The Role of Networks in Political Economy

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Submitted to the Department of Economics
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy in Economics

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 2013

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Abstract

This dissertation investigates the different roles that networks play in political economy. In the first chapter, I study how a political party uses electoral data to monitor and incentivize the political brokers who control its clientelistic networks. I study networks organized around rural communal lands in Mexico, which are largely controlled by the Institutional Revolutionary Party (PRI). I use the fact that the level at which brokers operate (the communal land) does not necessarily coincide with the level at which the electoral data is disclosed (the electoral section). Guided by a simple model, I compute a measure of how informative the available electoral data is about the performance of the PRI's political brokers, as a function of the degree of overlap between communal lands and electoral sections. I compare the vote share for the PRI in communal lands where the electoral data is more or less informative, both when the PRI does and does not have access to resources to fund and incentivize brokers. The results suggest that clientelistic networks contribute significantly to the enforcement of clientelistic transactions.

In the second chapter, which is co-authored with Joana Monteiro, we study 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.

In the third chapter, which is co-authored with Arun Chandrasekhar and Emily Breza, we shed light on the relationship between network characteristics and investment decisions through a lab experiment in the field. We focus on the role for third parties to act as informal contract enforcers. Our protocol builds on a basic two-party trust game with a sender and receiver, to which we introduce a third-party to serve as either a monitor or punisher. The ex-ante benefits of a third party judge are ambiguous. On one hand, a third party may result in larger sender transfers due to her ability to punish. On the other hand, the punisher might act in a way to build reputation or may crowd-out intrinsic motivation. Importantly, these costs and benefits of a punisher might vary with her centrality in the network. Our findings are consistent with both the role for the punisher to induce efficiency and to crowd out intrinsic motivation. They are also consistent with the effects of reputation-building by the punisher. Importantly, we find that very network-peripheral punishers are detrimental to efficiency, while network-central individuals may improve outcomes when given the technology to punish. We also show that these results cannot be explained by either the fact that the punisher also acts as a monitor, or by the punisher's characteristics such as elite status, educational attainment, caste, or proxies for wealth.

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Acknowledgments

I thank my advisers, Daron Acemoglu, Esther Duflo, James Snyder, and Tavneet Suri for their invaluable feedback and support at all stages of this dissertation. I am grateful to Emily Breza, Arun Chandrasekhar, Cynthia Kinnan, Joana Monteiro and Juan Pablo Xandri with whom I had the pleasure to work on the chapters of this dissertation and the papers that never made to it. This dissertation benefited from helpful conversations and suggestions from Abhijit Banerjee, Dave Donaldson, Matt Elliott, Ben Faber, Leopoldo Fergusson, Camilo García-Jimeno, Ben Golub, Daniel Hidalgo, Matthew O. Jackson, Chappell Lawson, Jacob Leshno, Ben Olken, Dan Posner, Pablo Querubin, Roberto Ramos, Ashish Shenoy, and Teppei Yamamoto. Participants at various talks at Berkeley, CIRANO Workshop on Networks in Trade and Finance, Columbia, Harvard, ITAM, MIT, MFA Meetings, NEDUC Meetings, Northwestern, and San Diego provided essential feedback.

This thesis would have not been possible without the assistance of María José Villaseñor during the field work in México, the help of our team of surveyors while conducting experiments in India, and the restless work of the staff at the MIT libraries in dealing with my countless requests. I am eternally grateful to my parents who supported me along the way with their teachings, prayers, and love. I specially thank the Menchaca Brandan family, who adopted me as their own son and encouraged me to work on México. Finally, last but far from least, I dedicate this thesis to Alejandra Menchaca, the love of my life, who patiently supported me throughout the process of this dissertation.

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Chapter 1

Monitoring Political Brokers: Evidence from Clientelistic Networks in México

1.1 Introduction

Political clientelism –the distribution of benefits targeted to individuals or groups in exchange for electoral support– is widespread in the developing world.[1] Both the political science and economics literatures argue that clientelism undermines democracy and economic development: it weakens the ability of citizens to hold elected officials accountable, and it diverts public resources to fund clientelistic transactions.[2] While the secret ballot does represent an obstacle for clientelism, the literature argues that parties are able to circumvent it using local political brokers, who control networks of voters and deliver their votes.[3] To mobilize these so called clientelistic networks, parties need to control resources to fund and incentivize brokers. Additionally, parties need to monitor the performance of their brokers to make sure they deliver the

[1]Among others, Kitschelt and Wilkinson (2007), and Schaffer (2007) document the prevalence of clientelism in the developing world.

[2]Hicken (2011) provides a comprehensive survey of the recent literature on clientelism.

[3]We later discuss different theories and supporting empirical evidence that Chandra (2004), Stokes (2005), Nichter (2008), Finan and Schechter (2012), and Lawson and Greene (2012) provide.

votes of their networks. While the literature has addressed the use of public resources for clientelistic purposes, we have a limited understanding as to how parties monitor their brokers.

In this paper, we study how a political party uses electoral data to monitor the brokers that control its clientelistic networks. We study the context of clientelistic networks on communal lands in México, which are largely controlled by the Institutional Revolutionary Party (PRI), a party that has traditionally relied on patronage and clientelistic practices for electoral gain. Communal lands, which were allocated through a land redistribution policy after the 1910 Mexican revolution, are tracts of land where property rights belong to communities as a whole, but each individual works on a specific plot and is entitled to its entire product. In each communal land there is an elected official that participates in the distribution of the government programs within the communal land. The literature and the fieldwork we conducted show that, in the states under the PRI's control, these officials operate as the PRI's political brokers, trading access to public programs for votes (Mackinlay Grohmann (2011)). This is an important phenomenon since communal lands represent 50% of agricultural land in México and, according to the Federal Electoral Institute (IFE), their peasants have the largest risk of being subject to clientelistic practices (IFE (2012)). [4]

Our identification strategy exploits two sources of variation. First, we use whether the PRI controls the state government at the time of the election to measure whether the PRI controls the resources needed to fund and incentivize brokers. State governments control the implementation of the bulk of public programs at the local level and incumbency is necessary to manipulate government funds for clientelistic purposes (Beer (2007), Holzner (2010)).[5] Second, to measure differences in the PRI's capacity to monitor its brokers, we exploit plausibly exogenous variation in overlap between the level at which brokers operate –communal lands– and the level at which the electoral data the PRI can use to monitor its brokers is disclosed –electoral

[4]Figure 1-1 illustrates the distribution of communal lands in México.

[5]According to the municipal and state public finance records, the annual expenditure of the state governments represents 80% of the joint expenditure of municipal and state governments.

sections.[6] Figure 1-2 and Figure 1-3 shows some examples of the variation in this overlap.

The literature, the fieldwork experience and the popular press suggest that the PRI uses electoral data to monitor the votes they secured through clientelistic practices.[7] In particular, Holzner (2003) suggests that the PRI monitors the electoral support from communal lands using electoral data and punishes the political brokers that fail to deliver the vote of their communities. During our fieldwork in the month prior to the 2012 federal election, several peasants, who were polling station officials representing the PRI in past elections, stated that the party watched electoral section level outcomes closely to make sure that the figures matched the expected support.

To guide our empirical analysis, we develop a simple model that characterizes the relationship between the PRI's monitoring capacity over its broker and the electoral support for the PRI in a communal land. In the model, the PRI and another party compete for votes offering a policy menu of public goods and transfers to voters. In addition, when the PRI is the incumbent party, it has access to resources to fund and incentivize a broker to mobilize its clientelistic networks. The PRI uses the available electoral section-level data to extract a signal about its broker's performance on which it conditions his funding. The overlap between the communal land and its overlapping electoral sections determines the precision of the signal, and therefore, the PRI's monitoring capacity. The model predicts that, when the PRI controls the government, communal lands where the electoral data allows high PRI monitoring ability should exhibit a larger electoral support for the PRI. The model predicts no difference when another party controls the government.

As a measure of the PRI's ability to monitor its brokers, we use what we denote as the *fit* of a communal land, which is the weighted average proportion of communal land voters in the electoral sections where they vote. For illustrative purposes, Fig-

[6]Electoral sections are the smallest electoral demarcation in México.

[7]An illustrative example from the popular press comes from the state of Nuevo Leon, where the PRI candidate for the state governorship acknowledge that they had an army of 100 thousand individuals to monitor the election (of 2,677,343 registered voters) and that 30 thousand of those were trained to work as representatives at the polling stations. The National Action Party (PAN) contender argued that the goal of such an army was to monitor the votes they secured through clientelistic practices (Reyes and Romo (2003)).

ure 1-4 shows one case of large *fit* and one case of small *fit*. *Fit* is a measure of overlap between communal lands where brokers operate and electoral sections where the PRI observes the electoral results it can use to monitor them, and thus it naturally affects the PRI's monitoring ability. A larger *fit* improves this ability, since the electoral section-level data is more informative about the work of brokers.

The results of the empirical analysis support the predictions of the model. Communal lands with larger *fit* display a larger electoral support for the PRI. In addition, this difference in votes only happens when the PRI controls the state government. To address the concern that results might be driven by omitted unobservable variables that predict PRI's electoral support and correlate with *fit*, we conduct a placebo test, looking at incumbency at the municipal rather than at the state government. PRI's incumbency at the municipal level is correlated with PRI's electoral support but should not allow the PRI to mobilize its clientelistic networks on communal lands since municipalities have a very limited budget relative to state governments. Our placebo exercise indicates that there is no differential effect of *fit* on the electoral support for the PRI.

The estimated effect of the communal land *fit* is meaningful. A one standard deviation increase in *fit* corresponds to a 1.5 percentage points increase in the vote share for the PRI. Such an effect accounts for one fifth of the incumbency advantage that the PRI enjoys when it controls the state government.

We then provide evidence that suggests that clientelistic networks operating in communal lands have an aggregate effect on election and policy outcomes. We use a difference in differences strategy where we compare municipalities with different shares of communal lands while controlling for the share of agricultural land, which includes communal and privates lands. We show that, when the PRI controls the state government, municipalities with a larger share of communal lands exhibit an increased vote share for the PRI and a lower provision of public goods, measured by the number of schools and teachers per capita. These results are not driven by differential pretrends or differences in the economic development of communal and private lands. A similar placebo test as before indicates no differential effect of the share of communal lands on electoral and policy outcomes.

Our work is closely related to the literature on clientelistic networks.[8] In seminal work, Stokes (2005) observes that machines use their deep insertion into voters' social networks to try to circumvent the secret ballot and infer the votes of individuals. Chandra (2004) advocates that clientelistic networks facilitate the monitoring of turnout, an idea later formalized and tested by Nichter (2008). Auyero (2000), Finan and Schechter (2012), and Lawson and Greene (2012) argue that clientelistic networks mitigate asymmetric information about voter's reciprocity, which allows parties to target benefits to individuals who are more likely to reciprocate with their vote.

Our work is also related to Robinson and Verdier (2013), Keefer (2006), and Keefer (2007), who argue that clientelism leads to an underprovision of public goods. We provide empirical evidence that supports their claim. To our knowledge, we are the first to provide empirical evidence that clientelism has a significant effect on aggregate electoral and policy outcomes. Finally, our work is also related to the literature that looks at the overlap between political markets and the level at which different types of information are disclosed. A prominent example is Snyder and Stromberg (2010), who look at the fit between political districts and newspaper markets.

Section 1.2 describes the historical development of clientelistic networks on communal lands in México. It also discusses the current clientelistic practices in these lands and reports the qualitative evidence that was collected during our fieldwork. To guide the empirical work, section 1.3 presents a model that captures the relationship between the PRI's monitoring capacity over its political brokers and the electoral support for the PRI in communal lands. Section 1.4 presents the empirical strategy and data. The empirical tests of the predictions of the model are in section 1.5. In section 1.6, we provide empirical evidence that supports that clientelistic networks on communal lands have aggregate effects on election and policy outcomes. Section 1.7 concludes.

[8]Also see Hicken (2011), Kitschelt and Wilkinson (2007), Manzetti and Wilson (2007), and Schaffer (2007) for a discussion on the work that documents the presence and features of clientelistic practices in developing economies.

1.2 Background

In this section, we highlight the main features of the historical development of clientelistic networks on communal lands. We place particular emphasis on how the PRI captured the administrative office of each communal land. We then explain current clientelistic practices in communal lands. We stress the importance of the PRI's control of state government to mobilize its clientelistic networks and the inability of other parties to take over the PRI's networks in states lost by the PRI. We conclude by presenting supporting qualitative data we collected during fieldwork in twelve municipalities across four states. We complement this data with qualitative evidence from the Mexican press to give a broader view of these issues across the whole of México.

1.2.1 Historical Background

After the 1910 Mexican revolution, where the redistribution of land was the central demand of the rural insurgents, there was significant land redistribution (Knight (1986)). Article 27 of the 1917 Constitution established the distribution of land in the form of either agrarian communities or *ejidos*, to which we refer jointly as communal lands. [9] The 1917 Constitution established the office of the commissariat to administer each communal land. Commissariats are democratically elected officials that mediate between the peasants of the communal lands and the government. Among their many responsibilities, they are in charge of the access and distribution of the government programs for their communities.

During its seven decades in power, the PRI established clientelistic networks on communal lands by controlling the commissariats through the state agrarian leagues of the National Peasant Confederation (CNC). The poor peasants living in communal lands, with no individual property rights, faced difficulties accessing private

[9] Agrarian communities represented the restitution of lands that were expropriated from communities of peasants during the rule of Porfirio Díaz between 1876 and 1910. During this period, there was extensive illegal expropriation of lands from communities of small landholders by landlords that led to a dramatic land concentration. *Ejidos* consisted of land that was granted to communities of petitioners that never had land. The logic behind the communal property rights over the land was to avoid the illegal expropriation and land concentration that took place during the rule of Porfirio Díaz.

credit markets and relied on the government for access to agricultural inputs. This dependence, together with their internal legal organization, made communal lands the perfect ground for the development of clientelistic networks (Sabloff (1981)). Commissariats became the PRI's political brokers, trading access to public programs for votes (Baños Ramírez (1988)), Mackinlay Grohmann (2011).[10] In turn, commissariats enjoy the rents associated with their powerful position. Their discretionary control in the distribution of public programs to the interior of their communities facilitates the extraction of rents (González Martínez (1997), Sabloff (1981)).

