The role of media networks in compensating political biases: evidence from radio networks in Brazil *

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Abstract

A central question in political economy is how to incentivize elected officials to allocate resources to those that need them the most. Research has shown that, while electoral incentives lead central governments to transfer fewer funds to non-aligned constituencies, media presence is instrumental in promoting a better allocation of resources. This study evaluates how these two phenomena interact by analyzing the role of media in compensating political biases. In particular, we analyze how media presence, connectivity and ownership affect the distribution of federal drought relief transfers to Brazilian municipalities. We find that municipalities that are not aligned with the federal government have a lower probability of receiving funds conditional on experiencing low precipitation. However, we show that the presence of radio stations compensates for this bias. This effect is driven by municipalities that have radio stations connected to a regional network rather than by the presence of local radio stations. In addition, the effect of network-connected radio stations increases with their network coverage. These findings suggests that the connection of a radio station to a network is important because it increases the salience of disasters, making it harder for the federal government to ignore non-allies. We show that our findings are not explained by the ownership and manipulation of media by politicians.

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1 Introduction

A central question in political economy is how to incentivize elected officials to allocate resources to those that need them the most. Theoretical work shows that politicians might distort the allocation of funds to increase the likelihood of remaining in office (Lizzeri and Persico [2001], Larreguy [2013]). A common example occurs in the allocation of federal grants. Extensive evidence points out that central governments often favor political allies and/or distribute fewer resources to nonaligned constituencies (Snyder and Ansolabehere [2006], Arulampalam et al. [2009], Berry et al. [2010], Brollo and Nannicini [2012]). Additionally, the literature shows that media presence is instrumental to hold politicians accountable and to promote a better allocation of public funds (Besley and Burgess [2002], Stromberg [2004], Snyder and Stromberg [2010], Bruns and Himmler [2011], Costas-Pérez et al. [2011]). We study the interaction of these two phenomena by analyzing the role of the media in compensating political biases. In particular, we analyze how media presence, connectivity and ownership affect the distribution of federal drought relief transfers to Brazilian municipalities.

The allocation of federal transfers for disaster relief in Brazil offers an interesting setting to analyze this question as it is subject to significant red tape, which allows political discretion. There is no automatic rule that determines that municipalities should receive support in the event of a natural disaster. Instead, municipalities need to request aid from the federal government and provide extensive documentation to prove that they have been severely affected by a disaster and do not have the financial ability to deal with it. This bureaucratic process allows the federal government to support allies and/or not to help to non-allies.

In Brazil voters receive information about disasters and the responsiveness of the federal government to the disasters from the media. Local and regional issues are usually discussed by commercial radio stations, which broadcast the bulk of local news in Brazilian municipalities. Most radio stations are independent and just reach a local audience but a share of them are connected to regional networks. These radio stations are connected to a central station that collects and organizes information, which it then distributes by satellite to local stations. Therefore, a radio station that is connected to network can both receive information about other places and add content that is considered relevant to a larger regional audience. We study how the presence of a network-connected radio station affects federal disaster relief response through its ability to spread local news to a larger audience.

To guide the empirical analysis, we develop a simple model in which a federal government decides how much disaster relief support it allocates to a municipality that experiences a drought, based on its own electoral incentives and on the opportunity cost of providing these funds. The effective aid an affected municipality receives depends on the funds it gets and the ability of the federal government to manage the drought aid. Voters learn about the federal government's performance, infer the ability of the party that controls the government, and decide whether to reelect it or replace it by another party. Voters rely on radio stations to learn about the federal government's performance. While local and network-connected radio stations spread this information to voters in the affected municipality, the radio stations connected to a network are also able to disseminate it to unaffected voters.

The model characterization shows that, to maximize its electoral chances, the federal government favors aligned constituencies, whose vote is more responsive to the federal government's performance. However, the model predicts that, while the presence of both local and network-connected radio stations increase the probability non-allies receive federal support, the radio stations connected to a network have a bigger effect than the local radio stations. Additionally, the model predicts that the effect of network-connected radio stations increases with the extent of their network coverage and the share of the federal government supporters reached by their news.

We test the model's predictions by investigating how non-alignment to the federal government and media presence affects the probability of receiving federal support conditional on experiencing low rainfall. Our main outcome variable is an indicator of whether the federal government declares a municipality state of emergency, which is a necessary condition for a municipality to receive federal support.[1] Our identification strategy relies on the plausibly exogenous levels of precipitation and identity of the winning party in close municipal elections. The level of rainfall a given municipality experiences over the period under analysis varies, and the lower the level, the higher the likelihood that the municipality receives federal support upon request. Changes in municipal alignment to the federal government take place every two years due to the timing of municipal and federal elections. Additionally, we exploit variation in the presence of local and network-connected radio stations across municipalities.[2]

Our core results are as follows. First, we find that municipalities that are not aligned to the federal government have a lower probability of receiving relief funds conditional on experience low precipitation. Second, we show that the presence of a radio station compensates this bias. Third, we provide evidence that this effect is driven by municipalities that have radio stations connected to a regional network rather than by the presence of local radio stations. Fourth, we show that television stations, which are generally connected to a national or regional network, have no effect. Fifth, we show that the effect of network-connected radio stations increases with their network coverage. Sixth, we show that it is unlikely that our findings are explained by differences in municipal economic development and financial capacity, or by the ownership and manipulation of media outlets by politicians.

Our findings suggest that it is indeed the case that the federal government is biased against non-aligned municipalities when it comes to the distribution of drought relief aid. However, as predicted by our model, the presence of a radio station connected to a network compensates for such a bias. Importantly, the effect of a network-connected radio station operates by increasing the accountability of the federal government towards the voters unaffected by the drought. Radio networks spread information about droughts and the responsiveness of the federal government to the voters outside the affected municipalities, thereby, increasing the electoral costs of non-responsiveness. On the contrary, since local radio stations belong to no network and network-connected televisions stations do not affect

[1]Data on the actual transfers is not available.

[2]While during our period of analysis several radio stations were established throughout Brazil, there is little within municipal variation in local and network-connected radio stations.

the content transmitted by their network, they have no effect.

This paper contributes to the literature that studies the strategic allocation of resources by central governments who aim to maximize their electoral support. A large body of work points out that the allocation of central transfers favors aligned constituencies in Brazil (Brollo and Nannicini [2012]), India (Arulampalam et al. [2009]), Portugal (Veiga and Pinho [2007]), Spain (Solé-Ollé and Sorribas-Navarro [2008]), and the United States (Berry et al. [2010]). Our paper similarly shows that electoral motives play a role in the allocation of disaster relief transfers in Brazil, but we also show how media can compensate for the central government's bias against non-aligned municipalities.

The idea that it is more costly for politicians to neglect voters with access to information about their performance via the media has been highlighted by earlier work. Stromberg [2004] analyzes radio expansion in the United States during the 1920s-1940s and shows that counties with more radio listeners received more New Deal relief funds. Besley and Burgess [2002] find that Indian state governments' provision of public food and calamity relief aid is more responsive to falls in food production and crop flood damage in states where newspaper circulation is high. Our paper also provides evidence that supports the importance of the role of media for political accountability. However, our focus is on the role of the media network for the diffusion of politically relevant information to enhance political accountability.

The remainder of the paper proceeds as follows. In section 2 we provide background information on the disaster relief policy and the media market in Brazil. In section 3 we develop a simple model that later guides the empirical analysis. In section 4 we present the data and the empirical analysis. In section 5 we shows our main results, present evidence on the mechanism that explains the effect of media, and discuss alternative explanations. In section 6 we conclude.

2 Background

2.1 Disaster relief policy

A central responsibility of the National Civilian Defense and Emergency System, managed by the Ministry of National Integration, is to support local governments to deal with the consequences of natural disasters. In the event of a drought, this support includes the supply of water trucks, food distribution, and temporary cash transfers ('bolsa estiagem").[3] Municipalities only receive this support if they request and obtain a declaration of state of emergency by the federal government.

The process to obtain a declaration of emergency is subject to significant red tape, which allows for discretion by the federal government. To get a declaration of emergency, a municipality has to send the federal government documents that prove the severity of the disaster and their lack of financial ability to deal with it. These documents encompass information on the characteristics of the disaster, the affected area, the affected population, the

[3] The federal government may also allow farmers to renegotiate agriculture debts or redeem agriculture insurance

estimated losses, the municipality budget, and the measures adopted by the municipal and state governments (CEPED [2012]).[4] Because of the bureaucratic nature of the emergency declaration process, there are several ways through which the federal government can aid allies and restrict help to non-allies. While the federal government can expedite a declaration of emergency and approve it before even analyzing the documentation, it can also delay the process by requiring additional information or even deny assistance by claiming that the municipal government has enough financial capacity to deal with the consequences of the drought.

The popular press provides several examples of the political discretion that takes place in the emergency declaration process. On February 17th, 2012, an article in Globo Newspaper shows that federal auditors found evidence that the Minister of National Integration authorized relief transfers to several municipalities before having a technical report that quantified the damage and the resources necessary for reparations. This decision benefited six municipalities in Bahia, the state of the Minister. In addition, four of municipalities were controlled either by the federal government's party or by the Minister's party.[5] The federal auditors found notes that clarified that the technical reports should be filed with dates that preceded the authorization of transfers. The federal auditors claimed that the understaffing of the Ministry of National Integration facilitated the discretion in the allocation of public funds.

2.2 Media in Brazil

Radio stations broadcast the bulk of local news in Brazilian municipalities. In 2008, there were 3,445 commercial radio stations distributed across 1,970 (out of 5565) municipalities.[6] Most radio stations are independent and just reach a local audience but about 410 (12%) are connected to a regional radio network. The radio stations connected to a network are commonly controlled by a central station or owned by a regional or national group (Gorgen [2002]). The central station transmits information on national and regional issues to local stations and receives information from them on local issues that are relevant for a wider audience.

The example of Emissora Rural helps to illustrate how network-connected radio stations operate.[7] Emissora Rural is connected to Rede Católicas de Radio (Catholic Radio Network), which is present in 150 municipalities across 5 states. Emissora Rural obtains journalistic information about national and international issues through the Rede Católicas de Radio, which provides around 10% of the content it broadcasts. In addition, Emissora Rural informs

[4]In addition, the mayor can enact a decree declaring state of calamity at municipal level, which also allows the municipality to expedite municipal procurement.

[5]The decision benefited Cairu (R$ 1,2 million), Lauro de Freitas (R$ 7 millions), Mascote (R$ 600 k), Valenca (R$ 700k), Conde (R$ 1 million) and Simoes Filho (R$ 1 million).

