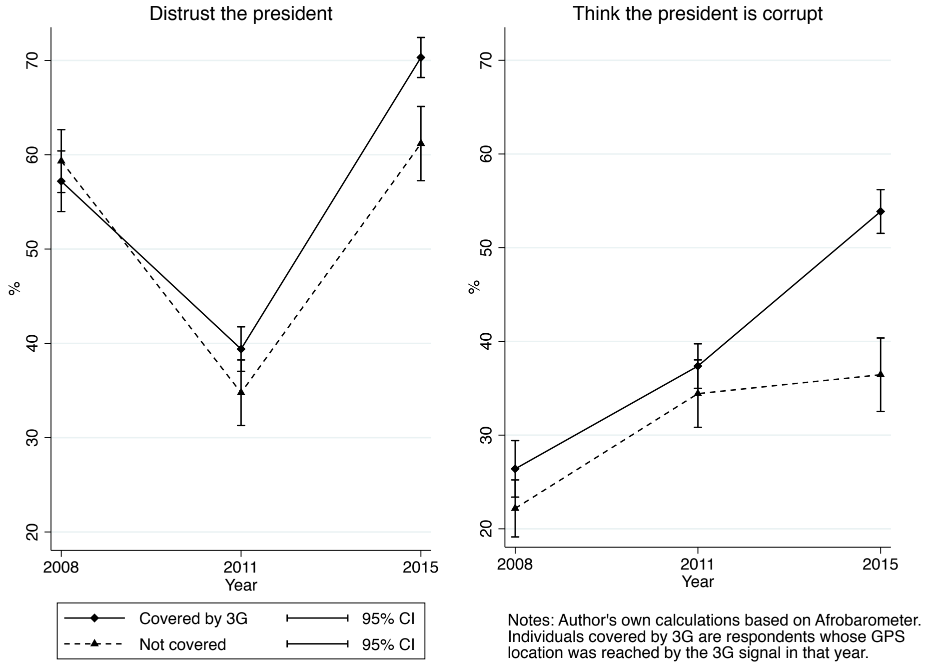
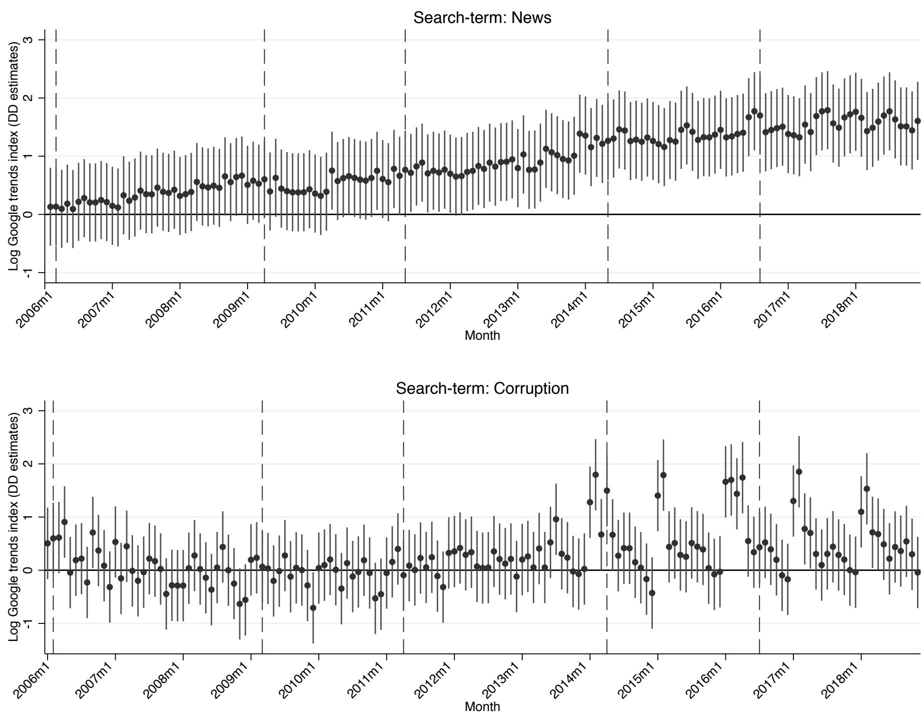
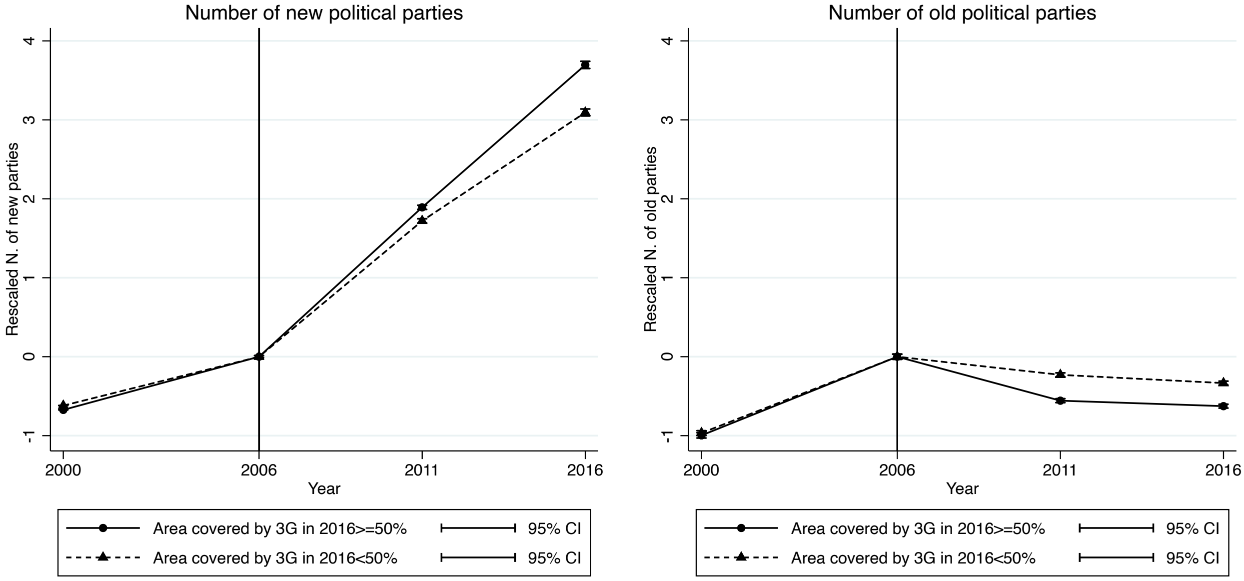