1.2.2 Recent Changes

México underwent a profound democratic transition in the last two decades that paradoxically led to a strengthening of the clientelistic practices in rural México (Schedler (2004)). A series of political reforms, beginning with a constitutional reform approved in 1989 and led by the creation of the Federal Electoral Institute (IFE) in 1990, eliminated vote fraud practices (e.g., ballot stuffing, intimidation, manipulation of voter registration lists, issuing multiple voting credentials to PRI supporters, multiple voting by PRI supporters). The PRI's response to the loss of its traditional methods of controlling election results was to change its electoral strategy by shifting from vote fraud to clientelism and vote buying.

In the last two decades, the functioning of the CNC and the PRI's clientelistic networks on communal lands has heavily relied on the funds from the PRI's state governments.[11] Municipal governments are very weak and state governments are responsible for the execution of the bulk of public programs at the local level. The PRI's state governors took advantage of the fiscal decentralization that took place in the 1990's to make use of the federal funds for clientelistic exchanges and the

[10]Often, the PRI operates through a local cacique instead, who in turn controls the commissariats. Caciques usually start as commissariats (González Martínez (1997)).

[11]An illustrative example comes from the state of Tlaxcala, where the PRI lost the state government in 1991, and returned in 2011. When the PRI recovered the state governorship, the president of the CNC in this state acknowledged that the peasant organization had lost presence in the state as a result of the political rivalry with the past two state governments. However, he asserted that he trusted that the organization would be able to recover its strength with the return of the PRI to the state government (Osorno Xochipa (2011)).

strengthening of their clientelistic networks in rural areas (Cornelius (2002)). The role of the PRI's state governments in the endurance of the party at the local level became even more important after the PRI lost the federal government to the National Action Party (PAN) in the 2000 presidential election (Langston (2003)).

Despite the PRI's loss of several states, and the consequent weakening of the influence of the CNC in these states, other political parties have not been able to contest the power of the CNC and take over the PRI's political networks in communal lands. The main reason is that the PAN and the Party of the Democratic Revolution (PRD) were not able to create a structure of control of commissariats in communal lands like the PRI did with the CNC during its long tenure in power.[12] The PAN created the Rural Action Program (PAR) in 2004 to coordinate the PAN's rural supporters (Cortés (2004), Soto (2004)). However, the PAN's project was a total failure (Galicia (2012)). In 1988, dissidents of the PRI and the CNC founded the Cardenist Peasant Central (CCC) to support the main contender against the PRI's candidate for presidency and challenge the PRI and the CNC's hegemony in the rural sector. Despite the fact that affiliates of the CCC belong to several leftist parties, including the PRI, the CCC has been mostly associated with the various forms of the PRD. However, the weight of the CCC in the communal land sector is minimal relative to that of the CNC. The most conservative estimates indicate that the CCC's affiliates account for less than 3% of the CNC's.[13]

The CNC has no equal. It has 88 federal legislators in the Chamber of Deputies, which represent 18% of the total, and a comparable political strength in the states. Thus, in coordination with state government, the CNC plays a very important role in the allocation of resources at the local level (Galicia (2012)). The manipulation of social programs for electoral purposes in México is severe (Martínez (2010)). Alianza Cívica, the main NGO that monitors electoral practices in México, estimates that during the 2009 election 27% of citizens were subject to vote buying and the conditioning of social programs for their votes (Zermeño (2012)). There are no separate

[12]The PAN and the PRD are mostly urban parties with weaker presence in rural areas.

[13]According the CCC website, http://cccardenista.net/, it has one hundred thousand affiliates. According to Zermeño (2011), unofficial figures suggest that the CNC has 4.5 million affiliates.

estimates for the individuals living in communal lands but, according to the figures of the CNC, its affiliates contribute more than 35% of the PRI's votes. After the PRI's loss in the 2000 presidential election, the federal legislators of the CNC claimed that they were the only PRI sector that fulfilled its vote quota, 6 million votes (Ramos (2000)). [14]

1.2.3 Evidence from Fieldwork and the Popular Press

During the fieldwork we conducted in the month prior to the 2012 presidential election, we observed a strong presence of the PRI's clientelistic practices in communal lands in the states that have always been under PRI control. On the contrary, we did not observe such practices in communal lands in states that the PRI previously lost to other parties. We conducted fieldwork in twelve municipalities of four states of México, which present a range of political configurations that are particularly relevant for our analysis: México, Morelos, Puebla and Tlaxcala.[15] The state of México is the PRI's largest stronghold in México; it has always controlled the state government and the majority of the municipal governments. Similarly, the PRI just lost the state of Puebla to the PAN in 2010. In contrast, in Morelos, the PRI lost the state government in 2000 to the PAN, which had control until 2012, when it lost to the PRD. Likewise, in Tlaxcala, the PRI just returned to state government in 2011 after two terms of non-PRI governors. During fieldwork we noted a strong prevalence of the PRI's clientelistic practices in communal lands in the state of México and important residuals of these in the state of Puebla. However, these practices appeared to be absent in the states of Morelos and Tlaxcala.

[14]It is also worth a brief mention of México's communal land certification program, which started in 1992 with the reform of Article 27 of the Constitution. The so called PROCEDE (*Programa de Certificación de Derechos Ejidales y Titulación de Solares*) consists of two main stages. The first stage constitutes a certification process in which each communal land has its boundaries delineated, and its land is divided into land for common use and land for individual plots. Additionally, the plots designated for private use are demarcated and renting is permitted. In a second stage, if a super-majority of the communal land members agree, peasants have the option of registering their plots into the private domain and then their land enters the private market. While most communal land has gone through the first stage, less than 3% has entered the private domain. Consequently, the PROCEDE has had a modest impact on the socio-economic situation of communal lands.

[15]Please refer to Appendix 1.7 for detailed supporting anecdotal evidence.

In the state of México, we found evidence that supports the presence of PRI clientelistic practices. We observed a close relationship between commissariats and the PRI's government: in all municipalities we visited, at least one commissariat or relative of the commissariat works in the government. Also, commissariats stated that the PRI's supporters in communal lands receive considerably more public assistance from the PRI's government. They also added that, for that to happen, it is crucial that commissariats are aligned with the party. In addition, we observed a conditioning of government support within communal lands by commissariats.

In the state of Puebla, we noticed that the PRI's clientelistic networks on communal lands are still present but they are weakening. The state of Puebla provides an interesting case study given the recent transition from the PRI to the PAN at the state government level. As in the state of México, we observed that most commissariats, which were elected under a PRI's governor, continue to support the PRI openly. Not surprisingly, the PRI's commissariats report a significant decrease in government aid with the recent party transition. Commissariats also mention a radical change in the conditioning of the state government assistance for electoral support. When asked about this matter, a commissariat explained, "when the PRI was in government, the conditioning was a serious problem. If we voted for the PRI, there was aid, if we did not, we were marginalized. With the change in government, everything is more flexible; people can vote for the party they want and the aid will still come."

The evidence from newspapers reflects that our observations from the states of México and Puebla are not unique to those states. Given the limited geographical coverage of our fieldwork, we complement it with qualitative data from the popular press. Qualitative evidence from newspapers suggests that, while the individuals from communal lands that support the PRI benefit the most when it comes to receiving aid, assistance to and within communal lands is conditioned on political support.

Further, in the states of México and Puebla, we observed that parties intervene in the political life of the communal lands to gain their political control. The PRI's control of the commissariats is a political asset since it is a necessary condition for the PRI to be able to mobilize its clients in the communal lands. Thus, candidates for commissariat often run representing a party, and vote buying and fraud characterize elections for commissariats. This situation is not unique to the states of our fieldwork. Many other cases show up in newspapers.

In the states of Morelos and Tlaxcala, we found limited evidence on clientelistic practices in communal lands. Commissariats stress that, while there was a conditioning of the assistance for electoral support in the times before the PRI lost the state government, that is no longer the case. Additionally, they mention that the rules of the programs of the state government are clear and these are not distributed to favor individuals associated to a given political party. It is worth noticing the relevance of these facts for the state of Tlaxcala, where the PRI returned to power two years ago. They suggest that, despite the return of the PRI to the state government, clientelistic exchanges are not as strong as before the PRI lost the state government.

Finally, the evidence we observed during fieldwork corroborates the mentioned role of the CNC. On the one hand, commissariats and peasants in the state of México report current support from the CNC. Evidence from newspapers also reveals that, in the states under the control of the PRI, the CNC conditions government assistance for electoral support to the PRI. On the other hand, commissariats and peasants of the states of Morelos, Puebla and Tlaxcala agree that the CNC disappeared together with the PRI when the PRI lost the state elections. However, commissariats in the state of Tlaxcala, where the PRI recovered the state government recently, indicated that there were several signs that the CNC was coming back to action. Additionally, we observed evidence that the PRI's clientelistic networks are latent and the return of the PRI to the state government, with the consequent strengthening of CNC, could reanimate the PRI's clientelistic practices in communal lands. A commissariat pointed out, "I do not support the PRI but, if the CNC returns, we will have to support the PRI so that we get government help."

1.3 Model

Our goal in this section is to develop a simple model to guide the empirical work. The model makes two contributions to our analysis. First, it characterizes the relationship between the PRI's capacity to monitor its political broker and the electoral support for the PRI in such a communal land. The model studies the case where the PRI controls the state government as well as the case where it does not. Second, the model links the PRI's monitoring capacity to the communal land *fit* we measure in the data. The main prediction of the model is that, when the PRI controls the state government, there should be a larger support for the PRI in communal lands where a large *fit* allows better PRI monitoring capacity. However, there should be no difference otherwise.

1.3.1 Setup

The model builds on a standard probabilistic voting model to which we add a standard principal-agent problem that incorporates the way the PRI monitors and provides incentives to its political broker so that he delivers the votes of its network. As the anecdotal evidence suggests (Holzner (2003)), the PRI faces an agency problem since, once the broker receives funds from the PRI, he has no incentives to exert any effort or to spend the funds to persuade voters to vote for the PRI. To address this problem, the PRI uses the available electoral data to extract a signal about the broker's performance on which it conditions funds to incentivize him.

Consider a communal land c inhabited by a population of peasants normalized to one. There are two political parties, the PRI and other party denoted by O that compete for the control of the government of state where the communal land is located. When in office, a party p uses the budget b^c, assigned to the communal land, to invest in a public good g_p^c, to make a transfer τ_p^c to individuals, and to potentially fund and incentivize a political broker, w_p, $\left(g_p^c + \tau_p^c + w_p \leq b^c\right)$.

A political broker that works for a given party p can exert an effort, a_p, to persuade voters to vote for party p. The effort is costly and a unit of effort a_p has a convex cost $\frac{1}{2}a_p^2$. The effort a_p can potentially encompass the energy to investigate the voters with the largest reciprocity as well as the funds that the broker targets to these voters (Finan and Schechter (2012), and Lawson and Greene (2012)). It could also represent the use of resources to identify and mobilize unlikely-to-vote supporters of party p (Chandra (2004), Nichter (2008)).

Parties choose the level of public goods, transfers and funds for political brokers to maximize their vote share and peasants are assumed to vote sincerely. From the perspective of parties, the utility of peasants of the communal land over the public good, the transfer, and political broker's effort is

$$u_p^{i,c}\left(g_p^c, \tau_p^c, a_p\right) = -\exp\left(-\left(u^c\left(g_p^c\right) + \tau_p^c + a_p + \left(\eta^c + \varphi^{i,c}\right) I_{PRI}\right)\right), \qquad (1.1)$$

where $u^c(\cdot)$ is increasing in its argument and strictly concave, I_{PRI} is an indicator for the PRI coming to the state office, $\varphi^{i,c}$ is an idiosyncratic ideology shock towards the PRI distributed uniformly on $\left[-\frac{1}{2}, \frac{1}{2}\right]$, and η^c is a normally distributed error that reflects the uncertainty about $u^c(\cdot)$, $\eta^c \sim \mathcal{N}(0, \sigma_c^2)$. We interpret σ_c^2 as the degree of aggregate uncertainty about the potential voting behavior of peasants of the communal land. Note that we take a reduced form approach and assume that the effort of the political broker a_p enters directly in the average voter's utility over party p's policies. This assumption reflects that the effort that the political broker exerts, a_p, is able to influence voters' utility for party p.

Given the setup, as in a standard probabilistic voting model, the vote share for the PRI is

$$\pi_{PRI}^c = \frac{1}{2} + \left(u^c\left(g_{PRI}^c\right) - u\left(g_O^c\right) + \tau_{PRI}^c - \tau_O^c + a_{PRI} - a_O\right) + \eta^c, \qquad (1.2)$$

where η^c represents the uncertainty about the potential voting behavior of peasants in communal land for a given policy vector $(g_{PRI}^c, \tau_{PRI}^c, a_{PRI}, g_O^c, \tau_O^c, a_O)$.

We assume that only the PRI has access to a political broker. This assumption mimics the evidence from the literature and our fieldwork, and the fact that the peasant organizations of other political parties are minimal relative to the PRI's CNC.

Additionally, we assume that, only when the PRI controls the state government, is it able to use public resources to fund its political broker to mobilize its networks.[16] Henceforth, since a_O and w_O are always zero, we drop the subscript in a_{PRI} and w_{PRI}.

When in control of the state government, the PRI offers a political broker operating in the communal land a linear contract $w = f + v \cdot s$, with $f,\ v \geq 0$, where $s = a + \varepsilon$ represents a noisy signal of a with $\varepsilon \sim \mathcal{N}(0, \sigma_\varepsilon^2)$, which we discuss in depth shortly.[17] For simplicity we assume that the political broker has the following utility over a contract (f, v) of

$$E\left[u^b(f,v)\right] = E\left[-\exp\left(-\left(f + v \cdot s - \frac{1}{2}a^2\right)\right)\right]. \tag{1.3}$$

Additionally, we assume that the political broker has an outside option of 0, and hence, a contract (f, v) has to be such that $E\left[u^b(f,v)\right] \geq 0$.[18]

1.3.2 Timing

The timing of the model is as follows:

1. nature draws the incumbent party,

2. each party p announces (g_p^c, τ_p^c),

3. the PRI proposes contract (f, v) to its political broker and he accepts,

4. shocks $\{\varphi^{i,c}\}_{i\in c}$ and η^c are realized,

5. broker exerts effort a,

6. voters vote sincerely,

[16]We could think of this game as the stage game of a dynamic game where current funds destined to mobilize political brokers and to fund clientelistic transactions were determined in the past election. Hence, when voters vote for the PRI, they are aware that a share of the future budget will be used for clientelistic purposes in future elections.

[17]The restriction to linear contracts is common in the literature, justified by the work by Holmstrom and Milgrom (1987).

[18]In equation (1.3) we implicitly assume that the broker experiences no utility over g_p^c, τ_p^c, η^c and $\varphi^{i,c}$. This avoids considering the potential convoluted case where the broker ends up working for the PRI but voting for the other party.