[6]Other 890 municipalities are only covered by community radio stations, which are low-power stations with a maximum broadcast range of one kilometer. Community radio stations are normally operated by local civic groups such as neighborhood associations.

[7]Information based on an interviewed with Marcelo Damasceno, the main journalist at Emissora Rural and former employee of Radio Grande Rio, a non-connected commercial radio.

the central station about local issues, which, in turn, the central station retransmits to other connected stations.

The capacity of network-connected radio stations to receive and transmit content differentiates them from other types of media. Local radio stations that are not connected to network are important to disclose information on local issues but are unable to reach other localities. Network-connected television stations retransmit national and regional programs but rarely contribute to the content of their network.[8]

3 Model

Our goal in this section is to develop a simple model to organize the empirical work. In the model, a federal government allocates disaster relief support, media spread the news on disasters and the responsiveness of the federal government to them. Voters then decide whether to vote for the federal government taking into account the information they have about its performance. The results of the model indicate that the federal government is biased against non-aligned municipalities when it comes to the distribution of drought relief funds. However, the presence of media compensates for such a bias. In addition, the effect of media increases with the extent of their coverage and the share of the federal government supporters reached by their news.

3.1 Agents and Actions

Consider a country with a number N of municipalities. Each municipality has an equal number of voters normalized to one who live two periods, $t \in \{1, 2\}$. Municipalities are subject to droughts and, in every period, nature chooses one municipality, which we denote as i, to suffer a drought. The rest of municipalities, which we denote as $j \in \{1, ..., N\} \setminus \{i\}$, suffer no drought.

In the event of a drought in municipality i in period t, the federal government allocates f_t funds as drought relief for municipality i from a given budget b. Denote the $\underline{f}$ as minimum amount of funds the federal government has to allocate to a municipality i that suffers a drought. The effective aid municipality i receives a_t is given by

$$a_t = \eta^{fed} \cdot f_t \tag{1}$$

where η^{fed} reflects the ability of the federal government's party has to allocate given resources to those mostly affected by a drought.

The ability of the federal government's party is unknown to both the party and the voters. Its prior is municipality specific and is uniformly distributed on $\left[1 - \frac{1}{2\phi_s}, 1 + \frac{1}{2\phi_s}\right]$ for $s = A$, NA. We assume that ϕ_s takes value ϕ_A when a municipality is controlled by a government that belongs to same party that controls the federal government –the municipality is aligned

[8] Local content in television is very limited: only 11% of the time of television channels is filled with regional information provided by the regional headquarter. [Valente [2009]]. Local issues are rarely discussed on TV.

to the federal government– and ϕ_{NA} otherwise, i.e., $\phi_s \in \{\phi_A, \phi_{NA}\}$. We assume that $\phi_A > \phi_{NA}$, which captures that there is less uncertainty about the ability of the federal government's party in aligned municipalities that in non-aligned ones.

At the end of period 1 voters decide whether they want to reelect the federal government's party for a second term or want to replace it by another party. If they decide to elect an alternative party, its ability to provide allocated given funds upon a drought is drawn from a uniform distribution with mean one, $E\left[\eta^{alt}\right] = 1$.

To decide whether they want to remove federal government's party, voters use the information they have on the effective aid the affected municipality i receives to update their prior on the ability of the federal government's party. A share θ of the voters from the affected municipality i observe such an aid directly. However, to learn about it, the other $(1-\theta)$ share of voters from municipality i, as well as the voters from municipalities j, rely on the information that local radio stations and radio networks broadcast.

Radio stations learn whether a drought hits one of the municipalities where they operate, infer the responsiveness of the federal government, a_t, and disclose such information in the areas where they operate. Thus, while a local radio station operating in municipality i is able to divulge a_t only in municipality i, a network-connected radio station operating in municipality i can not only disclose a_t in municipality i but also spread it to all the other municipalities j where its network operates. Denote λ_i as an indicator variable that captures whether there is a radio station in municipality i,

$$\lambda_i = \begin{cases} 1 & \text{if there is a radio station in municipality } i. \\ 0 & \text{otherwise.} \end{cases}$$

Denote $\mu_{i,j}$ as an indicator variable that captures whether there is a network-connected radio station in municipality i that also operate is municipality j,

$$\mu_{i,j} = \begin{cases} 1 & \text{if municipalities } i \text{ and } j \text{ share a radio network,} \\ 0 & \text{otherwise.} \end{cases}$$

3.2 Preferences

Voters in a given municipality have the following expected utility

$$u_v = -p_d \cdot (d - a_1) - \beta \cdot p_d \cdot (d - a_2),$$

where p_d is the probability that municipality suffers a drought in a given period, d is the disutility from experiencing a drought, and β is the time discount factor.

The party that controls the federal government has the following expected utility

$$u_f = (b - f_1) + \beta \cdot p_r \cdot (b - f_2),$$

where p_r is the probability that voters reelect the federal government's party.

3.3 Timing

Period 1

1. Nature chooses which municipality i suffers a drought.
2. The federal government allocates funds f_1 to municipality i.
3. Municipally i receives effective aid a_1.
4. Payoffs are realized.
5. The local radio station in municipality i announces a_1 in municipality i.
6. The radio network that has a radio station operating in municipality i announces a_1 in municipality i and the municipalities j where it is also located.
7. Voters vote.

Period 2

1. Nature chooses which municipality i suffers a drought.
2. The federal government allocates funds f_2 to municipality i.
3. Municipally i receives effective aid a_2.
4. Payoffs are realized.

3.4 Characterization

We characterize the solution of this model through backward induction. In period 2, the party that controls the federal government has no reelection incentives, and hence, it sets the drought relief funds to the minimum possible, $f_2 = \underline{f}$. The effective aid that a municipality that suffers a drought receives in period 2 is then given by $a_2 = \eta \cdot \underline{f}$.

At the time of the election voters care only about period 2 utility, which is a linearly increasing on η. Thus, voters decide to vote for the federal government's party if

$$E\left[\eta^{fed}|I_1\right] \geq E\left[\eta^{alt}\right], \tag{2}$$

where $E\left[\eta^{fed}|I_1\right]$ is the expected posterior belief that voters have over the ability of the federal government's party given the information they observe in period 1, I_1, and $E\left[\eta^{alt}\right] = 1$ is an alternative party's expected ability.

There are two types of voters that we denote as informed and uniformed voters. Informed voters are the voters that either belong to

1. the share θ of voters of municipality i that observe the responsiveness of the federal government, a_t, directly, or

2. the share $(1-\theta)$ of voters of municipality i that receive information on a_t from either a local radio station or a radio station connected to a network, or

3. the municipalities j that receive information on a_t from a radio network that operates in both municipality i and their municipality j.

Uninformed voters are the voters that either belong to

1. the share $(1-\theta)$ of voters of municipality i that receive no information on a_t from a radio station, or

2. the municipalities j that receive no information on a_t from a radio network that operates in both municipality i and their municipality j.

Since informed voters receive information about a_1, $I_1 = a_1$, they are able to update the prior on η^{fed} and form the following expected posterior belief over the ability of the federal government's party,

$$E\left[\eta^{fed}|a_1\right] = \frac{a_1}{\widetilde{f}_1}, \tag{3}$$

where $\widetilde{f}_1$ is the expected equilibrium f_1.

Using (3) and (1), we can re-express (2) as $\eta \geq \frac{\widetilde{f}_1}{f_1}$. Thus, the expected vote share for the federal government's party for informed voters is

$$\pi_s = \frac{1}{2} + \phi_s\left(1 - \frac{\widetilde{f}_1}{f_1}\right). \tag{4}$$

Uninformed voters are unable to update the prior belief over η^{fed}, $I_1 = \emptyset$, and hence, $E\left[\eta^{fed}|I_1\right] = 1$. Thus, since these voters are indifferent between the party that controls the federal government and alternative party, they randomly decide which one they vote, and hence,

$$\pi_s = \frac{1}{2}. \tag{5}$$

Using (4) and (5), the reelection probability that the party that controls the federal government has is given by the following expression

$$p_r = \frac{1}{2} + \frac{1}{N}\left(\theta \cdot \phi_i + \lambda_i \cdot (1-\theta) \cdot \phi_i + R_i^A \cdot \phi_A + R_i^{NA} \cdot \phi_{NA}\right)\left(1 - \frac{\widetilde{f}_1}{f_1}\right), \tag{6}$$

where $R_i^A = \sum_{j \neq i, \phi_j = \phi_A} \mu_{i,j}$ and $R_i^{NA} = \sum_{j \neq i, \phi_j = \phi_{NA}} \mu_{i,j}$ represent the number of aligned and non-aligned municipalities j where the radio network that operates in municipality i also operates, respectively.

The federal government party then solves the following problem

$$\max_{f_1 \le b} \left\{ (b - f_1) + \beta \cdot p_r \cdot \left(b - \underline{f} \right) \right\}.$$

Thus, from the first order condition and the constraint $f_1 \le b$, it follows that f_1 takes the following expression[9]

$$f_1 = \min \left\{ \beta \cdot \left(\theta \cdot \phi_i + \lambda_i \cdot (1 - \theta) \cdot \phi_i + R_i^A \cdot \phi_A + R_i^{NA} \cdot \phi_{NA} \right) \cdot \left(b - \underline{f} \right) / N, b \right\}. \quad (7)$$

From the expression of f_1 in (7), it follows that, given (β, θ, ϕ_A, ϕ_{NA}, R_i^A, R_i^{NA}, b, $\underline{f}$, N), there are three possible cases, A, B and C, which are reflected in the in Figure 4.

3.4.1 Case A: $\beta \cdot \theta \cdot \phi_{NA} \cdot \left(b - \underline{f} \right) / N \ge b$

In case A, the parameter restriction is such that, the federal government allocates all the budget to any municipality that suffers a drought in period 1, there is no bias of the federal government's party against non-aligned municipalities, and radio stations play no role. These results are reflected in the following proposition.

Proposition 1 *If* $\beta \cdot \theta \cdot \phi_{NA} \cdot \left(b - \underline{f} \right) / N \ge b$,

1. $f_1 = b$ *for any municipality affected by a drought in period* 1,
2. $f_1 (\phi_A, \cdot) = f_1 (\phi_{NA}, \cdot)$ *(no bias), and*
3. *For* $f_1 \left(\phi_{NA}, \lambda_i, R_i^A, R_i^{NA} \right)$, *it follows that* $f_1 (\phi_{NA}, 0, 0, 0) = f_1 \left(\phi_{NA}, \lambda_i, R_i^A, R_i^{NA} \right)$, $\forall\ \lambda_i$, R_i^A, $R_i^{NA} \ge 0$ *(no role for radio stations).*

All proofs are straightforward and omitted. The budget constrain is always binding and the federal government allocates all the budget to any municipality that suffers a drought in period 1. The votes the federal government's party would lose from any municipality affected by a drought in case it was not responsive enough are sufficient to discipline it. Thereby, whether the affected municipality is aligned to the federal government's party has no effect on the drought relief funds it receives. Whether there is a radio station in the affected has also no effect.