Figure C.8: Online information acquisition (monthly level)



Notes: The graph shows point estimates and 95% confidence intervals of a regression of the natural log of a search-term popularity index from Google trends on a full set of month dummies interacted with an indicator for search terms "news" (top panel) or "corruption" (bottom panel). Regression includes search-term and month fixed effects. The omitted month is January 2006. Regressions includes 3,432 observations from 22 search terms. The most conservative standard errors are used to construct the confidence intervals. The vertical dashed lines indicate the months in which national and municipal elections took place. The list of search terms included in the reference group reflects the general categories identified by Google. These are: Arts, Beauty, Books, Business, Cars, Computers, Finance, Fitness, Food, Games, Health, Hobbies, Home, Internet, Jobs, Law, Pets, Science, Shopping, Sports and Travel.

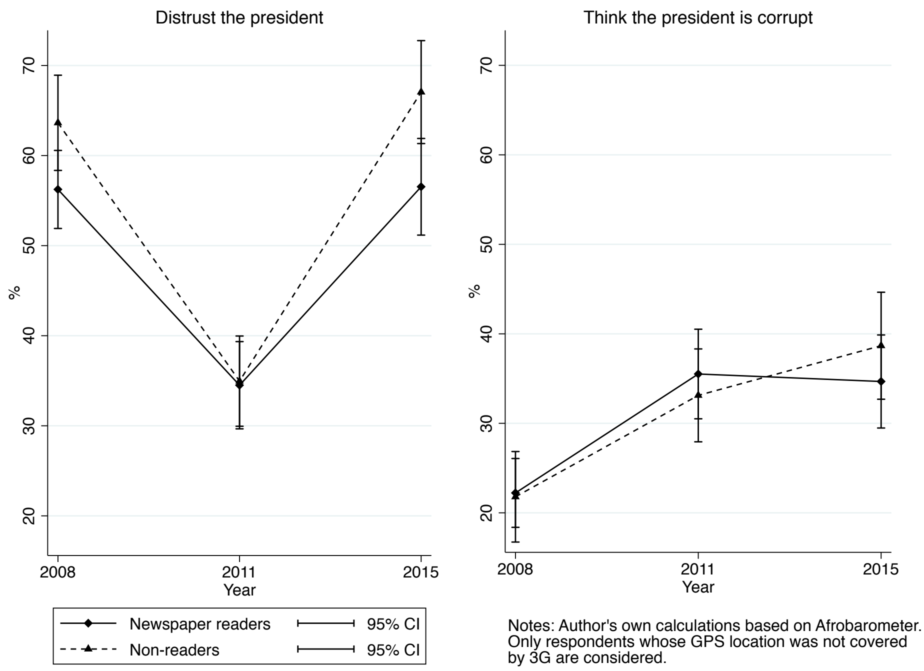
Figure C.9: Trends in number of new and old parties by 3G coverage



Notes: Provincial capitals and larger cities are excluded, as well as localities that were covered by 3G in 2006. Lines are re-scaled so that in 2006 the averages for the two subgroups exactly coincide and are equal to 0. A party is considered to be new if it did not run in any districts during the 2000 municipal elections.

Figure C.10: Traditional media use and political opinions over time (Afrobarometer)

(a) Opinions by newspaper readership to access information



(b) Opinions by TV use to access information