7. party p wins,

8. winner implements $\left(g_p^c, \tau_p^c\right)$, and

9. The PRI extracts a signal s over the effort a and pays its political broker w according to (f, v),

where 3., 5. and 9. occur only if the PRI controls the state government.

1.3.3 Signal Extraction

To construct the signal s on which the PRI conditions funds to the broker, the PRI uses the election data available at the electoral section level as well as its imperfect knowledge about the potential voting behavior of individuals inside and outside communal lands.[19] For exposition, we consider the case where the peasants of the communal land vote in a single electoral section e. The electoral section has a share α of voters that come from the communal land and a share $1-\alpha$ from outside the communal land. Note that α coincides with our definition of the communal land *fit*. Thus, the electoral support for the PRI of the voters from the electoral section e is

$$\pi_{PRI}^e = \alpha \pi_{PRI}^c + (1-\alpha)\, \pi_{PRI}^{nc}, \tag{1.4}$$

where π_{PRI}^c, which is defined in equation (1.2), represents the electoral support for the PRI of the voters that belong to the communal land. π_{PRI}^{nc} is the analogous element for the voters outside the communal land but without a since we assume that no clientelistic networks operate in non-communal lands.[20]

Recall that η^c and η^{nc} are independently normally distributed errors $-\eta^c \sim N\left(0, \sigma_c^2\right)$ and $\eta^{nc} \sim N\left(0, \sigma_{nc}^2\right)-$ that reflect the uncertainty about π_{PRI}^c and π_{PRI}^{nc}, respectively. We assume that $\sigma_c^2 \leq \sigma_{nc}^2$ to replicate that political brokers and the PRI might have better information about the potential voting behavior of peasants in communal lands relative to the one of outsiders.

[19]This knowledge about the potential voting behavior of individuals comes from the known part of their preferences and the promises over the public good and the transfer by parties.

[20]$\pi_{PRI}^{nc} = \frac{1}{2} + u^{nc}\left(g_{PRI}\right) - u^{nc}\left(g_O\right) + \tau_{PRI}^{nc} - \tau_O^{nc} + \eta^{nc}$.

Using the expressions of π^{e}_{PRI}, π^{c}_{PRI}, and π^{nc}_{PRI} the PRI extracts the following signal about the effort of the broker a,

$$s = a + \varepsilon, \tag{1.5}$$

where $\varepsilon = \eta^{c} + \left(\frac{1-\alpha}{\alpha}\right)\eta^{nc}$ with $\sigma^2_{\varepsilon} = \sigma^2_{c} + \left(\frac{1-\alpha}{\alpha}\right)^2 \sigma^2_{nc}$.[21] Note that the precision of the signal is increasing in the *fit* of the communal land,

$$\frac{\partial \sigma^2_{\varepsilon}}{\partial \alpha} = -2\left(\frac{1-\alpha}{\alpha^3}\right)\sigma^2_{nc} < 0. \tag{1.6}$$

This result is driven by two related elements. First, a larger communal land *fit* increases the signal to noise ratio. While the votes from communal land individuals are informative about the broker's performance, the votes from non-communal land individuals only provide noise. Thus, a larger *fit* makes electoral data more informative. Second, the assumption that $\sigma^2_{c} \leq \sigma^2_{nc}$ implies that a larger *fit* might not only increase the signal to noise ratio but also reduce the variance of the noise. The uncertainty about the potential voting behavior of individuals is what prevents the PRI from being able to extract a noiseless signal about the broker's effort. Hence, if this uncertainly is smaller for the communal land voters, a larger *fit* reduces the overall uncertainty.

1.3.4 Characterization of the Case Without Clientelism

We start by characterizing the case when another party controls the state government at the time of the election. Since we only characterize the equilibrium from the communal land, throughout the rest of our characterization we drop the superscript c. In this case there is no clientelism in equilibrium given that, since the PRI does not have access to resources to fund and incentivize its political broker, he exerts no effort to mobilize voters to vote for the PRI. Hence, PRI chooses (g_{PRI}, τ_{PRI}) to

[21] Note that $s = \frac{1}{\alpha}\pi^{e}_{PRI} - \frac{1}{2\alpha} - \left[u^{c}(g_{PRI}) - u^{c}(g_{O}) + \tau^{c}_{PRI} - \tau^{c}_{O}\right] - \left(\frac{1-\alpha}{\alpha}\right) \cdot \left[u^{nc}(g_{PRI}) - u^{nc}(g_{O}) + \tau^{nc}_{PRI} - \tau^{nc}_{O}\right]$. In constructing the variance of signal for tractability we assume that η^{c} and η^{nc} are independent.

maximize its expected electoral support,

$$\max_{\{g,\tau\}} \{u(g) + \tau\} \tag{1.7}$$
s.t.

$$g + \tau \leq b \tag{1.8}$$

$$g, \tau \geq 0, \tag{1.9}$$

where equation (1.7) is the part of the PRI's vote share in equation (1.2) that the PRI can influence, and equation (1.8) is the budget constraint. Thus, from the first order conditions of the maximization problem and the budget constraint, the PRI chooses $g_{PRI}^{O} = u'^{-1}(1)$ and $\tau_{PRI}^{O} = b - u'^{-1}(1)$. By symmetry, the other party chooses $g_{O}^{O} = u'^{-1}(1)$ and $\tau_{O}^{O} = b - u'^{-1}(1)$. Thus, in the case without clientelism, both parties offer the same public good and transfer. Consequently, using the expression of the PRI's vote share in equation (1.2) and $\left(g_{PRI}^{O}, \tau_{PRI}^{O}, g_{O}^{O}, \tau_{O}^{O}\right)$, the vote share for the PRI is

$$\pi_{PRI}^{O} = \frac{1}{2} + \eta \tag{1.10}$$

and there is Downsian convergence, i.e., there is an ex-ante equal vote share for both parties.

1.3.5 Characterization of the Case With Clientelism

When the PRI controls the state government, it has access to resources to fund and incentivize its political broker. The other party chooses $g_{O}^{PRI} = u'^{-1}(1)$ and $\tau_{O}^{PRI} = b - u'^{-1}(1)$ as in the no clientelism case. However, the PRI chooses $(g_{PRI}, \tau_{PRI}, f, v)$ to maximize its expected electoral support,

$$\max_{\{g,\tau,f,v\}} \{u(g) + \tau + a\} \tag{1.11}$$
s.t.

$$g + \tau + f + v \cdot a \leq b \tag{1.12}$$

$$g, \tau, f, v \geq 0, \tag{1.13}$$

$$a \in \arg\max_{a} \left\{ -\exp\left(-\left(f + v \cdot a - \frac{1}{2} v^2 \sigma_\varepsilon^2 - \frac{1}{2} a^2 \right) \right) \right\} \tag{1.14}$$

$$f + v \cdot a - \frac{1}{2} v^2 \sigma_\varepsilon^2 - \frac{1}{2} a^2 \geq 0 \tag{1.15}$$

where equation (1.11) is the part of the PRI's vote share in (1.2) that the PRI can influence, equation (1.12) reflects the expected budget constraint, equation (1.14) is the incentive compatibility constraint, which follows directly by using equation (1.3) and applying the moment generating function of a normal variable, and equation (1.15) is the individual rationality constraint. The incentive compatibility constraint makes sure that the political broker exerts the effort desired by the PRI, and the individual rationality constraint ensures that the broker accepts the contract (f, v).

Replacing equations (1.12), (1.14) and (1.15) into equation (1.11), we rewrite the problem as

$$\max_{v, \tau \geq 0} \left\{ u \left(b - \tau - \frac{1}{2} \left(1 + \sigma_\varepsilon^2 \right) v^2 \right) + \tau + v \right\} \tag{1.16}$$

where the first order conditions are given by

$$v : -u' \left(b - \frac{1}{2} \left(1 + \sigma_\varepsilon^2 \right) v^2 \right) \left(1 + \sigma_\varepsilon^2 \right) v + 1 = 0, \tag{1.17}$$

$$\tau : -u' \left(b - \frac{1}{2} \left(1 + \sigma_\varepsilon^2 \right) v^2 \right) + 1 + \lambda_\tau = 0 \tag{1.18}$$

To characterize the equilibrium outcome we can consider the case where $\tau \geq 0$ is not binding, which we denote as case A, and the case where $\tau \geq 0$ is binding, which we denote as case B.

Case A ($\tau \geq 0$ is not binding)

In the case where $\tau \geq 0$ is not binding, clientelism does not distort the allocation of the public good. The PRI's budget allocation to the public goods and transfer are $g_{PRI}^{PRI} = u'^{-1}(1)$ and $\tau_{PRI}^{PRI} = b - u'^{-1}(1) - \frac{1}{2(1+\sigma_\varepsilon^2)}$, respectively. Further, the PRI offers the broker a contract $(f, v) = \left(\frac{\sigma_\varepsilon^2 - 1}{2(1+\sigma_\varepsilon^2)^2}, \frac{1}{1+\sigma_\varepsilon^2} \right)$, where we assume that $\sigma_\varepsilon^2 > 1$, and the broker exerts an effort $a = \frac{1}{1+\sigma_\varepsilon^2}$.

Note that in this case clientelism does not alter the investment in the public good because of the assumption that the utility function of the voters is linear in the transfer. However, in the absence of this assumption, the conditioning of transfers for electoral support would alter the investment on the public good just as it does in the case where $\tau \geq 0$ is binding. Note from the expression of τ_{PRI}^{PRI} that the larger the precision of the signal, the more likely that $\tau \geq 0$ is binding, since more funds are crowded out from transfers to fund the broker.

Using the expression of the PRI's vote share in (1.2) and $\left(g_{PRI}^{PRI}, \tau_{PRI}^{PRI}, a, g_O^{PRI}, \tau_O^{PRI}\right)$, the vote share for the PRI when it controls the state office at the time of the election is

$$\pi_{PRI}^{PRI} = \frac{1}{2} + \frac{1}{2\left(1+\sigma_\varepsilon^2\right)} + \eta \tag{1.19}$$

Case B ($\tau \geq 0$ is binding)

In the case where $\tau \geq 0$ is binding, clientelism distorts the allocation of the public good since the funds destined to clientelistic exchanges crowd out the public good. The PRI's budget allocation to the public goods and transfer are $g_{PRI}^{PRI} = b - \frac{1}{2}\left(1+\sigma_\varepsilon^2\right)v^2$ and $\tau_{PRI} = 0$, respectively, where v is implicitly defined by equation (1.17). In addition, differentiating the first order condition equation (1.17), we show that the distortion on the public good is increasing in the precision of the signal, which, as we show below, captures the PRI's monitoring capacity.[22]

In this case, the vote share for the PRI when it controls the state office at the time of the election, π_{PRI}^{PRI}, does not take a closed form solution.

1.3.6 Estimating the Return to Clientelism

The increase in the electoral support that the PRI achieves in communal lands through the performance of its political broker, which we denote as $\Delta\pi_{PRI}$, is the difference between the vote share for the PRI when it controls the state office at the time of the

[22] $\frac{\partial g_{PRI}}{\partial \sigma_\varepsilon^2} = \frac{1}{\psi}\left(1+\gamma\psi\sigma_\varepsilon^2\right) v \frac{-u''(g)\left(1+\psi\sigma_\varepsilon^2\right)\gamma\psi v^3 + 2u'(g)\psi^2 v}{-2u''(g)(1+\psi\sigma_\varepsilon^2)^2 v^2 + 2u'(g)\psi\left(1+\gamma\psi\sigma_\eta^2\right)} > 0$

election, π_{PRI}^{PRI}, and the vote share for the PRI when it does not, π_{PRI}^{O}.

Note that, from the envelope condition of the PRI's maximization problem in (1.16), $\Delta\pi_{PRI}$ is increasing in the precision of the signal over the performance of the political broker, $\frac{\partial \Delta\pi_{c,s}^{PRI}}{\partial \sigma_\varepsilon^2} < 0$.[23] The intuition is that, when the precision of the signal is large, the marginal cost for the PRI to incentivize the political broker to exert effort is small. Thus, the increase in the electoral support due to clientelistic practices is larger.

We now develop a strategy to bring this testable implication of the model to the data. For that note that we can rewrite $\Delta\pi_{PRI}$ as

$$\pi_{PRI} = \frac{1}{2} + I^{PRI} \cdot \Delta\pi_{c,s}^{PRI} + \eta \tag{1.20}$$

where I^{PRI} is an indicator variable for whether the PRI controls the state government at the time of the election. Linearizing (1.20) on the *fit* of the communal land,

$$\pi_{PRI} = \beta_0 + \beta_1 \cdot I^{PRI} + \beta_2 \cdot fit + \beta_3 \cdot I^{PRI} \cdot fit, \tag{1.21}$$

where $\beta_2 = 0$ and $\beta_3 = \frac{\partial \Delta\pi_{c,s}^{PRI}}{\partial \sigma_\varepsilon^2} \frac{\partial \sigma_\varepsilon^2}{\partial \alpha} > 0$. $\beta_3 > 0$ since $\Delta\pi_{c,s}^{PRI}$ is increasing in the precision of the signal over the performance of the political broker, $\frac{\partial \Delta\pi_{c,s}^{PRI}}{\partial \sigma_\varepsilon^2} < 0$, and, from (1.6), the precision of the signal is increasing in the *fit* of the communal land, $\frac{\partial \sigma_\varepsilon^2}{\partial \alpha} < 0$. The intuition for $\beta_3 > 0$ is that a larger *fit* allows the PRI extracting a more precise signal about the performance of its broker. In turn, since the broker is risk-averse, a more precise signal facilitates the provision of incentives by the PRI, and therefore, delivers a larger electoral return to the funds allocated to the broker.

1.3.7 Predictions of the Model

The model first predicts that there should be a larger vote share for the PRI in communal lands with a larger *fit* when the PRI is in control of the state government. In these lands the PRI has better monitoring capacity, which facilitates the PRI's

[23] $\frac{\partial \Delta\pi_{PRI}}{\partial \sigma_\varepsilon^2} = -\frac{1}{2}u'(g)\, v^2 < 0$. The same conclusion rises in case A.

work at incentivizing them to exert more effort in persuading peasants to vote for the PRI

Second, the model predicts that the communal land *fit* should have no association with the vote share for the PRI when the it does not control the state government, since it has no resources to fund and incentivize its political broker, and consequently, its monitoring capacity is irrelevant.