3.4.2 Case B: $\beta \cdot \theta \cdot \phi_A \cdot \left(b - \underline{f} \right) / N \ge b > \beta \cdot \theta \cdot \phi_{NA} \cdot \left(b - \underline{f} \right) / N$

The parameter restriction in case B implies that, relative to case A, the situation is unchanged for aligned municipalities. However, there is potentially a bias in provision of drought relief by the federal government's party against non-aligned municipalities. Thus, there is scope for radio stations to compensate such a bias. These results are reflected in the following proposition.

[9] The second order condition holds since the vote share for the federal government party is concave in f_1.

Proposition 2 *If* $\beta \cdot \theta \cdot \phi_A \cdot \left(b - \underline{f}\right)/N \geq b > \beta \cdot \theta \cdot \phi_{NA} \cdot \left(b - \underline{f}\right)/N$,

1. *Consider the case* $\left(\lambda_i, R_i^A, R_i^{NA}\right) = (0, 0, 0)$,

$$f_1(\cdot) = \begin{cases} b & \textit{if aligned municipality } i, \\ \beta \cdot \theta \cdot \phi_{NA} \cdot \left(b - \underline{f}\right)/N < b & \textit{if non-aligned municipality } i \textit{ and,} \end{cases}$$

2. $f_1(\phi_A, \cdot) \geq f_1(\phi_{NA}, \cdot)$ *(bias),*

3. *For* $f_1\left(\phi_{NA}, \lambda_i, R_i^A, R_i^{NA}\right) < b$, *it follows that* $f_1(\phi_{NA}, 1, 1, 0) > f_1(\phi_{NA}, 1, 0, 1) > f_1(\phi_{NA}, 1, 0, 0) > f_1(\phi_{NA}, 0, 0, 0)$ *(role for radio stations, a network-connected radio station has a bigger effect than a local radio station, and its effect is bigger when the share of supporters of the federal government's party it reaches is larger).*

In the absence of a radio station operating in a non-aligned municipality affected by a drought, the electoral loss the federal government's party suffers when it is not responsive enough is no longer sufficient to discipline it. The difference in the federal government's aid towards aligned and non-aligned municipalities comes from the fact that aligned municipalities are more responsive to the government performance in the management of a drought.

As indicated in Figure 4, the radio stations operating in non-aligned municipalities contribute to compensate for the bias of the federal government's party. Further, network-connected radio stations are better able at compensating this bias than local stations since they can hold the federal government accountable to not only to the voters that are not directly informed in municipality i but also to all the other voters in the municipalities j where it also operates. In addition, the effect of a network-connected radio station should be increasing in both $R_{i,j}^A$ and $R_{i,j}^{NA}$ but relatively more in $R_{i,j}^A$. In words, the larger the proportion of their audience that is comprised of supporters of the federal government, the bigger the electoral cost they can potentially inflict to a non-responsive federal government.

3.4.3 Case C: $b > \beta \cdot \theta \cdot \phi_A \cdot \left(b - \underline{f}\right)/N$

Given the parameter restriction in case C, relative to case B, the situation is unchanged for non-aligned municipalities. However, the federal government no longer allocates all the budget to an aligned municipality if it suffers a drought in period 1. Thus, there is scope for radio stations to incentivize the federal government's provision of drought relief towards aligned municipalities. In addition, the bias of federal government's party against non-aligned municipalities persists. These results are reflected in the following proposition.

Proposition 3 $b > \beta \cdot \theta \cdot \phi_A \cdot \left(b - \underline{f}\right)/N$,

1. *Consider the case* $\left(\lambda_i, R_i^A, R_i^{NA}\right) = (0, 0, 0)$,

$$f_1(\cdot) = \begin{cases} \beta \cdot \theta \cdot \phi_A \cdot \left(b - \underline{f}\right)/N < b & \textit{if aligned municipality } i, \\ \beta \cdot \theta \cdot \phi_{NA} \cdot \left(b - \underline{f}\right)/N < b & \textit{if non-aligned municipality } i \textit{ and,} \end{cases}$$

2. $f_1(\phi_A, \cdot) \geq f_1(\phi_{NA}, \cdot)$ *(bias),*

3. *For* $f_1\left(\phi_s, \lambda_i, R_i^A, R_i^{NA}\right) < b$, *for* $s \in \{A, NA\}$, *it follows that* $f_1(\phi_s, 1, 1, 0) > f_1(\phi_s, 1, 0, 1)$ $> f_1(\phi_s, 1, 0, 0) > f_1(\phi_s, 0, 0, 0)$ *(role for radio stations, a network-connected radio station has a bigger effect than a local radio station, and its effect is bigger when the share of supporters of the federal government's party it reaches is larger).*

In the absence of a radio station operating in a aligned municipality affected by a drought, the electoral loss the federal government's party suffers when it is not responsive enough is no longer sufficient to discipline it. The bias of the federal government's party against non-aligned municipalities and the role that different radio stations plays work as in case B.

3.5 Data

We use several data sources to conduct our empirical analysis. Our main outcome variable comes from the National Secretariat of Civil Defense and it is a indicator variable for whether a municipality had a state of emergency declared due to a drought in a given year. During our period of analysis –2002 to 2008– the federal government declared a state of emergency due to droughts in over 3,200 municipalities, which represent an average of 8% of municipalities per year.

We identify municipalities that have experienced droughts by using information on the monthly level of rainfall at the meteorological station level between 1961 and 2010. INMET, the Brazilian Institute of Meteorology, provides this information for 280 stations, which are illustrated in Figure 1. As in the example in Figure 2, we interpolate this information for the whole of Brazil and then calculate the municipal levels of rainfall. Our main measure of drought is the municipal rainfall z-score for the Spring-Summer season, i.e., the deviation from the historical mean normalized by the historical standard deviation.[10] Since we focus on low precipitation events, we set positive z-scores to zero. As indicated in Table 1, the mean level for rainfall z-score in the period we study is -0.29 and the standard deviation is 0.41.

The election data is from the Tribunal Superior Eleitoral (Superior Electoral Court). A municipality is aligned to the federal government if it is governed by a mayor from the same party. This variable may change every two years since Municipal and Presidential elections take place every four years and are two years apart.[11] From 2002 to 2008, 92% of municipalities were non-aligned to the federal government. [12]

[10] We take into account only rainfall levels during Spring and Summer because this is the main crop season for the majority of crops cultivated in Brazil.

[11] While presidential elections occurred in 2002, 2006 and 2010, municipal elections took place in 2000, 2004 and 2008. Because the Labor Party (PT) governed Brazil from 2003 to 2010, in practice our variation comes mainly from power switches at federal level in 2003 and at municipal level in 2005 and 2009.

[12] We also calculate alternative definitions of political coalition which take into account whether the mayor is from the same party that controls the Minister of National Integration, which is responsible for Disaster Relief Policy. Results do not differ when we also consider as aligned municipalities the ones that are from the state where the Minister of National Integration is originally from and are aligned to the party that controls

We identify media presence in each municipality by using information from ANATEL, the Brazilian regulator of communications, on the universe of media outlets in Brazil, their location, the date they got their licensed issued, and the list of partners that are members of the board of each media outlet.[13] We rely on the Donos da Midia database to identify which radio and television stations are connected to a network. According to our database, 32 percent of municipalities have a commercial radio station, and 6 percent have a radio station connected to a network. Figure 3 illustrates the universe of Brazilian municipalities where a radio network operates in 2008. Television stations are more widespread, reaching 55 percent of municipalities. 99% of these television stations are connected to a network and they simply retransmit content.

Based on the Donos da Midia information on media networks, we calculated the coverage of each network by considering the number of municipalities in which each operates, and the total population in these municipalities. Additionally, we divided the measure of media network coverage into coverage on aligned municipalities and coverage on non-aligned municipalities by taking into account the political alignment of the municipalities reached by each media network. Table 1 indicates that a radio network covers on average 3.8 municipalities and potentially reaches 940,000 people.[14]

We track the political connection of each partner that is on the board of a media outlet by matching his or her name to the names of politicians. We use two different matching procedures depending on the politicians' rank. For local politicians, we identified the names of mayors and local councilors elected in 2000, 2004 and 2008, and consider a politician to own a media outlet if her name is on the board of a media outlet in the same municipality she was elected. Also, we consider that a politician is connected to a media outlet if she owns it or shares a family name with someone on the board of a media outlet located in the same municipality.[15] Our calculations indicate that, while 8% of Brazilian municipalities have a commercial radio station connected to a mayor or local councilor, 1% of municipalities have a network-connected radio associated to a local politician.

For state and federal congressmen, we use the list of elected politicians in 1998, 2002

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the Ministry. The specification where we also include as aligned municipalities all municipalities under the party that controls the Ministry provides noisy estimates. The reason is the nature of the party that controlled the Ministry over most of the our time-period, the Partido do Movimento Democrtico Brasileiro (PMDB). While the PMDB governs a fifth of the municipalities in Brazil, it is a very fragmented party controlled by several independent regional bosses.

[13]We identified the universe of media outlets in Brazil by considering all the outlets that appear in the Sistema de Controle de Radiofusao (SCR) at ANATEL website. This website also provides the location of each outlet and a list of all documents that have been issued to each media outlet. We use as a proxy for the date they got their licensed issued the date that the first document in the name of the outlet was issued. Information on partners come from ANATEL's Sistema de Acompanhamento de Controle Societario (SIACCO). We use a list of partners of media outlets from April 2012.

[14]We consider the state capitals in the computation of network coverage but we remove these municipalities from our sample in the empirical exercises. We want to avoid that state capitals drive the results because all these municipalities have a network-connected radio station and are politically important.

[15]We were very conservative in this matching and did not consider that two individuals are relatives if they share very common family names such as Silva, Costa and Santos. In particular, we did not match names whose frequency is greater than 5 percent in the state.

and 2006, and consider they own a media outlet if their name appears on the board of any media outlet in 2012, regardless the location of the media outlet and their political base. This assignment of media to congressmen follows the pattern we found in the data which indicates that many politicians own media in municipalities that are not their political strongholds or even in states that they do not represent. We identified that in 2% of the municipalities there is a commercial radio station directly owned by a congressmen. We acknowledge that our method may underestimate the number of media outlets controlled by politicians since research has shown that politicians indirectly control media by assigning relatives or friends to the board of media outlets (see Lima [2006] and Gorgen [2002]).[16]

Finally, we gather information from the 2000 population census, conducted by the Brazilian Bureau of Statistics (IBGE), on municipal characteristics such as population, urbanization rate, population density, income per capita, poverty rate and average years of schooling. We use these covariates in our empirical exercise to control for municipal characteristics that may correlate with media presence, economic development, and political alignment. FINBRA database, from the Brazilian Treasury, provides information on municipal revenue, which we use to control for the financial capacity of a municipality to deal with natural disasters.

4 Empirical Strategy and Data

4.1 Empirical Strategy

In this section we develop the empirical strategy used to test the predictions of the model. Our empirical approach, first, identifies whether case A, B or C best represents the setup we study. Second, it tests the predictions of our model regarding the role of media.

Our analysis is at the municipal level. To identify whether case A, B or C best represents the setup we study, we conduct two types of specifications. Our first specification, is as follows

$$dd_{mt} = \beta_0 + \beta_1 \cdot z_{mt} + \beta_2 \cdot na_{mt} + \beta_3 \cdot z_{mt} \cdot na_{mt} + \Gamma' X_{mt} + \eta_m + \phi_t + \varepsilon_{mt} \quad (8)$$

where dd_{mt} is a dummy variable that indicates whether a municipality m received a drought declaration in year t, z_{mt} is the normalized level of precipitation during the Spring-Summer season censored at zero, and na_{mt} is a dummy variable that indicates whether a municipality is not aligned to the federal government.[17] The specification includes municipality fixed effects η_m and year fixed effects ϕ_t. Standard errors are clustered at the state level.

X_{mt} are a series of controls interacted with z_{mt} that deal with potential concerns that our estimates of interest capture the effect of omitted variables related to municipal economic

[16] Unfortunately we do not have the municipality of origin for each congressman, and thereby, we are unable to perform the same matching procedure we use with local politicians to see whether they are indirectly connected to a media outlet.

[17] We normalize the level of precipitation during the Spring-Summer season by subtracting its historical mean and dividing it by its historical standard deviation. Results using an indicator variable for whether there is a drought are qualitatively similar.

development and state capacity. The controls include income per capita, poverty rate, municipal Gini coefficient, average years of schooling, infant mortality, share of households with electricity, municipal GDP per capita, municipal revenue per capita, tax revenue per capita, population, area, population density, urbanization, distance to state capital, and a dummy for being a coastal municipality.

A more robust specification includes a series of flexible controls for the municipal vote share of the federal government's party and their interaction with an indicator for a municipality not being aligned to the federal government's party, $f(vf_{mt}, na_{mt})$.[18] This specification delivers regression discontinuity estimates, and thus, addresses the fact that potential differences between aligned and non-aligned municipalities might confound our estimates.[19]

β_3 allows us to address whether case A, B or C best represents the setup we study. If $\beta_3 < 0$, our model suggests we should be under case B or C since it implies that non-aligned municipalities are less likely to receive drought relief. If $\beta_3 = 0$, our model suggests that we should be in case A since it indicates that municipalities are equally likely to receive drought relief regardless whether they are aligned to the federal government or not.[20]

Our second specification, is as follows

$$\begin{aligned} dd_{mt} &= \beta_0 + \beta_1 \cdot z_{mt} + \beta_2 \cdot na_{mt} + \beta_3 \cdot z_{mt} \cdot na_{mt} + \sum_{j \in \{lr,rn,tv\}} \beta_{4j} \cdot media\_j_{mt} \\ &\quad + \sum_{j \in \{lr,rn,tv\}} \beta_{5j} \cdot media\_j_{mt} \cdot z_{mt} + \sum_{j \in \{lr,rn,tv\}} \beta_{6j} \cdot media\_j_{mt} \cdot na_{mt} \\ &\quad + \sum_{j \in \{lr,rn,tv\}} \beta_{7j} \cdot media\_j_{mt} \cdot z_{mt} \cdot na_{mt} + \Gamma' X_{mt} + \eta_m + \phi_t + \varepsilon_{mt} \end{aligned} \tag{9}$$

where $media\_lr_{mt}$ captures the presence of a local commercial radio station, $media\_rn_{mt}$ captures the presence of a commercial radio station connected to a network, and $media\_tv_{mt}$ captures the presence of a television station. For robustness, we also provide regression discontinuity estimates as in the specification in equation (9).[21] Standard errors are clustered at the state level.

If the results our first specification suggest that either case B or C best represent the setup we study, the model predicts that $\beta_{7j} > 0$ for $j \in \{lr, rn\}$, as well as $\beta_{7rn} > \beta_{7lr}$. That is, while both local and network-connected radio stations compensate the bias that non-aligned municipalities suffer when it comes to receiving drought relief, radio stations connected to a network are better able at compensating such a bias. Further, while in case B the model

[18] $f(vf_{mt}, na_{mt}) = \gamma_1 \cdot vf_{mt} + \gamma_2 \cdot na_{mt} \cdot vf_{mt} + \gamma_3 \cdot vf_{mt}^2 + \gamma_4 \cdot na_{mt} \cdot vf_{mt}^2 + \gamma_5 \cdot vf_{mt}^3 + \gamma_6 \cdot na_{mt} \cdot vf_{mt}^3$. Alternative specifications yield quantitative similar results.

[19] Unfortunately, we do not have enough variation to conduct a local linear regression specification. To that end, we would need significant variation in the levels of precipitation experienced by municipalities with highly contested elections.

[20] If $\beta_3 > 0$, our model would not be able to describe the data.

[21] The inability to provide local linear regression estimates is exacerbated in this specification. To that end, we would not only need sufficient variation in the levels of precipitation but also enough variation in the presence of media outlets in municipalities with highly contested elections.

predicts that $\beta_{5j} = 0$ for $j \in \{lr, rn\}$, in case C it predicts that $\beta_{5j} > 0$ for $j \in \{lr, rn\}$. In words, media should contribute to the likelihood that aligned municipalities receive drought aid in case C but not in case B. Additionally, the model predicts that, regardless whether we are in case B or C, $\beta_{5j} = \beta_{7j} = 0$ for $j \in \{tv\}$ since television stations rarely broadcast local content and do not disseminate local information through their network.

5 Results

5.1 Results

Table 2 reports the results of our empirical specification in equation (8). Column (1) presents the baseline specification, and column (2) adds a series of flexible controls for the municipal vote share of the federal government's party and their interaction with a municipal non-alignment indicator. Consistent with cases B and C of the model, results in column (1) suggest that non-aligned municipalities are 5% less likely to receive drought relief from the federal government. Regression discontinuity estimates in column (2) indicate that this result is not driven by potential differences in aligned and non-aligned municipalities.

Overall the results from Table 2 are consistent with cases B and C of the model. Table 3 reports the results of the empirical specification in equation (9) to disentangle which of these two cases best represents the data. Column (1) presents the most basic specification where we interact the regressors in specification (8) with an indicator of municipal presence of a radio station connected to a network. Column (2) adds the interactions with an indicator of municipal presence of a local radio station. Column (3) adds instead the interactions with an indicator of municipal presence of a television station. Column (4) adds the interactions with both an indicator of municipal presence of a local radio station and an indicator of municipal presence of a television station. Columns (5) to (8) provide regression discontinuity estimates for the specifications in columns (1) to (4).

Consistent with case B, results in column (1) suggest that, while radio stations connected to a network contribute to the likelihood that non-aligned municipalities receive drought relief from the federal government, such an effect is absent for the case of aligned municipalities. The magnitude of the effect of network-connected radio stations is such that it compensates the federal government's bias against non-aligned municipalities.

Columns (2) to (4) of Table 3 show that local radio stations and television stations do not have the same effect of radio stations connected to a network. Thus, as predicted by the model, the effect that network-connected radio stations have on the likelihood that non-aligned municipalities receive drought relief from the federal government is significantly larger than the one of local radio stations. The estimates on the effect of local radio stations and television stations are consistent with the fact that they do not affect the content of the media in other municipalities. Regression discontinuity estimates in columns (5) to (8) indicate that the mentioned results are not driven by potential differences in aligned and non-aligned municipalities.

5.2 Channel

Overall, results from Table 2 and 3 are consistent with case B of the model. They indicate that radio stations connected to a network contribute significantly to compensate for the bias in the distribution of drought relief that the federal government has against non-aligned municipalities. To further test the implications of the model, we test the mechanism. In the model, the coverage of the network of a network-connected radio station that operates in a non-aligned municipality affected by a drought is essential for the likelihood that the municipality receives drought relief from the federal government.

To test for the empirical relevance of such a mechanism, we consider the following specification

$$\begin{aligned} dd_{mt} = {} & \beta_0 + \beta_1 \cdot z_{mt} + \beta_2 \cdot na_{mt} + \beta_3 \cdot z_{mt} \cdot na_{mt} + \beta_4 \cdot cov\_rn_{mt} \\ & + \beta_5 \cdot cov\_rn_{mt} \cdot z_{mt} + \beta_6 \cdot cov\_rn \cdot na_{mt} \\ & + \beta_7 \cdot cov\_rn_{mt} \cdot z_{mt} \cdot na_{mt} + \Gamma' X_{mt} + \eta_m + \phi_t + \varepsilon_{mt}, \end{aligned} \tag{10}$$

where cov_rn_{mt} represents the coverage of a radio network that operates in municipality m. Standard errors are clustered at the state level.

Panel A in Table 4 reports the results of the empirical specification in equation (10) where the measure of coverage is the number of municipalities that belong to the radio network. We consider as a regressor the coverage of a radio network in aligned and non-aligned municipalities in column (1), only in aligned municipalities in column (2), and only in non-aligned municipalities in column (3). The distinction between coverage on aligned and non-aligned municipalities allows us to test the prediction that the effect of network-connected radio stations should be larger when the coverage of their networks outside municipality i is in aligned municipalities rather than in non-aligned municipalities. Columns (4) to (6) provide regression discontinuity estimates for the specifications in columns (1) to (3).

Results in column (1) support the model's prediction that the coverage of the radio network is central for the probability that non-aligned municipalities receive drought relief from the federal government after experiencing low precipitation.[22] Additionally, while we lack statistical power to distinguish between the effect of the coverage in aligned and non-aligned municipalities, as predicted by the model, results in column (2) and (3) are indicative that the effect of the coverage in aligned municipalities is stronger. Regression discontinuity estimates in columns (4) to (6) indicate that the mentioned results are not driven by potential differences in aligned and non-aligned municipalities.

Panel B in Table 4 replicates the estimates in *Panel A* using an alternative measure of coverage: the population covered by the radio network. Results in *Panel B* are in line with those in *Panel A*.