Lastly, the model predicts that places with more clientelism should experience a lower public good provision since the resources to fund and incentivize the broker crowd out the budget that otherwise would be allocated to public goods. Note that, while this prediction is actually only for *Case B*, we have explained that this prediction is absent in *Case A* due to the artifice of linear utility in the transfer.

1.4 Empirical Strategy and Data

1.4.1 Empirical Strategy

In this section we develop the empirical strategy used to test the predictions of the model. Our empirical approach tests whether communal lands with a larger *fit* exhibit larger electoral support for the PRI when the state government is under the control of the PRI.

The variation in *fit* comes from the initial location of the communal lands and the subsequent drawing of the electoral sections. In 1994, the Federal Electoral Institute (IFE) designed the sections for electoral purposes so that each included a minimum of 50 and a maximum of 1500 voters. Additionally, each electoral section was conceived to fall fully within a single municipality and to avoid the partition of voters from the same locality.

The demarcation had no political considerations, which is essential for the validity of the identification strategy. When the IFE demarcated the electoral sections in 1994, it represented an autonomous institution administered by a body of councilors, who are citizens with no links to any party or state branch. To get a sense of the institutional strength of the IFE, note that the 1994 federal elections were the first conducted by the IFE, and it was the first time in Mexican history that elections were free from vote fraud (Schedler (2004)). Additionally, the electoral sections were demarcated inside already set municipalities and electoral districts. Hence, the political manipulation of electoral sections could not have allowed for the grouping of voters to win municipalities or electoral districts, a strategy commonly known as gerrymandering.

The variation in the PRI's control of the state government comes mostly from states switching from the PRI to another party. The PRI not only held México's presidency for 71 years, but for a long period it also controlled the politics of all states, many of which are still under the control of the PRI. In our period of analysis (1991 - 2010), out of 31 sates, 17 states experienced a change in party in the state government.[24] Additionally, out of these states, the PRI recently regained the state government in four.

The main outcome of our empirical analysis is the vote share for the PRI in municipal elections. Since municipal and state government elections are commonly staggered, the electoral support for the PRI in interim municipal elections represents a signal to the PRI about the good performance of its political brokers in mobilizing its networks. Hence, if the PRI is able to successfully mobilize its clientelistic networks when it controls the state government, this should be reflected in its electoral support in municipal elections. In addition, municipal elections also have the advantage that they take place every three years, which provides a large sample size and allows us to analyze pretrends.[25]

Our analysis is at the electoral section level and our estimation equation follows

[24]13 out the other 14 states have always had a state governor of the PRI.

[25]The available state election data provides little variation to empirically test the implications of the model. State government elections take place every six years and the data at the section and municipal level is not available for many states for the first half of the period of analysis. This lack of data constitutes a serious problem since identification comes from states that switch from the PRI to another party. Many states have missing state government election data under the PRI, which removes them from the sample of identifying observations.

directly from aggregating (1.21) to the electoral section level,[26]

$$\pi_{emst} = \beta_0 + \beta_1 \cdot I_{st}^{PRI} + \beta_2 \cdot fit_{ems} + \beta_3 \cdot I_{st}^{PRI} \cdot fit_{ems} \quad (1.22)$$

$$+\Gamma' X_{emst} + \Delta' G_{ems} + \eta_{ms} + \phi_y + \varepsilon_{emst} \quad (1.23)$$

where π_{emst} is the vote share for the PRI in electoral section e in municipality m in state s in year t, I_{st}^{PRI} is an indicator of whether the PRI controls the state government at the time of the election, and fit_{ems} is the communal land *fit* aggregated at the electoral section level,[27] η_{ms} are municipality fixed effects, which control for municipality characteristics that are invariant over time. A more robust specification includes electoral section fixed effects η_{ems}, and therefore, identification only comes from communal lands that experienced a change in the party that controls the state government. ϕ_t are year dummies that control for national level trends. A more robust specification includes state-year dummies, $\phi_{s,t}$, which control for state-level trends. Standard errors are clustered at the state level.

Recall that the model from *Section 3* predicts that $\beta_2 = 0$ and $\beta_3 > 0$. In words, communal lands with larger *fit* should exhibit a larger support for the PRI but only when the PRI controls the state government.

X_{emst} includes controls for area, number of registered voters and communal land share, and the interaction of these variables with I_{st}^{PRI}. X_{emst} addresses the concern that *fit* may pick differences in these variables, which might be associated with other correlates of electoral support for the PRI. G_{ems} includes a series of flexible polynomials of latitude and longitude of the centroid of each communal land interacted with state dummies. G_{ems} addresses the concern that the spatial distribution of *fit* is correlated with the electoral support for the PRI.

The identification assumption is that *fit* is plausibly exogenous, and consequently,

[26] For details on the derivation of the estimation equation, please see Appendix 1.7.

[27] $fit_{e,m,s} = \alpha_{e,m,s} \cdot \sum_i \rho_{c_i,e,m,s} \cdot fit_{c_i,m,s}$ where $\alpha_{e,m,s}$ is the share of voters from communal lands in the electoral section, $\rho_{c_i,e,m,s}$ is the share of voters from communal lands in the electoral section that come from communal land c_i, and $fit_{c_i,m,s}$ is the *fit* of communal land c_i. To construct $fit_{e,m,s}$ we approximate $\alpha_{e,m,s}$, $\rho_{c_i,e,m,s}$, and $fit_{c_i,m,s}$ using area shares: $\alpha_{e,m,s} = \frac{area_{c,m,s} \cap area_{e,m,s}}{area_{e,m,s}}$, $\rho_{c_i,e,m,s} = \frac{area_{c_i,m,s} \cap area_{e,m,s}}{area_{c,m,s} \cap area_{e,m,s}}$, and $fit_{c_i,m,s} = \sum_{e \in E_{c_i,m,s}} \frac{area_{c_i,m,s} \cap area_{e,m,s}}{area_{c_i,m,s}} \frac{area_{c_i,m,s} \cap area_{e,m,s}}{area_{e,m,s}}$.

uncorrelated with omitted unobservable variables that correlate with PRI's electoral support. The prediction of the model that $\beta_2 = 0$ helps us to address the validity of the identification assumption. If $\beta_2 > 0$, it would cast doubt about the plausible exogeneity of *fit*. Additionally, we conduct a placebo analysis, which we describe later in detail, that supports the validity of the identification assumption.

1.4.2 Data

We use election data at the electoral section and the municipal level for all municipal elections from 1994 to 2010 for which data is available as our main outcome variable.[28] Prior to 1994, electoral figures were directly manipulated by the PRI through vote fraud practices. The election data at the section level comes from the state electoral institutes, which are responsible for conducting municipal and state governor elections. The election data at the municipal level comes from several sources: the Alain de Remes' 1980-1990 electoral data base, the BANAMEX-CIDAC's 1985-2010 electoral data base, and different state electoral institutes.

To compute the measure of *fit* used in our empirical analysis, we use geospatial data on the location of the communal lands and the electoral sections in México. The electoral section data is from the Federal Electoral Institute (IFE). The communal land data comes from the Agrarian National Registry (RAN), which collected the data during the rollout of México's land certification program –the PROCEDE. The RAN facilitated the spatial location of all communal lands that completed the certification stage of the program or were in the process of certification by the end of 2006. The sample includes more than 95% of the communal lands in México.

To construct an indicator of whether the PRI controls the state government at the time of the election, we used electoral data at the state level for all state gubernatorial elections from 1985 to 2010. The source of this data is the BANAMEX-CIDAC's 1985-2010 electoral data base.

Finally, the data on other regressors of interest and policy outcomes come from the 2007 Agricultural Census, several Population Censuses (1990 to 2010), and the

[28]The data at the municipality level is available for all elections.

State and Municipal Data Base System (1994-2010). The source of all these data sets is the Mexican National Institute of Statistics and Geography (INEGI).

1.5 Results

1.5.1 Preview of Results

Figure 1-5 show that communal lands with a larger *fit* exhibit a larger PRI vote share only when the PRI controls the state government. Figure 1-5 shows two plots that illustrate the relationship between the vote share for the PRI and communal land *fit*. The plot on the left indicates the cases when the PRI controls the state government and the plot on the right depicts the cases when it does not. As predicted by the model, the left plot shows that communal lands with a larger *fit* exhibit a larger electoral support for the PRI when it controls the state government. Additionally, the right plots suggests that *fit* presents no clear association with the electoral support for the PRI when another party is the incumbent.

Figure 1-6 illustrates the evolution of the vote share for the PRI over time for the states that experience a change in state government control from the PRI to another party. The data is divided into communal lands above and below the median level of *fit*. As predicted, *Figure 5* indicates that communal lands with a larger *fit* exhibit a larger electoral support for the PRI only when it controls the state government. Additionally, there are no differential trends in electoral support for the PRI in communal lands with different *fit*. Hence, we could interpret our estimation equation as a difference in differences where the changes in the party that controls the state government are plausibly exogenous.

1.5.2 Results

Table 1.1 reports the results of our empirical specification that tests whether communal lands with a larger *fit* exhibit a larger PRI vote share when the PRI controls the state government. Column (1) presents the baseline specification in equation

(1.22), column (2) includes spatial controls for the location of communal lands within each state, column (3) introduces electoral section fixed effects, and column (4) adds state-year fixed effects.

As predicted, all columns in Table 1.1 indicate that *fit* has a significant positive effect on the PRI's vote share when the PRI controls the state government. As also predicted by the model, columns (1) and (2) indicate that the effect of *fit* is indistinguishable from zero when another party controls the state government. The results in column (4) suggest that, when the PRI is the incumbent party at the state government level, a one standard deviation increase in *fit* corresponds to a 1.5 percentage points (pp) increase in the vote share for the PRI. To interpret the importance of the coefficient, note that 1.5 pp account for 19% of the 8 pp of incumbency advantage that the PRI enjoys when it controls the state government. In addition, in 11% of municipal elections, the winning margin is less than 1.5 pp.

The predictions of the model are supported by the results. While a larger *fit* leads to a larger PRI vote share, the effect is only evident when the PRI controls the state government.

1.5.3 Placebo

We conduct a placebo exercise to address any concerns that results might be driven by omitted unobservable variables that correlate with PRI's electoral support. In our placebo exercise, instead of considering the incumbency of the PRI in the state office, we use its incumbency in the municipal office. PRI's control of the municipal government is correlated with PRI's electoral support but should not allow the PRI to mobilize its clientelistic networks on communal lands. Commissariats have weak links with municipal authorities (Hevia de la Jara (2010)) and municipal governments are very weak relative to the state governments, which are responsible for the execution of the bulk of public programs at the local level. Hence, if *fit* captures the variation in omitted unobservable variables that are correlated with the PRI's electoral support, our placebo estimates should also be significantly positive. However, if our identification assumption is valid, estimates should be zero.

Table 1.2 replicates columns (1) to (4) in Table 1.1 and looks at the effect of *fit* when the PRI controls the municipal government. Results support the validity of our identification strategy. They indicate that a larger *fit* does not contribute to the electoral support for the PRI when the PRI controls the municipal government at the time of the election.

1.6 Aggregate Effects of Clientelism

We now turn to the aggregate effects of clientelism on electoral and policy outcomes. Our goal in this section is twofold. First, we want to show that the presence of clientelistic networks on communal lands has an aggregate effect on election outcomes. This is particularly relevant since, e.g., a priori there could be a general equilibrium interaction across places, and therefore, aggregate effects aren't just the aggregation of the communal land-level results.[29] Additionally, note that the effect we estimate might not solely reflect the PRI's monitoring over its political brokers.[30]

To identify the aggregate effect of clientelism on election outcomes, we look at municipality level outcomes and exploit a difference in differences strategy where we use private lands as a control group for communal lands. In doing this, we use the fact that there is a larger presence of clientelistic networks operating in communal lands than in private ones. Consequently, communal lands should exhibit a larger electoral support for the PRI relative to private lands when the PRI controls the state government.

Our second goal is to see whether the presence of clientelistic networks on communal lands has aggregate effects on policy outcomes. In the model in *Section 3* we show that communal lands where clientelistic networks operate more extensively have lower investments in public goods when the PRI controls the state government. The intuition is that funding a political broker has a larger electoral return in communal lands and, consequently, it crowds out the provision of public goods.

[29]We are currently exploring this theoretical possibility.

[30]Unfortunately, we cannot look at the interaction of the share of communal land with aggregate *fit* since we do not have enough variation in *fit* at the municipal level.

To estimate the effect of clientelism on policy outcomes, we look at schooling outcomes and use an identification strategy analogous to the one we use for the case of the election outcomes. Schooling outcomes are an appropriate measure of public good provision for two reasons. First, since the 1992 National Agreement for the Modernization of Basic Education, states have been responsible for the administration of basic education at the local level in México (Helper et al. (2006), Santibañez et al. (2005)).[31] Second, they represent an appropriate measure of public goods, since exclusion is hard. Figure 1-7 illustrates that it is hard to exclude students from a communal land or those close to a communal land from attending a nearby school.

1.6.1 Empirical strategy

Our baseline specification to test the aggregate effect of the presence of clientelistic networks on communal lands on election and policy outcomes is the following:

$$y_{msy} = \beta_0 + \beta_1 \cdot I_{sy}^{PRI} + \beta_2 \cdot I_{sy}^{PRI} \cdot cl_{ms} + \beta_3 \cdot I_{sy}^{PRI} \cdot al_{ms} + \tag{1.24}$$

$$\beta_4 \cdot v_{sy} + \beta_5 \cdot cl_{ms} \cdot v_{sy} + \beta_6 \cdot al_{ms} \cdot v_{sy} + \eta_m + \phi_{sy} + \varepsilon_{msy} \tag{1.25}$$

where y_{msy} is an outcome of interest in municipality m in state s in year y, I_{sy}^{PRI} is an indicator of whether the PRI controls the state government at the time of the election, cl_{ms} is the share of communal land area over the total area of a given municipality, al_{ms} is the share of total agricultural land over the total area of a given municipality, and v_{sy} is the vote share that the PRI obtained in the last state government election by the year y. η_m are municipality fixed effects, and hence, identification comes from within variation in municipalities that experienced a change in the party that

[31]The majority of the financial resources still comes from the Federal Subsecretary of Basic Education (*Subsecretaría de Educación Básica* - SEP). However, states do raise their own funds to invest in new teachers or schools.

With respect to other potential outcomes for public goods, conversely, the public health system is mostly administered by the federal government. Between the Mexican Social Security Institute (*Instituto Mexicano del Seguro Social* - IMSS) and the Institute for Social Security and Services for State Workers (*Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado* - ISSSTE), the federal government provides health care coverage to most individuals. The IMSS and the ISSSTE are federal government organizations that provide health care to workers in the private sector and federal employees, respectively.

controls the state government.[32] ϕ_{sy} are either year dummies or state-year dummies that control for national-level or state-level trends.[33] Standard errors are clustered at the state level.