[22] Regressions, where we also include $media\_rn_{mt} \cdot z_{mt}$, $media\_rn_{mt} \cdot na_{mt}$, and $media\_rn_{mt} \cdot z_{mt} \cdot na_{mt}$, yield the same result although with lower statistical power. There are only 6% of municipalities with radio networks and we lack enough variation across them. Additionally, using the continuous measure of non-alignment also yields a qualitatively similar result.

5.3 Alternative Explanations

While results suggest that network-connected radio stations play a significant role in compensating for the federal government's bias against non-aligned municipalities in the distribution of drought relief aid, there is the concern that the presence of a radio station connected to a network might capture the effect of other omitted municipal attributes. Potential candidates are variables related to the municipal economic development, state capacity and political influence.

5.3.1 Economic Development and State Capacity

If less developed municipalities or municipalities that have weaker state capacity are also more likely to have a regional network operating, the presence of a regional network could be simply picking up the fact that the federal government is more likely to distribute drought relief aid to these types of municipalities. To address the empirical relevance of the concern of omitted variables related to the municipal economic development and state capacity, we conduct the following empirical test

$$\begin{aligned} outcome_m &= \beta_0 + \beta_1 \cdot na_m + \sum_{j \in \{all, rn,\}} \beta_{2j} \cdot media\_j_m + \\ & \sum_{j \in \{all, rn\}} \beta_{3j} \cdot media\_j_m \cdot na_m + \varepsilon_m, \end{aligned} \tag{11}$$

where $outcome_m$ is a variable that measures either the municipal economic development or the financial capacity of municipality m, $media\_all_{mt}$ captures the presence of a commercial radio station in municipality m, and $media\_rn_{mt}$ is an indicator variable that there is a commercial radio station connected to a network in municipality m. Standard errors are clustered at the state level.

Table 5 reports the results of our empirical specification in equation (11) for the cross section of Brazilian municipalities in 2002, the first year of our sample. In *Panel A* the outcome variables are the municipal: population, urbanization rate, area, distance to state capital, indicator for coastal, income per capita, and Gini coefficient. In *Panel B* the outcome variables are the municipal: poverty rate, average years of schooling, mortality rate, share of households with electricity, GDP per capita, revenue per capita, and tax revenue per capita. Table 6 provides regression discontinuity estimates for the specifications in Table 5.

Consider the universe of non-aligned municipalities where there is a radio stations. Results in Table 5 and Table 6 indicate that, out of the 14 municipal outcomes we consider, none of them is statistically different when the radio station is connected to a network. Thus, while we lack randomness in the location of radio stations connected to a network, these results suggest it is unlikely that the presence of a network-connected radio station might capture the effect of other omitted municipal attributes related to the economic development and state capacity.

5.3.2 Political Influence

It still remains the concern that the effect of a network-connected radio station that we estimate might not capture the influence of media but rather the political influence of the municipality. In particular, a radio station connected to a network may be located in a municipality that constitutes the political stronghold of a powerful politician. This is a concern given the evidence that media outlets are controlled by political bosses and used as means to consolidate political power. [23] To address this worry, we conduct the following specification

$$\begin{aligned} dd_{mt} = \; & \beta_0 + \beta_1 \cdot z_{mt} + \beta_2 \cdot na_{mt} + \beta_3 \cdot media\_rn_{mt} + \beta_4 \cdot z_{mt} \cdot na_{mt} \\ & + \beta_5 \cdot media\_rn_{mt} \cdot z_{mt} + \beta_6 \cdot media\_rn_{mt} \cdot na_{mt} \\ & + \beta_7 \cdot media\_rn_{mt} \cdot z_{mt} \cdot na_{mt} + \beta_8 \cdot media\_pol_{mt} \\ & + \beta_9 \cdot media\_pol_{mt} \cdot z_{mt} + \beta_{10} \cdot media\_pol_{mt} \cdot na_{mt} \\ & + \beta_{11} \cdot media\_pol_{mt} \cdot z_{mt} \cdot na_{mt} + \Gamma' X_{mt} + \eta_m + \phi_t + \varepsilon_{mt} \end{aligned} \tag{12}$$

where $media\_rn_{mt}$ captures the municipal presence of a radio station connected to a network, and $media\_pol_{mt}$ is an indicator variable that a politician (mayor, local councilor, and state and federal congressman) owns a network-connected radio station in municipality i or it is associated to it through a family member.[24] Standard errors are clustered at the state level.

Table 7 reports the results of our empirical specification in equation (12). Column (1) considers the simplest specification where we only look at the effect of local politician's ownership and association to a network-connected radio station without controlling for the regressors that capture the effect of the presence of a radio station connected to a network. Column (2) adds theses regressors. Columns (3) and (4) provide regression discontinuity estimates for the specifications in columns (1) and (2).

Results in column (2) show that the finding that radio stations connected to a network are able to compensate for the federal governments' bias against non-aligned municipalities is robust to the inclusion of regressors that capture the level of political influence on media a municipality might have. Additionally, these results suggest that local politicians' ownership and association to network-connected radio stations do not help non-aligned municipalities to compensate for the federal governments' bias in the distribution of drought relief support. Regression discontinuity estimates in columns (3) and (4) are consistent with these results.

[23]For instance, Boas and Hidalgo [2011] finds that media control facilitates the entrenchment of local politicians in Brazil. Politicians have a higher chance to obtain a license of a community radio station and the ownership of a radio station increases substantially the probability of winning local elections. Stadnik [1991] points out that 79 out of 503 Congressmen owned directly or indirectly a TV or radio station in 1991. In addition, Motter [1994] documents that half of the concessions for television and radio stations issued in six decades were distributed by former president Sarney between 1985 and 1998 and disproportionally favored politicians who voted on key legislation, such as amendments to the 1988 constitution.

[24]Results do not differ when instead we consider separate specifications for local politicians (mayors and local councilors) and congressmen.

5.3.3 Placebo Exercise

Finally, as a placebo exercise, instead of considering the definition of radio network as in the Donos da Midia database, we constructed an alternative definition exploiting the ownership structure across different media outlets. We consider that a radio station is part of a network if one of its board members is also part of the board of another radio station located in a different municipality. We then conduct the following specification

$$\begin{aligned} dd_{mt} \;=\;& \beta_0 + \beta_1 \cdot z_{mt} + \beta_2 \cdot na_{mt} + \beta_3 \cdot media\_rn_{mt} + \beta_4 \cdot z_{mt} \cdot na_{mt} \\ &+ \beta_5 \cdot media\_rn_{mt} \cdot z_{mt} + \beta_6 \cdot media\_rn_{mt} \cdot na_{mt} \\ &+ \beta_7 \cdot media\_rn_{mt} \cdot z_{mt} \cdot na_{mt} + \beta_8 \cdot share\_own_{mt} \\ &+ \beta_9 \cdot share\_own_{mt} \cdot z_{mt} + \beta_{10} \cdot share\_own_{mt} \cdot na_{mt} \\ &+ \beta_{11} \cdot share\_own_{mt} \cdot z_{mt} \cdot na_{mt} + \Gamma' X_{mt} + \eta_m + \phi_t + \varepsilon_{mt} \end{aligned} \tag{13}$$

where $share\_own_{mt}$ is an indicator variable that a radio station belongs to a radio network according to the alternative definition.

Table 8 reports the results of our empirical specification in equation (13). Column (1) considers the simplest specification where we only look at the effect of the presence of a radio that is connected to other radio stations through common ownership without controlling for the presence of a radio station connected to a network. Column (2) adds regressors that control for such a presence. Columns (3) and (4) provide regression discontinuity estimates for the specifications in columns (1) and (2).

Results in columns (1) and (2) indicate that connectivity to radio stations in other municipalities through common ownership does not contribute to the likelihood that a non-aligned municipalities receives federal drought relief support. Columns (3) and (4) show that these results also hold when we consider a regression discontinuity specification.

These results support the prediction of the model that network-connected radio stations are important because they disclose information on disasters to non-affected places. Radio stations connected through ownership do not play this role because they do not have systematic mechanisms to collect and share information on a frequent basis, as the ones central stations represent for radio networks.

In addition, it is possible that the alternative definition of radio network we consider in our placebo analysis might also capture the capacity that media owners have to exert political influence. The reason is that the media owners that control several media outlets are better positioned to exert political influence. If such was the case and media owners exerted political influence, our placebo analysis estimates would indicate that media owners do use their political influence to compensate political biases.

6 Conclusion

In this paper, we provide evidence of the role of media in compensating for central governments' bias against non-aligned constituencies in the distribution of resources. We analyze how media presence, connectivity and ownership affect the distribution of federal drought relief transfers to Brazilian municipalities.

Our identification strategy exploits exogenous variation in precipitation and the identity of the winning party in close municipal elections, as well as variation in the presence of local and network-connected radio stations.

We show that, while municipalities that are not non-aligned to the federal government are significantly less like to receive drought relief aid when experiencing low precipitation, the presence of a radio station connected to a network compensates for such a bias. The effect of network-connected radio stations is absent for local radio stations and television stations. The main difference of radio stations connected to a network relative to local radio stations and television stations is that network-connected radio stations affect the content of the media in other municipalities. Hence, these findings suggest the importance radio networks for the dissemination of local information that is politically relevant.

We provide additional suggestive evidence that suggests that the effect of network-connected radio stations increases with their network coverage outside the affected municipalities. This evidence reinforces the idea that the mechanism behind our results is media's ability to spread the news to other constituencies. Also, we show evidence that rules out that our findings are explained by the omitted variables that capture the municipal economic development and state capacity or by the manipulation of media outlets by politicians.

Our findings bring to light the federal government's strategic allocation of resources for electoral purposes and point out that radio networks play a central role for the political accountability, and consequently, have important policy implications. First, our results suggest the need of regulation and independent auditing of the process of allocation of federal resources to avoid distortions. Second, our results stress the need of bearing in mind the importance of the media network's role in the diffusion of politically relevant information when developing market mechanisms that enhance political accountability.

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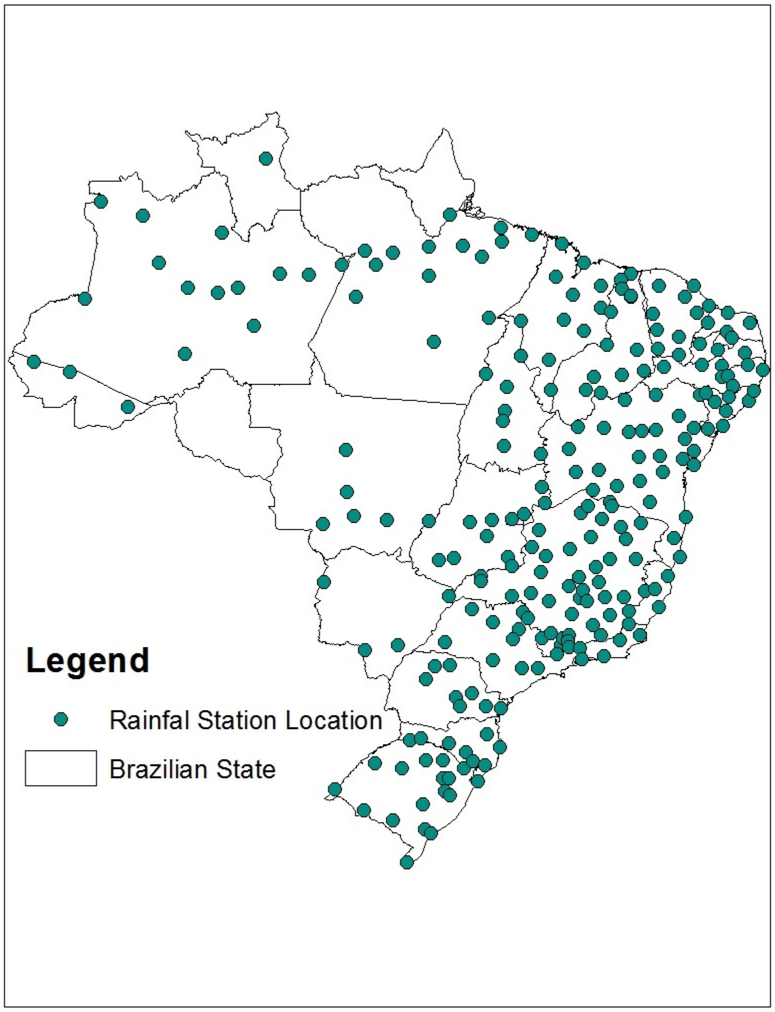


Figure 1: Rainfall Stations

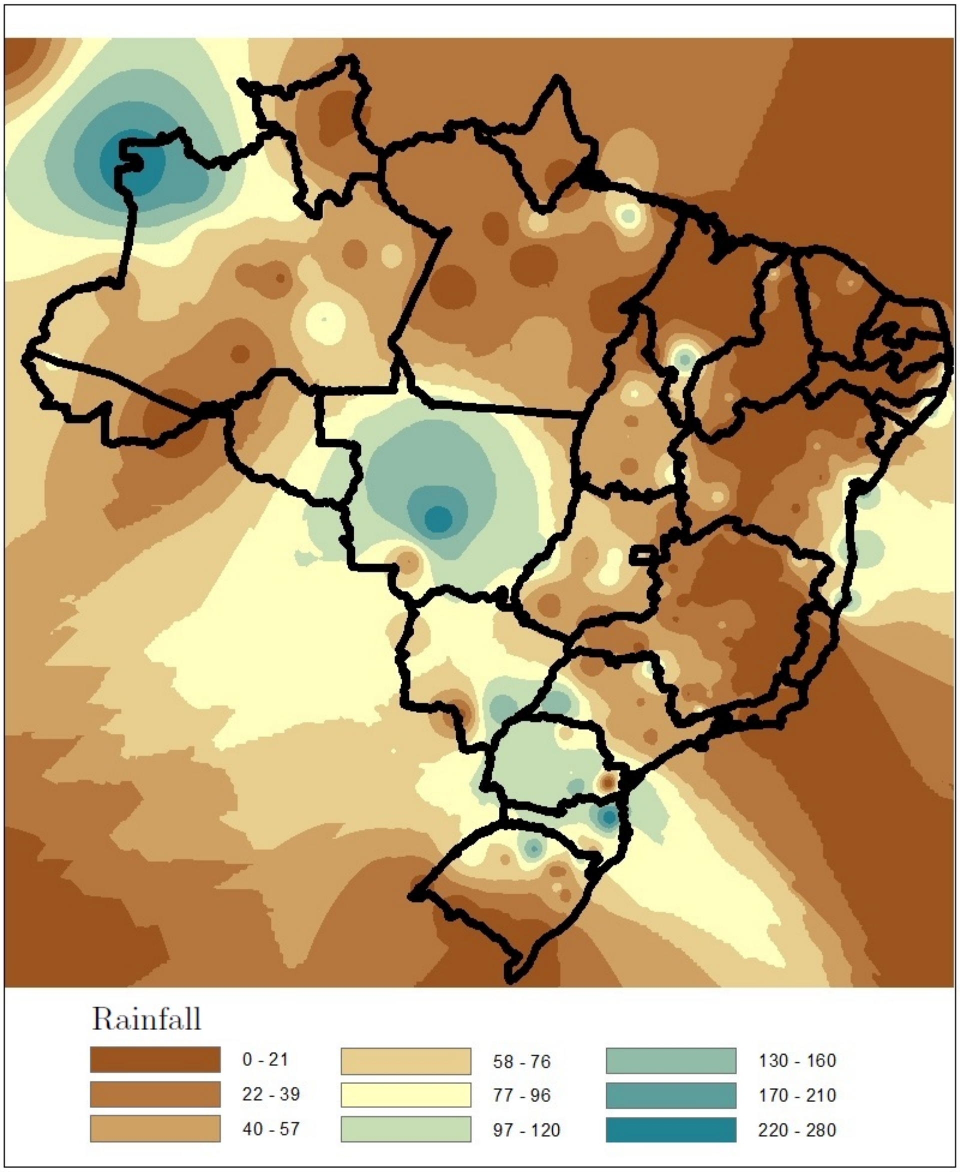


Figure 2: Example of Rainfall Interpolation

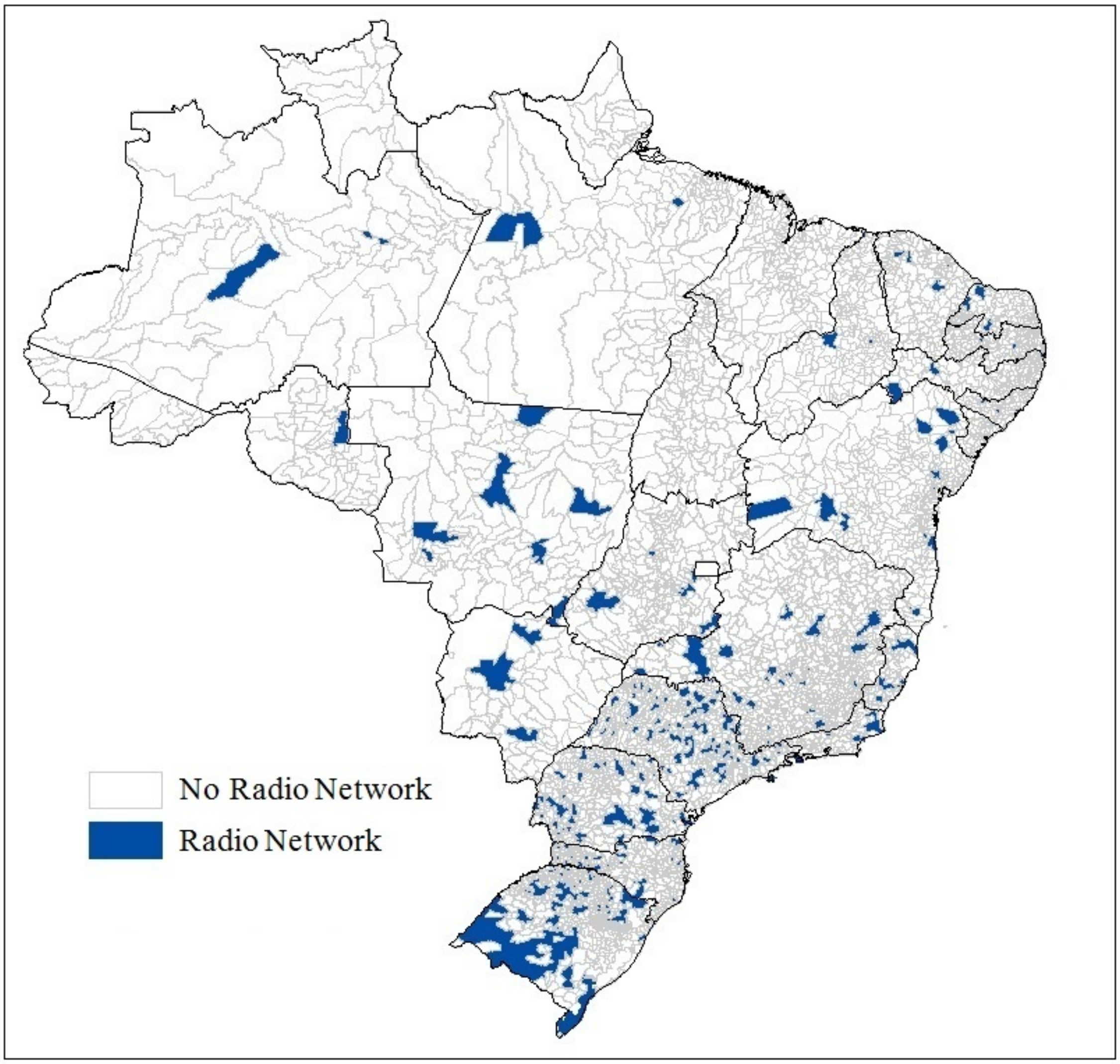
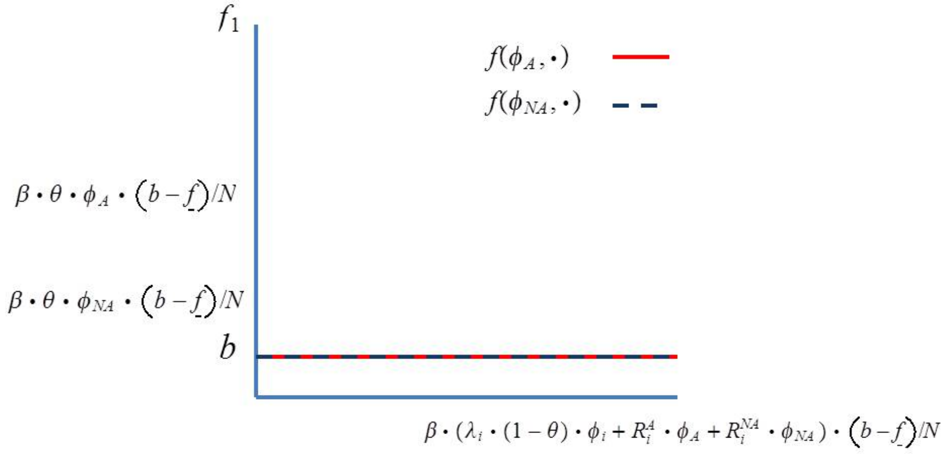
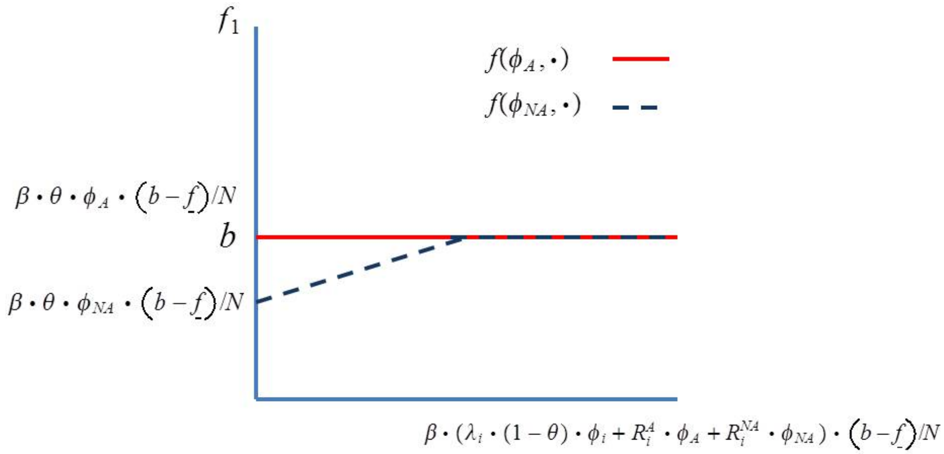