β_2 captures the effect of the PRI's control of the state government on municipalities with a larger share of communal lands. We expect $\beta_2 > 0$ when the outcome variable is a measure of the PRI's electoral support, and $\beta_2 < 0$ when the outcome variable is a measure of schooling supply.

There is a concern that, in the case of the electoral outcomes, β_2 might be capturing reverse causality, i.e., that differential trends in the electoral support for the PRI in communal lands drive party changes in the state government. This concern is mitigated in the most robust specification that includes control for state-level trends. This specification accounts for any differential trend in the electoral support for the PRI in communal lands that is correlated with state-level trends. In addition, in all specifications we control for the interaction between the state vote share that the PRI obtained in the last state gubernatorial election and the municipal shares of both communal and agricultural land. Further, we conduct a placebo analysis as we did above.

1.6.2 Preview of Results on Election Outcomes

For a preview of the results, Figure 1-8 illustrates the vote share for the PRI over time for the states that experience a change in state government control from the PRI to another party. The data is divided into municipalities above and below median level of communal land in the municipality. Figure 1-8 indicates no presence of differential pretends between municipalities above and below the median municipal level of communal land under PRI's state governments. Additionally, Figure 1-8 shows that municipalities above the median municipal level of communal land exhibit a larger voter share for the PRI when the PRI controls the state government. However,

[32] η_m control for municipality characteristics that are invariant over time, including the levels of cl_{ms} and al_{ms}.

[33] When ϕ_{sy} are state-year dummies, I_{sy}^{PRI} and v_{sy} are absorbed.

such a difference disappears the moment the PRI loses the state government.

1.6.3 Results on Election Outcomes

Table 1.3 reports the results of our empirical specification on election outcomes. Columns (1) and (3) present the baseline specification as characterized in equation (1.24), and columns (2) and (4) add state-year dummies. Columns (3) and (4) add controls that capture municipal economic development.

As predicted, all columns in Table 1.3 indicate that a larger share of communal lands has a significant positive effect on the PRI's vote share when the PRI controls the state government. Results in column (2) indicate that the baseline result is robust to the introduction of state-year fixed effects, which suggests that state-level trends in support for the PRI are not driving the results. To interpret the importance of the coefficients, the specification in column (4) suggests that, when the PRI controls the state government, a one standard deviation increase in the share of communal lands corresponds to a 2.6 pp increase in the vote share for the PRI in municipal elections. Note that 2.6 pp account for 30% of the 8 pp of incumbency advantage that the PRI enjoys when it controls the state government. In addition, in 18% of municipal elections the winning margin is less than 2.6 pp.

To deal with the concern that communal lands are not only capturing the presence of clientelistic networks but also potential differences in economic development that correlate with electoral support for the PRI, columns (3) and (4) include a series of controls that account for these potential differences. These consist of the share of households with access to electricity, piped water and connection to drainage, which are the measures of economic development that are consistently captured in all censuses in México. Results from columns (3) and (4) indicate that our findings are robust.

We should note a caveat on the estimates we present in columns (3) and (4). The model suggests that clientelism might result in a lower provision of public goods. Consequently, when we include controls that capture economic development, we control for outcome variables, which is a strategy that delivers unidentified estimates

(Angrist and Pischke (2009)). Thus, we provide estimates in columns (3) and (4) for robustness but do not consider them the most preferred specification.

Table 1.4 replicates the estimates from Table 1.3 using an indicator of PRI winning the municipal election as an outcome instead, and has similar implications. Overall, the findings in Table 1.3 and Table 1.4 support that municipalities with a larger share of communal lands exhibit larger electoral support for the PRI when the PRI controls the state government.

To address the reverse causality concern, we conduct a placebo test using the incumbency of the PRI in the municipal office instead of its incumbency in the state office. Results in Table 1.5 indicate that municipalities with a larger share of communal lands do not present differential electoral support for the PRI when the PRI controls the municipal government.

Note that municipalities with a larger share of agricultural lands, which include both communal and private lands, exhibit a lower vote share for the PRI when the PRI controls the municipal government. This phenomenon simply reflects the downward trend we observe in Figure 1-8. During the period we study, there is a significant decrease in the support for the PRI. The reason this decrease is larger for municipalities with a larger share of agricultural lands is that urban areas were the first ones to turn against the PRI in the late 1980s and early 1990s.

1.6.4 Results on Policy Outcomes

Table 1.6 reports the results on schooling supply outcomes. Odd columns present the baseline specification, as characterized in equation (1.24), and even columns add state-year dummies. In the first two columns, the outcome is the number of primary and secondary schools per 1,000 inhabitants. The outcome in columns (3) and (4) is the number of primary and secondary teachers per 1,000 inhabitants. In the last two columns, the outcome is the number of students that attend primary and secondary schools per 1,000 inhabitants.[34]

[34] The number of students is not necessarily indicative of the quality of the education supply. However, a lower number of students enrolled per capita confirms the effect of a worse schooling

Overall, the estimates in Table 1.6 suggest that municipalities that have a larger share of communal lands have a significantly lower educational supply when the PRI is the party in the state government. Results in column (2) indicate that, when the PRI is the incumbent party, a one standard deviation increase in the share of communal lands corresponds to a 3.93 percentage drop in the number of primary and secondary schools relative to the sample mean. The third column shows that one standard deviation more in the share of communal lands is associated with a 3.09 percentage decrease in the number of primary and secondary schools relative to the sample mean, if the PRI is in power. Estimates in column (5) imply that, when the PRI controls the state government, a one standard deviation increase in the share of communal lands denotes a 2.24 percentage drop in the number of students enrolled in primary and secondary schools relative to the sample mean. These results are robust to introducing state-year fixed effects.

To address the worry that communal lands are not only capturing the presence of clientelistic networks but also differences in economic development, Table 1.7 controls for the economic development of the municipalities. Results are robust to adding these controls.

Overall, the findings in Table 1.6 and Table 1.7 support that municipalities with a larger share of communal lands exhibit a reduced provision of public goods - measured by schooling supply - when the PRI controls the state government.

Finally, our placebo estimates in Table 1.8 indicate that municipalities with a larger share of communal lands do not present differences in schooling outcomes when the PRI is in office at the municipal level.

1.7 Conclusion

In this paper, we make two contributions to our understanding of how clientelistic transactions prevail in a secret ballot context, and the effect of clientelism on electoral

supply measured by the two other outcome variables. The results do not change when primary and secondary education are consider separately.

and policy outcomes. Our main contribution is to provide empirical evidence that suggests that the PRI uses electoral results to monitor political brokers to make sure they deliver the votes of its clientelistic networks.

Exploiting plausibly exogenous differences in the *fit* between communal lands and electoral sections that facilitate the PRI's supervision of its brokers, we show that communal lands with a larger *fit*, which enable better PRI's monitoring capacity, exhibit a larger electoral support for the PRI. This phenomenon only happens when the PRI controls the state government, and consequently, the resources necessary to fund and incentivize its brokers. While the direct evidence on the monitoring of brokers by the PRI is from the field work, the empirical findings are consistent with these observations. There seems to be no other explanations that would account for these empirical findings.

Second, we show that, when the PRI controls the state government, municipalities with a larger share of communal lands exhibit an increased vote share for the PRI and a lower provision of public goods, measured by schooling supply. We use a difference in differences strategy where we compare municipalities with different shares of communal lands while controlling for the share of agricultural land, which includes communal and privates lands. Results are not driven by differential pre-trends or difference in the economic development of communal and private lands. Our second contribution provides empirical support to the literature that argues that clientelism undermines democracy and economic development (Keefer 2007, Kitschelt and Wilkinson 2007, Lyne 2007).

These results have several policy implications. Naturally, there is the need to clarify and strengthen the operation rules of social programs. The lack of transparency of the rules contributes significantly to the manipulation of programs for clientelistic purposes in México (Martínez 2010). Out of the federal and state programs registered in the Initiative for the Strengthening of the Institutionalization of the Social Programs in México (IPRO), 21% lack operation rules, 27% have no beneficiary list, 40% have a beneficiary list but it is not public, 27% have no criteria to select beneficiaries, and 32% have no evaluation mechanisms.[35] Additionally, there might be scope for a demarcation of electoral sections that minimizes the capacity of parties to monitor its political brokers. Further, in case such a demarcation was not possible, since our findings identify the locations where clientelistic exchanges are more likely to prevail, they can be used to target the areas where to focus to crack down on clientelistic practices.

In future work, to provide further evidence of the effect of the monitoring of brokers by the PRI on election and policy outcomes, we will look at the effect of *fit* on turnout at the electoral section level, and the allocation of social programs and schooling supply at the communal land level. We have already requested turnout data to the IFE, data on allocation of social programs to the Secretariat of Social Development, and data on the location and opening date of all primary and secondary schools in the whole of México to the Secretariat of Public Education.

[35]IPRO is a website where federal and state governments can voluntarily register the social programs they are executing. http://www.programassociales.org.mx/

Appendix A: Fieldwork and Popular Press Evidence

I conducted fieldwork in June 2012, the month prior to the presidential election, in twelve municipalities of four Mexican states: México, Morelos, Puebla and Tlaxcala. On average I interviewed three commissariats or former commissariats (in case of short tenure of the current one) and two peasants in each municipality. In addition, I complemented the fieldwork evidence with qualitative evidence from the Mexican press to give a broader view of these issues across the whole of México.

Here there are some anecdotal evidence excerpts from the fieldwork and the popular press, which provide supporting evidence on the presence of the PRI's clientelistic practices in communal lands in the states under PRI control.

On the importance of the alignment of communal lands and commissariats to the PRI to receive assistance from PRI state governments:

In the state of México, a commissariat stated, "the PRI government listens to everybody equally but, logically, it does not give the same support to everybody; it supports its people more."

In the state of México, another commissariat affirmed, "it is easier for a commissariat to get support from people from his own party since, if they are not from his party, they put a series of obstacles in his way."

After a flood in the state of Tabasco, the PRI's state government delivered aid to its supporters in communal lands under the threat that they would no longer get any help if they did not attend rallies and vote for the PRI's candidate in the upcoming election. The community from the *ejido* Las Coloradas in the municipality of Cárdenas, also affected by floods, did not receive any aid since it had historically voted for the PRD (Reforma (2000)).

A commissariat explained, "when the PRI was in government, the conditioning was a serious problem. If we voted for the PRI, there was aid, if we did not, we were marginalized. With the change in government, everything is more flexible; people can vote for the party they want and the aid will still come."

On the conditioning of aid within communal lands by commissariats in

PRI states:

When asked about the distribution of the resources that come to the *ejido*, a commissariat mentioned, "most people support the PRI, those that do not vote for the PRI are excluded; they clearly know they cannot get anything from me."

Several peasants hinted that government aid only makes it to the party supporters within the *ejido*.

After a flood in the state of Tabasco, a peasant from the *ejido* Rafael Martínez de Escobar in the municipality of Huimanguillo complained that the government promised him relief but that the commissariat informed him that "by the instruction of the state government, assistance is only given to PRI's supporters" (Marí (2001)).

On the PRI's work to control commissariats:

In the last election for commissariat in largest *ejido* in the state of Puebla, the exiting commissariat and the PRI's municipal president were charged with fraud to facilitate a win by the PRI candidate. Witnesses argue that the commissariat, illegally assisted by the municipal president, issued a number of permits to represent absent peasants that exceeded the number agreed upon by the candidates before the election. The municipal president also contributed to the issuing of such permits even though by regulation the commissariat is the only one entitled to do so. Also, in the course of the election they allowed peasants that did not belong to the *ejido* to vote. Dead people also appeared on the list of voters of the election. The tenure of the elected commissariat is about to end and the decision of the agrarian tribunal that has to rule on the validity of the election is still pending. Copies of the witnesses declaration to the agrarian tribunal are available upon request.

The former commissariat of the *ejido* El Quemado in the municipality of Gómez Palacio in the state of Durango was accused of vote buying and other irregularities in the elections to pick his successor. He, also a state legislator of the PRI, was alleged to have paid 3,000 pesos ($230) for each vote and to allow peasants that were not part of the *ejido* to vote (Acosta 2009).

On the CNC:

Commissariats and peasant in the state of México report assistance from the CNC.

Peasants from communal lands in the states of Michoacán and Nayarit acknowledge that the PRI and the CNC use them for electoral purposes but claim that it is the only way they can get some support when they are in power (Reforma (2005)).

On the eve of the gubernatorial elections in the state of Oaxaca, it was reported that the PRI distributed 50 tons of fertilizers to the peasants of the *ejido* 20 de Noviembre that were affiliated with the CNC (García et al. 2004).

A commissariat in the state of Puebla mentioned, "the CNC was here when the PRI was in the government. With the change in government, it is no longer present."

A commissariat from the state of Morelos pointed out, "the CNC fell with the PRI government because the assistance is ultimately from programs that belong to the state and federal governments."

When the PRI recovered the state governorship in 2011 in the state of Tlaxcala, the president of the CNC in this state acknowledged that the peasant organization had lost presence in the state as a result of the political rivalry with the past two state governments. However, he asserted that he trusted that the organization would be able to recover its strength with the return of the PRI to the state government (Osorno Xochipa (2011)).

A commissariats of the state of Tlaxcala indicated, "the CNC has disappeared for a long time but it is now coming back with the return of the PRI to the state government."

Another commissariat from the state of Tlaxcala stated "I do not support the PRI but, if the CNC returns, we will have to support the PRI so that we get help."