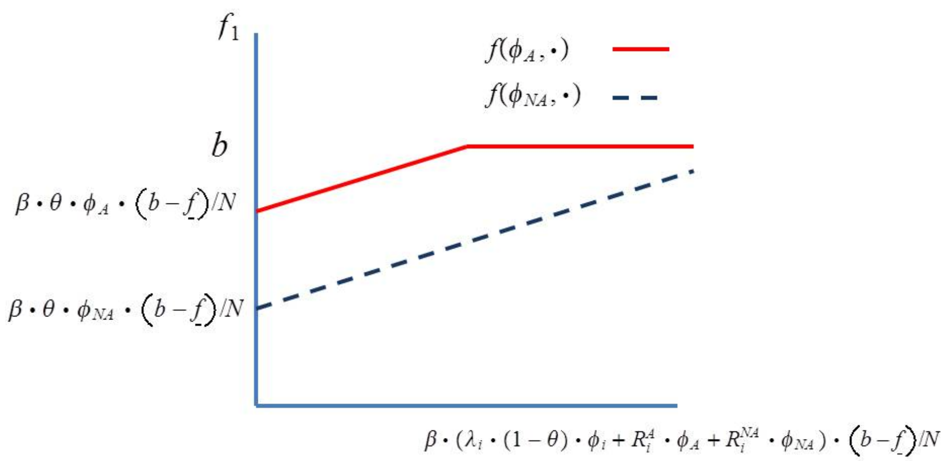
Figure 3: Municipalities with a Radio Network



(a) Case A



(b) Case B



(c) Case C

Figure 4: Model Cases

Table 1: Summary Statistics

Variable	Observations	Mean	S.D.
State of emergency declared	38752	0.08	0.28
Drought (- z-score of rainfall censored at zero)	38752	0.29	0.41
Municipality not aligned to federal government	38737	0.92	0.27
Radio station	38752	0.32	0.47
Network-connected radio station	38752	0.06	0.23
Television	38752	0.57	0.5
Network-connected television station	38752	0.55	0.5
Radio station associated to local politician	38752	0.08	0.27
Network-connected radio station associated to local politician	38752	0.01	0.1
Radio station associated to congressman	38752	0.02	0.15
Network-connected radio station associated to congressman	38752	0	0.04
Radio station associated to politician	38752	0.09	0.28
Network-connected radio station associated to politician	38752	0.01	0.090
Number of municipalities covered by radio network	38752	3.81	17.73
Total population covered by radio network (1,000 hab.)	38752	940	5000

Note: Local politicians includes mayors and local councilors. Congressmen include federal and state congressmen. Any politician includes both local politicians and congressmen.

Table 2: Federal government's bias against non-aligned municipalities

	(1)	(2)
Drought	0.211	0.244
	(0.372)	(0.380))
Non-alignment	0.003	0.007
	(0.016)	(0.035)
Drought x Non-alignment	-0.050	-0.062
	(0.021)**	(0.025)**
RD Controls	No	Yes
Observations	36,580	36,580
R-squared	0.405	0.408

Note: The outcome variable is an indicator of whether the federal government declares a municipality state of emergency. All specifications include municipality fixed effects. Standard errors are clustered at the state level. * p<.1, ** p<.05, *** p<.01.

Table 3: Estimates on the compensation effect of network-connected radio stations on the federal government's bias against non-aligned municipalities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Drought	0.280	0.349	0.294	0.354	0.310	0.377	0.304	0.365
	(0.422)	(0.475)	(0.473)	(0.515)	(0.430)	(0.479)	(0.474)	(0.516)
Non-alignment	0.009	0.003	0.001	-0.001	0.011	0.006	0.005	0.002
	(0.017)	(0.016)	(0.012)	(0.012)	(0.034)	(0.034)	(0.030)	(0.031)
Network-Connected Radio Station	0.041	0.048	0.044	0.048	0.028	0.035	0.031	0.036
	(0.063)	(0.074)	(0.067)	(0.076)	(0.060)	(0.072)	(0.064)	(0.074)
Drought x Non-align.	-0.062	-0.071	-0.065	-0.069	-0.072	-0.077	-0.075	-0.077
	(0.024)**	(0.025)***	(0.030)**	(0.030)**	(0.028)**	(0.028)**	(0.034)**	(0.034)**
Non-align. x Network-Conn. Radio Station	-0.067	-0.078	-0.072	-0.079	-0.068	-0.079	-0.072	-0.080
	(0.040)	(0.046)	(0.043)	(0.048)	(0.040)	(0.047)	(0.043)	(0.048)
Drought x Network-Conn. Radio Station	-0.07	-0.053	-0.068	-0.054	-0.055	-0.042	-0.057	-0.044
	(0.062)	(0.071)	(0.071)	(0.076)	(0.066)	(0.074)	(0.075)	(0.079)
Drought x Non-align. x Net.-Conn. Radio Stat.	0.168	0.146	0.166	0.147	0.149	0.133	0.148	0.134
	(0.075)**	(0.080)*	(0.077)**	(0.082)*	(0.068)**	(0.078)	(0.072)*	(0.081)
Drought x Non-align. x Local Radio		0.025		0.027		0.014		0.014
		(0.022)		(0.019)		(0.025)		(0.022)
Drought x Non-align. x Television			0.005	-0.005			0.006	-0.000
			(0.034)	(0.035)			(0.036)	(0.036)
RD Controls	No	No	No	No	Yes	Yes	Yes	Yes
Observations	36580	36580	36580	36580	36580	36580	36580	36580
R-squared	0.405	0.406	0.405	0.406	0.409	0.409	0.409	0.409

Note: The outcome variable is an indicator of whether the federal government declares a municipality state of emergency. All specifications include municipality fixed effects. Standard errors are clustered at the state level. Columns (2), (4), (6) and (8) include the following omitted regressors: local radio station, drought x local radio station, and non-alignment x local radio station. Columns (3), (4), (7) and (8) include the following omitted regressors: television station, drought x television station, and non-alignment x television station. * p<.1, ** p<.05, *** p<.01.

Table 4: Estimates on the effect of the network coverage of network-connected radios

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Coverage is the logarithmic number of municipalities a radio network covers						
Drought	0.298	0.302	0.299	0.329	0.334	0.329
	(0.430)	(0.430)	(0.430)	(0.439)	(0.438)	(0.438)
Non-alignment	0.009	0.009	0.009	0.011	0.013	0.012
	(0.018)	(0.017)	(0.018)	(0.034)	(0.034)	(0.034)
Coverage	0.008	0.108	-0.159	0.003	0.106	-0.157
	(0.019)	(0.046)**	(0.105)	(0.018)	(0.043)**	(0.095)
Drought x Non-alignment	-0.063	-0.062	-0.063	-0.073	-0.072	-0.073
	(0.025)**	(0.025)**	(0.025)**	(0.028)**	(0.028)**	(0.028)**
Drought x Coverage	-0.013	-0.023	-0.014	-0.010	-0.016	-0.010
	(0.017)	(0.032)	(0.017)	(0.018)	(0.034)	(0.019)
Non-alignment x Coverage	-0.018	-0.026	-0.017	-0.018	-0.027	-0.017
	(0.010)*	(0.017)	(0.010)	(0.010)*	(0.018)	(0.010)
Drought x Non-align. x Cov.	0.044	0.083	0.045	0.039	0.070	0.040
	(0.019)**	(0.036)**	(0.019)**	(0.017)**	(0.032)**	(0.018)**
RD Controls	No	No	No	Yes	Yes	Yes
Observations	36,580	36,580	36,580	36,580	36,580	36,580
R-squared	0.406	0.406	0.406	0.409	0.410	0.409

Panel B: Coverage is the logarithmic population covered by radio network (per 1,000 habitants)						
Drought	0.274	0.279	0.272	0.304	0.311	0.302
	(0.419)	(0.422)	(0.418)	(0.428)	(0.431)	(0.426)
Non-alignment	0.009	0.009	0.009	0.010	0.011	0.011
	(0.018)	(0.018)	(0.018)	(0.035)	(0.034)	(0.035)
Coverage	0.003	0.010	-0.040	0.002	0.010	-0.038
	(0.004)	(0.005)*	(0.042)	(0.004)	(0.005)*	(0.040)
Drought x Non-alignment	-0.062	-0.062	-0.062	-0.072	-0.072	-0.072
	(0.025)**	(0.025)**	(0.025)**	(0.028)**	(0.028)**	(0.028)**
Drought x Coverage	-0.005	-0.005	-0.005	-0.004	-0.004	-0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)
Non-alignment x Coverage	-0.004	-0.005	-0.004	-0.004	-0.005	-0.004
	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)
Drought x Non-align. x Cov.	0.010	0.012	0.010	0.009	0.010	0.009
	(0.005)**	(0.005)**	(0.005)**	(0.004)**	(0.005)**	(0.004)**
RD Controls	No	No	No	Yes	Yes	Yes
Observations	36,580	36,580	36,580	36,580	36,580	36,580
R-squared	0.405	0.406	0.406	0.409	0.409	0.409

Note: The outcome variable is an indicator of whether the federal government declares a municipality state of emergency. All specifications include municipality fixed effects. Standard errors are clustered at the state level. The measure of coverage is the number of municipalities that belong to the radio network in Panel A and the population covered by the radio network in Panel B. "Coverage" is the coverage of a radio network in aligned and non-aligned municipalities in columns (1) and (4), only in aligned municipalities in column (2) and (5), and only in non-aligned municipalities in columns (3) and (6). * p<.1, ** p<.05, *** p<.01.

Table 5: Estimates on differences in covariates of non-aligned municipalities that have a radio network operating

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A							
Outcome:	Population	Urbanization Rate	Area	Distance to State Capital	Coastal	Income per Capita	Gini Index
Non-alignment	-0.040	-0.037	-0.089	-0.003	0.001	-0.002	-0.002
	(0.036)	(0.009)***	(0.052)*	(0.007)	(0.009)	(0.004)	(0.002)
Radio Station	1.297	0.171	0.668	-0.011	0.038	0.055	0.014
	(0.064)***	(0.016)***	(0.093)***	(0.012)	(0.016)**	(0.006)***	(0.004)***
Radio Network	2.065	0.282	0.590	-0.010	0.020	0.149	0.006
	(0.122)***	(0.030)***	(0.177)***	(0.023)	(0.030)	(0.012)***	(0.008)
Non-alignment x Radio Station	0.030	0.037	-0.031	-0.006	-0.002	0.009	-0.002
	(0.071)	(0.017)**	(0.103)	(0.014)	(0.018)	(0.007)	(0.005)
Non-align. x Radio Net.	-0.168	-0.001	0.084	0.026	0.011	-0.007	0.003
	(0.134)	(0.033)	(0.194)	(0.025)	(0.033)	(0.013)	(0.009)
Observations	5,531	5,478	5,478	5,478	5,478	5,478	5,478
R-squared	0.377	0.189	0.054	0.002	0.006	0.177	0.008
Panel B							
Outcome:	Poverty Rate	Years of Schooling	Mortality Rate	Electricity	GDP per Capita	Revenue per Capita	Tax Revenue per Capita
Non-alignment	0.768	-0.007	0.003	-0.465	0.000	-0.057	-0.007
	(0.914)	(0.047)	(0.001)**	(0.690)	(0.000)	(0.044)	(0.003)***
Radio Station	-10.063	0.898	-0.009	6.574	0.002	-0.225	0.016
	(1.623)***	(0.084)***	(0.002)***	(1.226)***	(0.000)***	(0.078)***	(0.004)***
Radio Network	-26.014	2.093	-0.023	11.891	0.004	-0.165	0.055
	(3.089)***	(0.160)***	(0.004)***	(2.332)***	(0.001)***	(0.150)	(0.009)***
Non-alignment x Radio	-2.256	0.106	-0.002	1.063	-0.000	0.056	0.011
	(1.798)	(0.093)	(0.002)	(1.357)	(0.000)	(0.086)	(0.005)**
Non-align. x Radio Net.	0.629	-0.062	-0.002	0.617	-0.000	0.030	-0.006
	(3.388)	(0.175)	(0.005)	(2.558)	(0.001)	(0.164)	(0.009)
Observations	5,478	5,478	5,478	5,478	5,531	5,196	5,196
R-squared	0.101	0.216	0.052	0.056	0.030	0.006	0.060

Note: The outcome variable is an indicator of whether the federal government declares a municipality state of emergency. All specifications include municipality fixed effects. Standard errors are clustered at the state level. "Population" is the logarithmic of the total municipal population. "Area" is the logarithmic of the total municipal area. "Coastal" is an indicator of whether the municipality is on the coast. "Years of schooling" is the average years of schooling of the total municipal population. "Electricity" is the municipal share of households with electricity. * p<.1, ** p<.05, *** p<.01.

Table 6: Regression discontinuity estimates on differences in covariates of non-aligned municipalities that have a radio network operating

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A							
Outcome:	Population	Urbanization Rate	Area	Distance to State Capital	Coastal	Income per Capita	Gini Index
Non-alignment	-1.223	-1.815	18.679	2.638	0.037	0.582	0.513
	(7.194)	(1.762)	(10.555)*	(1.380)*	(1.821)	(0.724)	(0.495)
Radio Station	1.284	0.174	0.648	-0.008	0.038	0.057	0.013
	(0.064)***	(0.016)***	(0.094)***	(0.012)	(0.016)**	(0.006)***	(0.004)***
Radio Network	2.060	0.282	0.583	-0.005	0.020	0.152	0.006
	(0.123)***	(0.030)***	(0.180)***	(0.023)	(0.031)	(0.012)***	(0.008)
Non-alignment x Radio Station	0.023	0.031	-0.041	-0.007	-0.003	0.007	-0.001
	(0.071)	(0.017)*	(0.104)	(0.014)	(0.018)	(0.007)	(0.005)
Non-alignment x Radio Net.	-0.188	-0.004	0.076	0.023	0.009	-0.012	0.003
	(0.135)	(0.033)	(0.197)	(0.026)	(0.034)	(0.013)	(0.009)
Observations	5,386	5,340	5,340	5,340	5,340	5,340	5,340
R-squared	0.379	0.204	0.055	0.005	0.006	0.188	0.009
Panel B							
Outcome:	Poverty Rate	Years of Schooling	Mortality Rate	Electricity	GDP per Capita	Revenue per Capita	Tax Revenue per Capita
Non-alignment	-103.198	-0.704	-0.022	-260.553	0.031	13.794	0.622
	-183.029	-9.467	-0.245	(138.456)*	-0.05	-8.81	-0.48
Radio Station	-10.691	0.92	-0.01	6.818	0.002	-0.216	0.019
	(1.630)***	(0.084)***	(0.002)***	(1.233)***	(0.000)***	(0.079)***	(0.004)***
Radio Network	-26.505	2.112	-0.024	11.91	0.004	-0.143	0.059
	(3.115)***	(0.161)***	(0.004)***	(2.356)***	(0.001)***	-0.153	(0.008)***
Non-alignment x Radio Station	-1.55	0.074	-0.001	0.895	0	0.054	0.007
	(1.805)	(0.093)	(0.002)	(1.365)	(0.001)	(0.088)	(0.005)
Non-alignment x Radio Net.	1.34	-0.101	-0.001	0.641	-0.001	0.014	-0.012
	(3.412)	(0.177)	(0.005)	(2.581)	(0.001)	(0.168)	(0.009)
Observations	5,340	5,340	5,340	5,340	5,386	5,061	5,061
R-squared	0.108	0.225	0.058	0.061	0.032	0.007	0.081

Note: The outcome variable is an indicator of whether the federal government declares a municipality state of emergency. All specifications include municipality fixed effects. Standard errors are clustered at the state level. ”Population” is the logarithmic of the total municipal population. ”Area” is the logarithmic of the total municipal area. ”Coastal” is an indicator of whether the municipality is on the coast. ”Years of schooling” is the average years of schooling of the total municipal population. ”Electricity” is the municipal share of households with electricity. * p<.1, ** p<.05, *** p<.01.

Table 7: Estimates on the effect of ownership and association to network-connected radio station for all type of politicians (mayors, local councilors, congressmen)

	(1)	(2)	(3)	(4)
Drought	0.219	0.277	0.252	0.308
	(0.380)	(0.419)	(0.387)	(0.425)
Non-alignment	0.005	0.009	0.007	0.010
	(0.017)	(0.017)	(0.036)	(0.035)
Politician Owner	0.099	0.065	0.110	0.077
	(0.107)	(0.095)	(0.109)	(0.098)
Drought x Non-align.	-0.050	-0.062	-0.061	-0.072
	(0.022)**	(0.024)**	(0.025)**	(0.028)**
Drought x Politician Owner	0.104	0.199	0.107	0.186
	(0.374)	(0.389)	(0.379)	(0.391)
Non-align. x Politician Owner	-0.101	-0.047	-0.117	-0.063
	(0.116)	(0.101)	(0.119)	(0.103)
Drought x Non-align. x Pol. Owner	-0.025	-0.203	-0.061	-0.225
	(0.334)	(0.364)	(0.336)	(0.368)
Radio Network		0.036		0.023
		(0.056)		(0.052)
Drought x Radio Network		-0.096		-0.079
		(0.059)		(0.058)
Non-alignment x Radio Network		-0.062		-0.062
		(0.034)*		(0.034)*
Drought x Non-align. x Radio Net.		0.194		0.172
		(0.099)*		(0.092)*
RD Controls	No	No	Yes	Yes
Observations	36,580	36,580	36,580	36,580
R-squared	0.405	0.406	0.409	0.409

Note:The outcome variable is an indicator of whether the federal government declares a municipality state of emergency. All specifications include municipality fixed effects. Standard errors are clustered at the state level. * p<.1, ** p<.05, *** p<.01.

Table 8: Estimates on the effect of connectivity to radio stations in other municipalities by shared ownership

	(1)	(2)	(3)	(4)
Drought	0.264	0.314	0.296	0.344
	(0.396)	(0.438)	(0.402)	(0.444)
Non-alignment	0.005	0.008	0.011	0.013
	(0.019)	(0.019)	(0.035)	(0.034)
Shared Ownership	-0.014	0.032	-0.029	0.017
	(0.047)	(0.067)	(0.045)	(0.064)
Drought x Non-align.	-0.051	-0.056	-0.060	-0.066
	(0.023)**	(0.025)**	(0.027)**	(0.029)**
Drought x Shared Ownership	0.027	0.061	0.038	0.069
	(0.047)	(0.050)	(0.047)	(0.051)
Non-align. x Shared Ownership	-0.012	0.006	-0.011	0.008
	(0.028)	(0.023)	(0.027)	(0.022)
Drought x Non-align. x Shared Own.	0.011	-0.033	-0.000	-0.039
	(0.049)	(0.052)	(0.048)	(0.050)
Radio Network		0.038		0.024
		-0.058		-0.054
Drought x Radio Network		-0.091		-0.080
		(0.066)		(0.067)
Non-alignment x Radio Network		-0.070		-0.072
		(0.034)**		(0.035)*
Drought x Non-align. x Radio Network		0.186		0.171
		(0.084)**		(0.076)**
RD Controls	No	No	Yes	Yes
Observations	36,580	36,580	36,580	36,580
R-squared	0.405	0.406	0.409	0.409

Note: The outcome variable is an indicator of whether the federal government declares a municipality state of emergency. All specifications include municipality fixed effects. Standard errors are clustered at the state level. "Network by Shared Ownership" indicates that a radio station has a board member that is also part of the board of another radio station located in a different municipality. * p<.1, ** p<.05, *** p<.01.