Appendix B: Derivation of Estimation Equation

The vote share for the PRI in electoral section e in municipality m in state s in year t can be decomposed as follows

$$\pi_{e,m,s,t} = \alpha_{e,m,s} \cdot \pi_{c,e,m,s,t} + (1 - \alpha_{e,m,s}) \cdot \pi_{nc,e,m,s,t} \tag{1.26}$$

where $\alpha_{e,m,s}$ is the share of voters from communal lands in the electoral section, and $\pi_{c,e,m,s,t}$ and $\pi_{nc,e,m,s,t}$ are the vote shares for the PRI of the communal land voters and the non-communal land voters, respectively. In turn,

$$\pi_{c,e,m,s,t} = \sum_i \rho_{c_i,e,m,s} \cdot \pi_{c_i,m,s,t} \tag{1.27}$$

where $\rho_{c_i,e,m,s}$ is the share of voters from communal lands in the electoral section that come from communal land c_i and $\pi_{c_i,m,s,t}$ is the vote share for the PRI of the voters that come from communal land c_i. Replacing $\pi_{c_i,m,s,t}$ with (1.21), and $\pi_{nc,e,m,s,t}$ with

$$\pi_{nc,e,m,s,t} = \beta_0 + \beta_{1,nc} \cdot I_{s,t}^{PRI} + \eta_{nc} + \varepsilon_{nc,e,m,s,t} \tag{1.28}$$

it follows that

$$\pi_{e,m,s,t} = \beta_0 + \beta_1 \cdot I_{s,t}^{PRI} + \beta_2 \cdot fit_{e,m,s} + \beta_3 \cdot fit_{e,m,s} \cdot I_{s,t}^{PRI} + \eta_{e,m,s} + \varepsilon_{e,m,s,t} \tag{1.29}$$

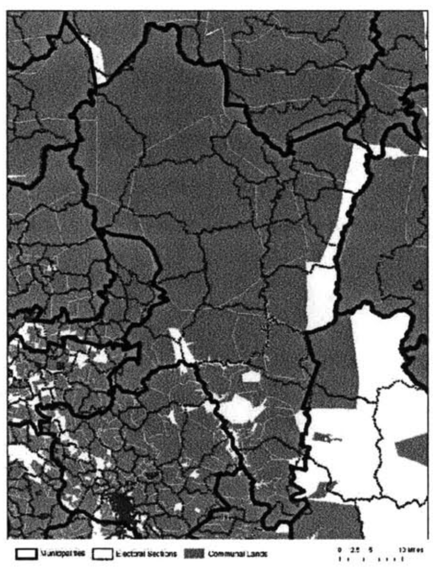
where $fit_{e,m,s} = \alpha_{e,m,s} \cdot \sum_i \rho_{c_i,e,m,s} \cdot fit_{c_i,m,s}$.

Appendix C: Figures and Tables

Figure 1-1: Distribution of communal lands in México

Note: State boundaries are in black, communal lands in green, and non-communal land areas in white.

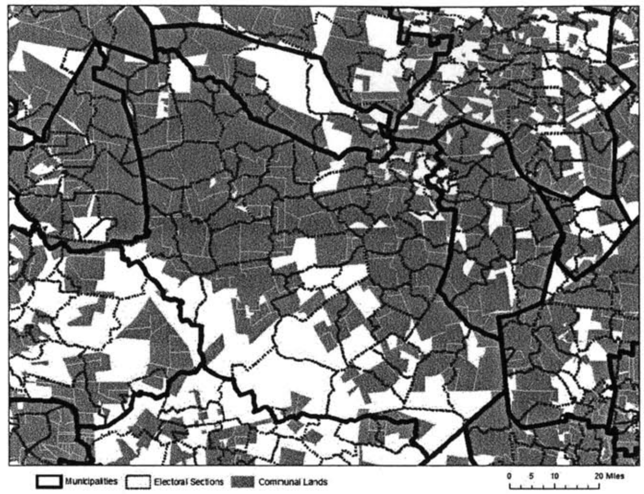
(a) Ocampo in Coahuila state



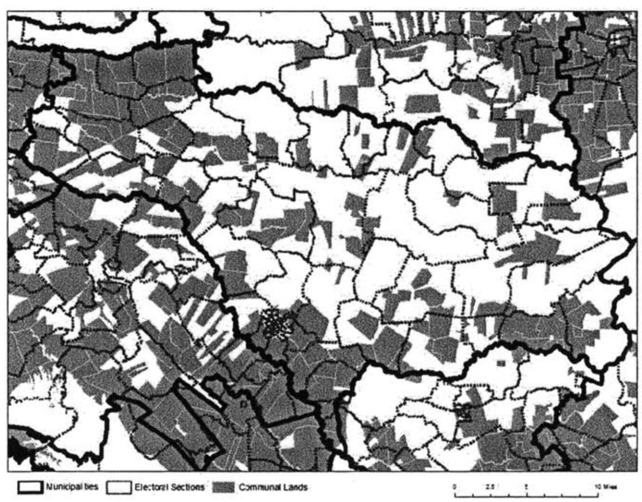
(b) Del Nayar in Nayarit state

Figure 1-2: Examples of the variation in the correspondence between communal lands and electoral sections from Coahuila and Nayarit states

Note: The figures illustrate the variation in the correspondence between communal lands and electoral sections. Municipal boundaries are in black, electoral sections in dotted blue, communal lands in green, and non-communal land areas in green.



(a) Concepcion del Oro Mazapil, and Melchor Ocampo in Zacatecas state



(b) Tierra Blanca in Veracruz state

Figure 1-3: Examples of the variation in the correspondence between communal lands and electoral sections from Veracruz and Zacatecas states

Note: The figures illustrate the variation in the correspondence between communal lands and electoral sections. Municipal boundaries are in black, electoral sections in dotted blue, communal lands in green, and non-communal land areas in green.

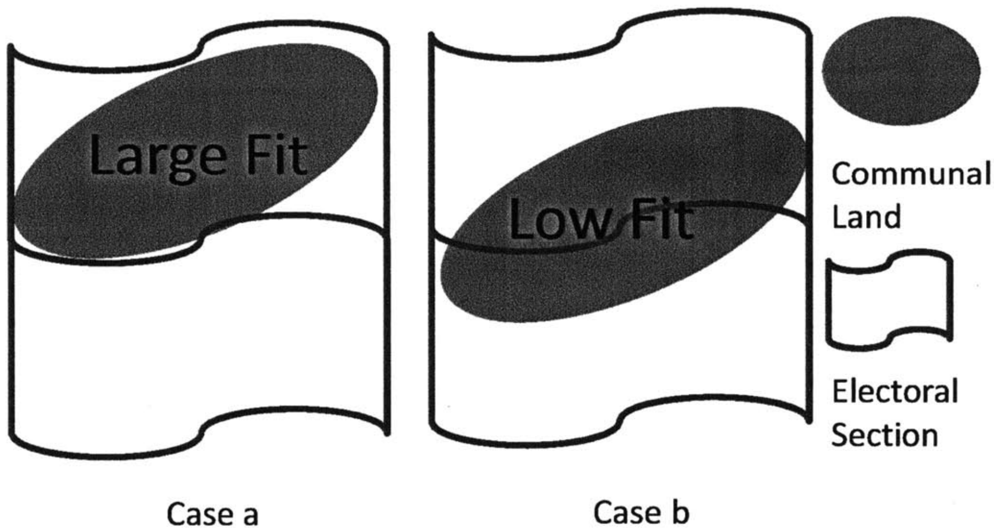


Figure 1-4: Examples of communal land fit

Note: The *fit* of a communal land is the weighted average proportion of communal land voters in the electoral sections where they vote. In *Case a* almost exclusively peasants of the communal land vote in the electoral section overlapping with the communal land, and hence, the communal land has a large *fit*. In *Case b* communal land peasants vote together with a significant amount of individuals from outside the communal land, and therefore, the communal land has a small *fit*.

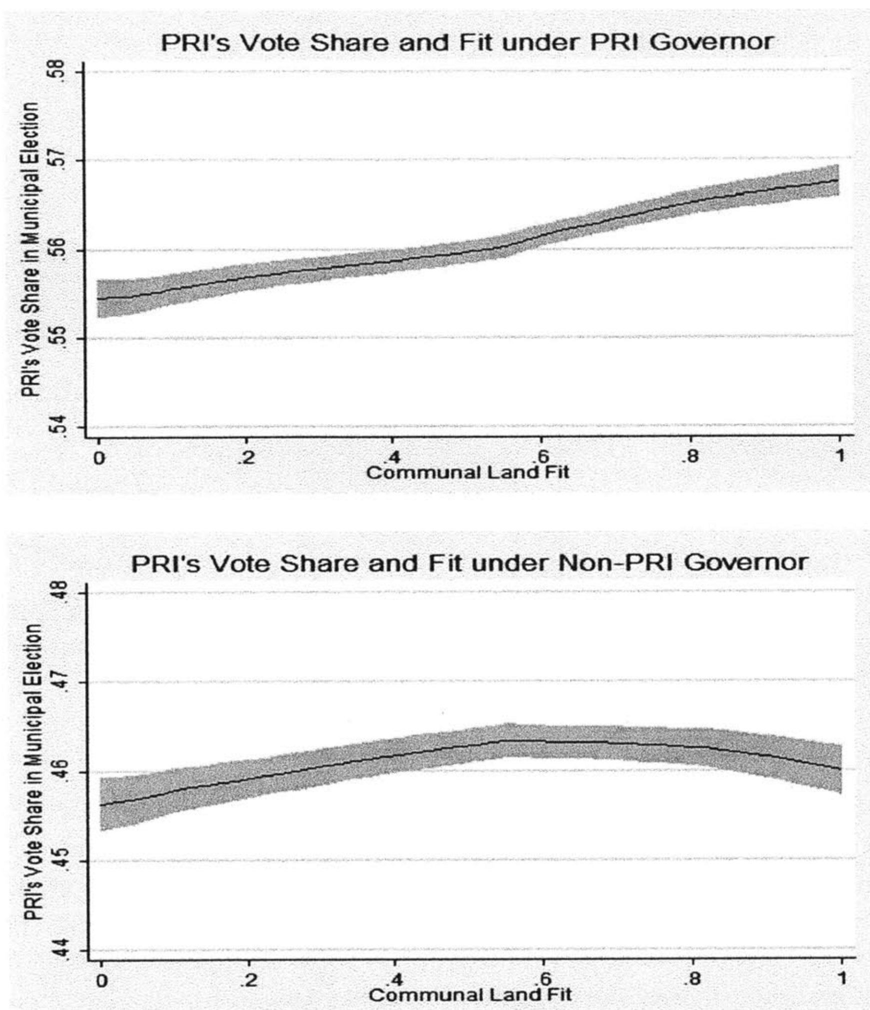


Figure 1-5: The relationship between communal land fit and the PRI's vote share under PRI and non-PRI governors

Note: The PRI's vote share in municipal elections is on the y-axis and the communal land fit on the x-axis. The left figure indicates the case when the PRI controls the state government and the right figure when it does not.

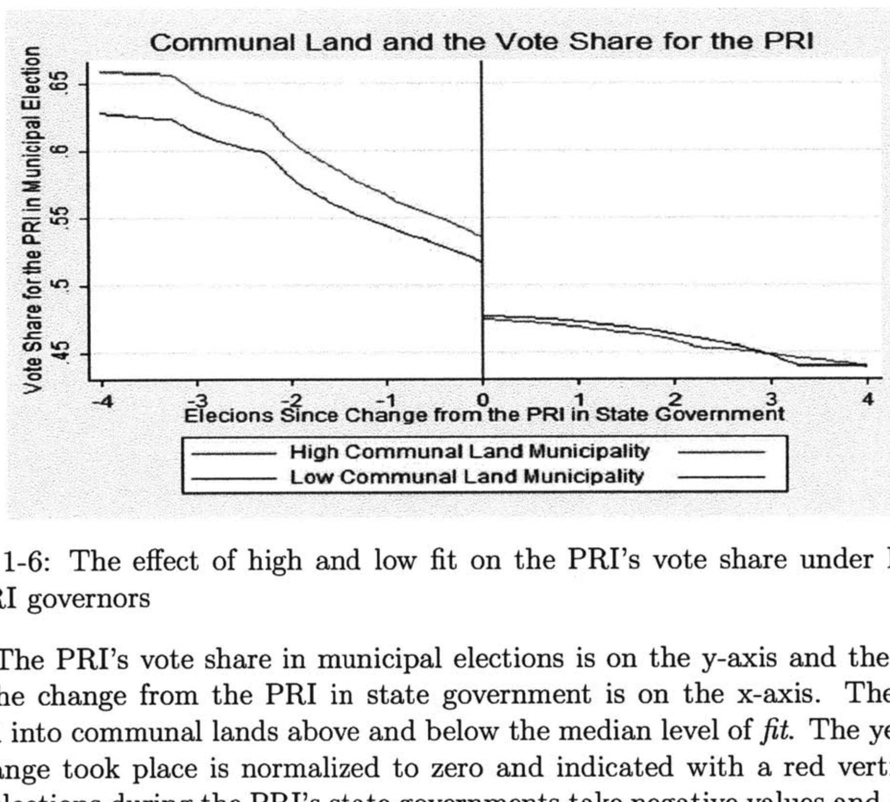


Figure 1-6: The effect of high and low fit on the PRI's vote share under PRI and non-PRI governors

Note: The PRI's vote share in municipal elections is on the y-axis and the election since the change from the PRI in state government is on the x-axis. The data is divided into communal lands above and below the median level of *fit*. The year when the change took place is normalized to zero and indicated with a red vertical line. Thus, elections during the PRI's state governments take negative values and elections during state governments of other parties take positive values. By construction, only municipalities that experienced a change in party at the state government level are included in the plot.

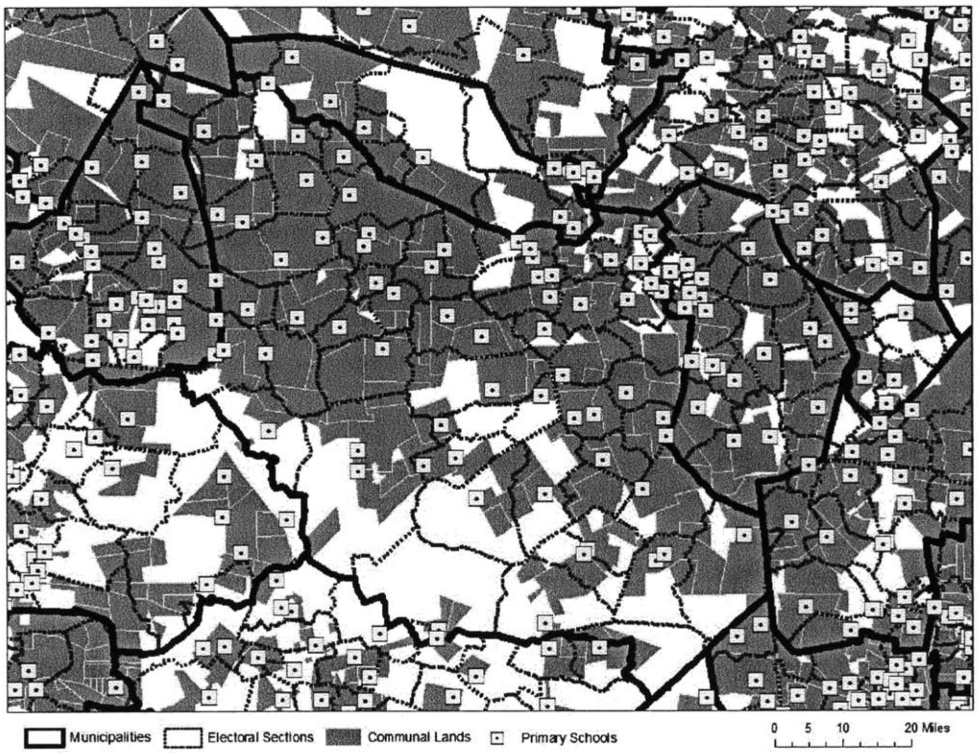


Figure 1-7: Example of the location of schools

Note: The figure illustrates that primary schools are non-excludable. Municipal boundaries are in black, electoral sections in dotted blue, communal lands in green, non-communal land areas are in white, and primary schools yellow squares.

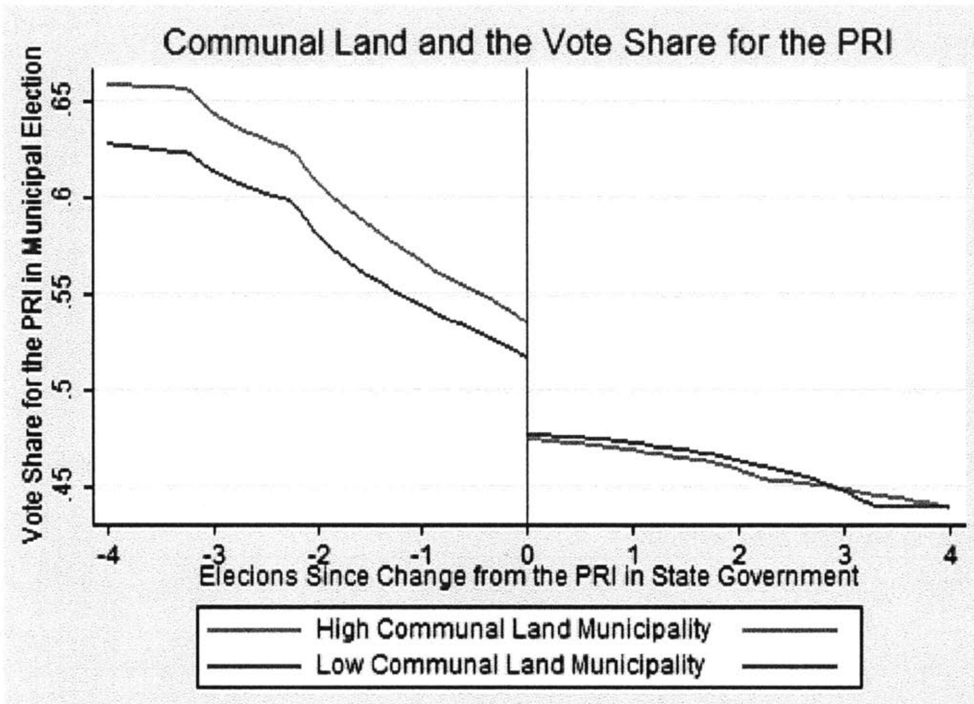


Figure 1-8: The effect of high and low communal land on the PRI's vote share under PRI and non-PRI governors

Note: The PRI's vote share in municipal elections is on the y axis and the election since the change from the PRI in state government is on the x axis. The data is divided into municipalities above and below median level of communal land in the municipality. The year when the change took place is normalized to zero and indicated with a red vertical line. Thus, elections during the PRI's state governments take negative values and elections during state governments of other parties take positive values. By construction, only municipalities that experienced a change in party at the state government level are included in the plot.

Table 1.1: The effect of fit on the PRI's vote share in municipal elections

	(1)	(2)	(3)	(4)
PRI's Governor	.1214***	.1259***	.1723***	
	[.0422]	[.0423]	[.0556]	
Fit	-0.0047	-0.0067		
	[.0229]	[.0243]		
PRI's Governor * Fit	.0808***	.0859***	.1249**	0.0717*
	[.0289]	[.0291]	[.0486]	[.0426]
Effect (pp)	1.71	1.82	2.64	1.52
Municipality Fixed Effects	Yes	Yes		
Electoral Section Fixed Effects			Yes	Yes
Spatial controls		Yes		
State - Year Fixed Effects				Yes
Mean Outcome	0.5045	0.5045	0.5045	0.5045
Mean Fit	0.4235	0.4235	0.4235	0.4235
Standard Deviation Fit	0.2115	0.2115	0.2115	0.2115
Observations	133943	133943	133943	133943
R-squared	0.2808	0.2883	0.5062	0.567

Note: In all specifications, the unit of observation is the electoral section, we include year fixed effects, and we cluster standard errors at the state level. Also we control for the area, number of registered voters and communal land share, and their interactions with PRI's Governor. Fit is the area weighted average of the communal land fit of the communal lands that overlap with the electoral section, times the share of the electoral section that overlaps with communal lands. The communal land fit captures the area weighted average share of each section that overlaps with the communal land. Spatial controls include flexible polynomials of latitude and longitude of the centroid of each electoral section interacted with state dummies. Effect is the impact of a one standard deviation increase in fit. pp indicates percentage points. * p<.1, ** p<.05, *** p<.01.

Table 1.2: Placebo on the effect of fit on the PRI's vote share in municipal elections

	(1)	(2)	(3)	(4)
PRI's Mayor	0.0142	0.0115	.0546**	.0461**
	[.0238]	[.0241]	[.0199]	[.0202]
Fit	0.0018	0.0047		
	[.0175]	[.0175]		
PRI's Mayor * Fit	0.0104	0.009	0.0149	0.0139
	[.0165]	[.0163]	[.0125]	[.013]
Effect (pp)	0.22	0.19	0.32	0.29
Municipality fixed effects	Yes	Yes		
Electoral fixed effects			Yes	Yes
Spatial controls		Yes		
State - Year Fixed Effects				Yes
Mean Outcome	0.5044	0.5044	0.5044	0.5044
Mean Fit	0.4236	0.4236	0.4236	0.4236
Standard Deviation Fit	0.2115	0.2115	0.2115	0.2115
Observations	133730	133730	133730	133730
R-squared	0.2824	0.2893	0.2813	0.3467

Note: In all specifications, the unit of observation is the electoral section, we include year fixed effects, and we cluster standard errors at the state level. Also we control for the area, number of registered voters and communal land share, and their interactions with PRI's Mayor. Fit is the area weighted average of the communal land fit of the communal lands that overlap with the electoral section, times the share of the electoral section that overlaps with communal lands. The communal land fit captures the area weighted average share of each section that overlaps with the communal land. Spatial controls include flexible polynomials of latitude and longitude of the centroid of each electoral section interacted with state dummies. Effect is the impact of a one standard deviation increase in fit. pp indicates percentage points. * p<.1, ** p<.05, *** p<.01.

Table 1.3: Difference in differences estimates of the effect of a PRI governor on the PRI's vote share in municipal elections

	(1)	(2)	(3)	(4)
PRI's Governor	-0.0214		0.0369	
	[.0264]		[.1576]	
Communal Land * PRI's Governor	.1565**	.1409***	.1507**	.1405***
	[.061]	[.0376]	[.0616]	[.0459]
Agricultural Land * PRI's Governor	-0.0067	-0.0473	-0.0053	-0.0425
	[.0462]	[.0466]	[.0416]	[.0412]
Effect (pp)	5.34	4.81	5.14	4.80
State - Year Fixed Effects		Yes		Yes
Controls for Economic Development			Yes	Yes
Mean of Ouctome	0.541	0.541	0.5408	0.5408
Mean of Communal Land	0.2333	0.2333	0.2332	0.2332
Standard Deviation of Communal Land	0.1847	0.1847	0.1846	0.1846
Mean of Agricultural Land	0.5249	0.5249	0.5252	0.5252
Standard Deviation of Agricultural Land	0.2837	0.2837	0.2837	0.2837
Observations	13902	13902	13855	13855
R - squared	0.5603	0.6577	0.5709	0.6641

Note: In all specifications, the unit of observation is a municipality, we include municipality and year fixed effects and we cluster standard errors at the state level. Controls for economic development include the share of households with access to electricity, piped water and connection to drainage, and their interaction with a dummy that indicates a PRI governor at the time of the election. Effect is the impact of a one standard deviation increase in share of communal land. pp indicates percentage points. * p<.1, ** p<.05, *** p<.01.

Table 1.4: Difference in differences estimates of the effect of a PRI governor on whether the PRI wins in municipal elections

	(1)	(3)	(2)	(4)
PRI's Governor	-0.0811		-0.1106	
	[.1195]		[.5689]	
Communal Land * PRI's Governor	.4844*	.3658*	.4436*	.392*
	[.246]	[.2053]	[.2467]	[.2272]
Agricultural Land * PRI's Governor	-0.0025	-0.1809	-0.0058	-0.1926
	[.1214]	[.1592]	[.1237]	[.1754]
Effect (pp)	15.54	11.73	14.23	12.57
State - Year Fixed Effects		Yes		Yes
Controls for Economic Development			Yes	Yes
Mean of Ouctome	0.5759	0.5759	0.5756	0.5756
Mean of Communal Land	0.2333	0.2333	0.2332	0.2332
Standard Deviation of Communal Land	0.1847	0.1847	0.1846	0.1846
Mean of Agricultural Land	0.5249	0.5249	0.5252	0.5252
Standard Deviation of Agricultural Land	0.2837	0.2837	0.2837	0.2837
Observations	13902	13902	13855	13855
R - squared	0.3481	0.4661	0.3539	0.4692

Note: In all specifications, the unit of observation is a municipality, we include municipality and year fixed effects and we cluster standard errors at the state level. Controls for economic development include the share of households with access to electricity, piped water and connection to drainage, and their interaction with a dummy that indicates a PRI governor at the time of the election. Effect is the impact of a one standard deviation increase in share of communal land. pp indicates percentage points. * p<.1, ** p<.05, *** p<.01.

Table 1.5: Difference in differences estimates of the effect a PRI mayor on the PRI's vote share in municipal elections

	(1)	(2)	(3)	(4)
PRI's Mayor	0.006		0.0142	
	[.0215]		[.1156]	
Communal Land * PRI's Mayor	-0.0076	-0.0064	-0.0137	-0.0301
	[.0328]	[.0227]	[.0288]	[.0229]
Agricultural Land * PRI's Mayor	-.0584*	-.0462***	-.0608**	-.0733***
	[.0298]	[.0125]	[.0283]	[.0182]
Effect (pp)	-0.14	-0.12	-0.25	-0.56
State - Year Fixed Effects		Yes		Yes
Controls for Economic Development			Yes	Yes
Mean of Ouctome	0.5409	0.5409	0.5407	0.5407
Mean of Communal Land	0.2333	0.2333	0.2331	0.2331
Standard Deviation of Communal Land	0.1846	0.1846	0.1846	0.1846
Mean of Agricultural Land	0.5248	0.5248	0.525	0.525
Standard Deviation of Agricultural Land	0.2837	0.2837	0.2837	0.2837
Observations	13822	13822	13779	13779
R - squared	0.5648	0.6608	0.5728	0.6674

Note: In all specifications, the unit of observation is a municipality, we include municipality and year fixed effects and we cluster standard errors at the state level. Controls for economic development include the share of households with access to electricity, piped water and connection to drainage, and their interaction with a dummy that indicates a PRI governor at the time of the election. Effect is the impact of a one standard deviation increase in share of communal land. pp indicates percentage points. * $p<.1$, ** $p<.05$, *** $p<.01$.

Table 1.6: Difference in differences estimates of the effect of a PRI governor on educational outcomes

Outcomes	Schools	Schools	Teachers	Teachers	Students	Students
	(1)	(2)	(3)	(4)	(5)	(6)
PRI's Governor	0.0195		.4327**		7.904	
	[.0236]		[.1937]		[6.497]	
Communal Land * PRI's Gov.	-.2649***	-.2857***	-1.362***	-.9697***	-32.78***	-25.08***
	[.0569]	[.0741]	[.3992]	[.3555]	[11.8]	[9.673]
Agricultural Land * PRI's Gov.	0.0222	0.0821	-0.1248	0.2694	2.821	14.18
	[.0416]	[.0605]	[.2827]	[.3395]	[9.317]	[9.215]
Effect (%)	3.93	4.24	3.09	2.20	3.24	2.48
State - Year Fixed Effects		Yes		Yes		Yes
Mean Ouctome	1.276	1.276	8.343	8.343	191.6	191.6
Mean Communal Land	0.234	0.234	0.2339	0.2339	0.2334	0.2334
Standard Deviation Com. Land	0.1894	0.1894	0.1892	0.1892	0.1891	0.1891
Mean Agricultural Land	0.5272	0.5272	0.5272	0.5272	0.5264	0.5264
Standard Deviation Agr. Land	0.2861	0.2861	0.2857	0.2857	0.2862	0.2862
Observations	32663	32663	32781	32781	33015	33015
R - squared	0.9807	0.9828	0.9111	0.9346	0.8018	0.832

Note: In all specifications, the unit of observation is a municipality, we include municipality and year fixed effects and we cluster standard errors at the municipal level. Schools, Teachers and Students indicate the number per 1,000 inhabitants. Controls for economic development include the share of households with access to electricity, piped water and connection to drainage, and their interaction with a dummy that indicates a PRI governor at the time of the election. Effect is the impact of a one standard deviation increase in share of communal land over the mean of the outcome variable. * p<.1, ** p<.05, *** p<.01.

Table 1.7: Difference in differences estimates of the effect of a PRI governor on educational outcomes controlling for covariates of economics development

Outcomes	Schools	Schools	Teachers	Teachers	Students	Students
	(1)	(2)	(3)	(4)	(5)	(6)
PRI Governor	-0.3929		-1.743		-55.87**	
	[.4829]		[1.106]		[23.77]	
Communal Land * PRI's Gov.	-.1648***	-.2195***	-1.204***	-.8139**	-30.32***	-21.29**
	[.0533]	[.0713]	[.3827]	[.3512]	[11.01]	[9.46]
Agricultural Land * PRI's Gov.	-0.001	0.0483	-0.1899	0.1254	0.8899	9.231
	[.0402]	[.0572]	[.2803]	[.3431]	[9.294]	[9.294]
Effect (%)	2.45	3.26	2.73	1.85	2.99	2.10
State - Year Fixed Effects		Yes		Yes		Yes
Controls for Economic Dev.	Yes	Yes	Yes	Yes	Yes	Yes
Mean Ouctome	1.276	1.276	8.343	8.343	191.6	191.6
Mean Communal Land	0.234	0.234	0.2339	0.2339	0.2334	0.2334
Standard Deviation Com. Land	0.1894	0.1894	0.1892	0.1892	0.1891	0.1891
Mean Agricultural Land	0.5272	0.5272	0.5272	0.5272	0.5265	0.5265
Standard Deviation Agr. Land	0.2861	0.2861	0.2857	0.2857	0.2862	0.2862
Observations	32619	32619	32737	32737	32972	32972
R - squared	0.9809	0.9829	0.9114	0.9349	0.803	0.8331

Note: In all specifications, the unit of observation is a municipality, we include municipality and year fixed effects and we cluster standard errors at the municipal level. Schools, Teachers and Students are per 1,000 inhabitants. Controls for economic development include the share of households with access to electricity, piped water and connection to drainage, and their interaction with a dummy that indicates a PRI governor at the time of the election. Effect is the impact of a one standard deviation increase in share of communal land over the mean of the outcome variable. * p<.1, ** p<.05, *** p<.01.

Table 1.8: Difference in differences estimates of the effect of a PRI mayor on educational outcomes

Outcomes	Schools	Schools	Teachers	Teachers	Students	Students
	(1)	(2)	(3)	(4)	(5)	(6)
Communal Land * PRI Mayor	0.0013	-0.0046	-0.0941	-0.1239	-2.564	-3.928
	[.0377]	[.0371]	[.2112]	[.2086]	[5.266]	[5.258]
Agricultural Land * PRI Mayor	0.0245	0.0294	0.1381	0.1206	3.251	2.962
	[.0216]	[.0252]	[.121]	[.1362]	[2.957]	[3.252]
Effect (%)	0.02	-0.07	-0.21	-0.27	-0.25	-0.38
State - Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Controls for Economic Development		Yes		Yes		Yes
Mean Ouctome	1.267	1.266	8.321	8.322	191.3	191.3
Mean Communal Land	0.2342	0.2342	0.2342	0.2341	0.2337	0.2336
Standard Deviation Communal Land	0.1843	0.1843	0.1842	0.1841	0.1841	0.1841
Mean Agricultural Land	0.5283	0.5284	0.5283	0.5284	0.5275	0.5276
Standard Deviation Land	0.2829	0.2829	0.2825	0.2826	0.2831	0.2831
Observations	30013	29964	30130	30081	30364	30315
R - squared	0.9826	0.9831	0.9334	0.9349	0.8287	0.8303

Note: In all specifications, the unit of observation is a municipality, we include municipality and year fixed effects and we cluster standard errors at the municipal level. Schools, Teachers and Students are per 1,000 inhabitants. Controls for economic development include the share of households with access to electricity, piped water and connection to drainage, and their interaction with PRI mayor. Effect is the impact of a one standard deviation increase in share of communal land over the mean of the outcome variable. * p<.1, ** p<.05, *** p<.01.

Chapter 2

The Role of Media Networks in Compensating Political Biases: Evidence from Radio Networks in Brazil

2.1 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 non-aligned constituencies (Ansolabehere and Snyder (2006), Arulampalam et al. (2009), Berry et al. (2010), Brollo and Nannicini (2012)). Additionally, the literature shows that media presence is instrumental in holding politicians accountable and promoting 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, and therefore to 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 withhold assistance from 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 a 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 or replace it by another party. Voters rely on radio stations to acquire information 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 are 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 municipal 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 the identity of the winning party in close municipal elections. The rainfall a given municipality experiences over the period under analysis varies, and the lower the amount, 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 experiencing low precipitation. Second, we show that the presence of a radio station compensates for this bias. Third, we provide evidence that this effect

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

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

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 do not belong to a network and network-connected televisions stations do not affect 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 declines 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 in political accountability. However, our focus is on the role of the media network in the diffusion of politically relevant information for the enhancement of 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. Section 6 concludes.

2.2 Background

2.2.1 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 in dealing 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 a state of emergency by the federal government.

The process to obtain a declaration of a state of emergency is subject to significant red tape, which allows for discretion by the federal government. To get a declaration of a state 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

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

it. These documents encompass information on the characteristics of the disaster, the affected area, the affected population, the 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 withhold 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 revealed 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 the municipalities were controlled either by the federal government's party or by the Minister's party.[5] The federal auditors found notes indicating 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.

2.2.2 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)

[4]In addition, the mayor can enact a decree declaring state of calamity at the 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).

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 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]

2.3 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, and media spread the news on disasters and the federal government's responsiveness. Voters then decide whether to vote for the federal government taking into account the information

[6]Additionally, 890 municipalities are 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 interview with Marcelo Damasceno, the main journalist at Emissora Rural and former employee of Radio Grande Rio, a non-connected commercial radio.

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

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.

2.3.1 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

$$a_t = \eta^{fed} \cdot f_t \tag{2.1}$$

where η^{fed} reflects the ability of the federal government's party 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 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 than 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 funds in response to a drought is drawn from a uniform distribution with mean one, $E\left[\eta^{alt}\right] = 1$.

To decide whether they want to remove the 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 observes 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,

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

2.3.2 Preferences

Voters in a given municipality have the following expected utility

$$u_v = -p_d \cdot (d - a_1) - \beta \cdot p_d \cdot (d - a_2)\,, \tag{2.2}$$

where p_d is the probability that a 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

$$u_f = (b - f_1) + \beta \cdot p_r \cdot (b - f_2), \tag{2.3}$$

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

2.3.3 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.

2.3.4 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 stricken by 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 increasing in η. Thus, voters decide to vote for the federal government's party if

$$E\left[\eta^{fed}|I_1\right] \geq E\left[\eta^{alt}\right], \tag{2.4}$$

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,

$$E\left[\eta^{fed}|a_1\right] = \frac{a_1}{\widetilde{f}_1}, \tag{2.5}$$

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

Using (2.5) and (2.1), we can re-express (2.4) as $\eta \geq \frac{\widetilde{f}_1}{f_1}$. Thus, the expected vote share for the federal government's party for informed voters is

$$\pi_s = \frac{1}{2} + \phi_s\left(1 - \frac{\widetilde{f}_1}{f_1}\right). \tag{2.6}$$

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 for, and hence,

$$\pi_s = \frac{1}{2}. \tag{2.7}$$

Using (2.6) and (2.7), the reelection probability that the party that controls the federal government has is given by the following expression:

$$p_r = \frac{1}{2} + \frac{1}{N}\left(\theta \cdot \phi_i + \lambda_i \cdot (1-\theta) \cdot \phi_i + R_i^A \cdot \phi_A + R_i^{NA} \cdot \phi_{NA}\right)\left(1 - \frac{\widetilde{f}_1}{f_1}\right), \tag{2.8}$$

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

$$\max_{f_1 \leq b}\left\{(b - f_1) + \beta \cdot p_r \cdot \left(b - \underline{f}\right)\right\}. \tag{2.9}$$

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

$$f_1 = \min\left\{\beta \cdot \left(\theta \cdot \phi_i + \lambda_i \cdot (1-\theta) \cdot \phi_i + R_i^A \cdot \phi_A + R_i^{NA} \cdot \phi_{NA}\right) \cdot \left(b - \underline{f}\right)/N, b\right\}. \tag{2.10}$$

From the expression of f_1 in (2.10), 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 Figure 2-4.

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

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

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* $f_1(\phi_{NA}, 0, 0, 0) = f_1\left(\phi_{NA}, \lambda_i, R_i^A, R_i^{NA}\right)$, $\forall\ \lambda_i,\ R_i^A,\ R_i^{NA} \geq 0$ *(no role for radio stations).*

All proofs are straightforward and omitted. The budget constraint is always binding and the federal government allocates all the budget to any municipality that suffers a drought in period 1. The votes that the federal government's party would lose due to lack of responsiveness from any municipality affected by a drought 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 municipality also has no effect.

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

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

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.

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 increasing in the share of its audience that supports the federal government's party).*

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's performance in the management of a drought.

As indicated in Figure 2-4, 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 for this bias than local stations since they can hold the federal government accountable 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 $R^A_{i,j}$ and $R^{NA}_{i,j}$ but relatively more in $R^A_{i,j}$. 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.

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 the 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* $\left(\lambda_i, R^A_i, R^{NA}_i\right) = (0, 0, 0)$,

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

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

3. *For* $f_1\left(\phi_s, \lambda_i, R^A_i, R^{NA}_i\right) < b$, *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 increasing in the share of its audience that supports the federal government's party).*

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.

2.3.5 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 an indicator variable for whether a municipality had a state of emergency declared due to 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 2-1. As in the example in Figure 2-2, 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 2.1, 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.

[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 the federal level in 2003 and at the municipal level in 2005 and 2009.

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We identify media presence in each municipality by using information from ANATEL, the Brazilian regulator of communications, on all media outlets in Brazil, their location, the date they were 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 2-3 illustrates all the 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 of aligned municipalities and coverage of non-aligned municipalities by taking into account the political alignment of the municipalities reached by each media network. Table 2.1 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

[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 those that are from the state from which the Minister of National Integration originates and are aligned to the party that controls 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 all 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. As a proxy for their licensing date, we use 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 state capitals driving the results because all these municipalities have a network-connected radio station and are politically important.

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 with a local politician.

For state and federal congressmen, we use the list of elected politicians in 1998, 2002 and 2006, and consider they own a media outlet if their name appears on the board of any media outlet in 2012, regardless of 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

[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.

[16] Unfortunately we do not have the municipality of origin for each congressman, and thus 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.

development, and political alignment. The 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.

2.4 Empirical Strategy and Data

2.4.1 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

$$dd_{mt} = \beta_0 + \beta_1 \cdot z_{mt} + \beta_2 \cdot na_{mt} + \beta_3 \cdot z_{mt} \cdot na_{mt} + \Gamma' X_{mt} + \eta_m + \phi_t + \varepsilon_{mt} \quad (2.11)$$

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 that 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 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, munici-

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

pal 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 with 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 of whether or not they are aligned to the federal government.[20]

Our second specification is as follows

$$\begin{aligned} dd_{mt} &= \beta_0 + \beta_1 \cdot z_{mt} + \beta_2 \cdot na_{mt} + \beta_3 \cdot z_{mt} \cdot na_{mt} + \sum_{j\in\{lr,rn,tv\}} \beta_{4j} \cdot media\_j_{mt} \quad (2.12) \\ &+ \sum_{j\in\{lr,rn,tv\}} \beta_{5j} \cdot media\_j_{mt} \cdot z_{mt} + \sum_{j\in\{lr,rn,tv\}} \beta_{6j} \cdot media\_j_{mt} \cdot na_{mt} \\ &+ \sum_{j\in\{lr,rn,tv\}} \beta_{7j} \cdot media\_j_{mt} \cdot z_{mt} \cdot na_{mt} + \Gamma' X_{mt} + \eta_m + \phi_t + \varepsilon_{mt} \end{aligned}$$

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 (2.12).[21]

[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 quantitatively 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

Standard errors are clustered at the state level.

If the results of 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 to compensate for such a bias. Further, while in case B the model 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 of 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.

2.5 Results

2.5.1 Results

Table 2.2 reports the results of our empirical specification in equation (2.11). 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 2.2 are consistent with cases B and C of the model. Table 2.3 reports the results of the empirical specification in equation (2.12) 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 (2.11)

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.

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 2.3 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.

2.5.2 Channel

Overall, results from Table 2.2 and 2.3 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

$$\begin{aligned} dd_{mt} &= \beta_0 + \beta_1 \cdot z_{mt} + \beta_2 \cdot na_{mt} + \beta_3 \cdot z_{mt} \cdot na_{mt} + \beta_4 \cdot cov\_rn_{mt} \\ &\quad + \beta_5 \cdot cov\_rn_{mt} \cdot z_{mt} + \beta_6 \cdot cov\_rn \cdot na_{mt} \\ &\quad + \beta_7 \cdot cov\_rn_{mt} \cdot z_{mt} \cdot na_{mt} + \Gamma' X_{mt} + \eta_m + \phi_t + \varepsilon_{mt}, \end{aligned} \tag{2.13}$$

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 2.4 reports the results of the empirical specification in equation (2.13) 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) indicate that the effect of the coverage in aligned municipalities

[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.

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 2.4 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*.

2.5.3 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.

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 on 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

$$\begin{aligned} outcome_m &= \beta_0 + \beta_1 \cdot na_m + \sum_{j \in \{all, rn,\}} \beta_{2j} \cdot media\_j_m + \\ & \sum_{j \in \{all, rn\}} \beta_{3j} \cdot media\_j_m \cdot na_m + \varepsilon_m, \end{aligned} \tag{2.14}$$

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 for a commercial radio station connected to a network in municipality m. Standard errors are clustered at the state level.

Table 2.5 reports the results of our empirical specification in equation (2.14) 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 2.6 provides regression discontinuity estimates for the specifications in Table 2.5.

Consider the universe of non-aligned municipalities where there are radio stations. Results in Table 2.5 and Table 2.6 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 that it is unlikely that the presence of a network-connected radio station might capture the effect of other omitted municipal attributes related to economic development and state capacity.

Political Influence

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 remains. 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

[23]For instance, Boas and Hidalgo (2011) find 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 substantially increases 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.

worry, we conduct the following specification

$$\begin{aligned} dd_{mt} = \; & \beta_0 + \beta_1 \cdot z_{mt} + \beta_2 \cdot na_{mt} + \beta_3 \cdot media\_rn_{mt} + \beta_4 \cdot z_{mt} \cdot na_{mt} \\ & + \beta_5 \cdot media\_rn_{mt} \cdot z_{mt} + \beta_6 \cdot media\_rn_{mt} \cdot na_{mt} \\ & + \beta_7 \cdot media\_rn_{mt} \cdot z_{mt} \cdot na_{mt} + \beta_8 \cdot media\_pol_{mt} \\ & + \beta_9 \cdot media\_pol_{mt} \cdot z_{mt} + \beta_{10} \cdot media\_pol_{mt} \cdot na_{mt} \\ & + \beta_{11} \cdot media\_pol_{mt} \cdot z_{mt} \cdot na_{mt} + \Gamma' X_{mt} + \eta_m + \phi_t + \varepsilon_{mt} \end{aligned} \tag{2.15}$$

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 2.7 reports the results of our empirical specification in equation (2.15). Column (1) considers the simplest specification where we only look at the effect of local politician's ownership of and association with 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 the municipal potential political influence on media. Additionally, these results suggest that local politicians' ownership of and association with network-connected radio stations does not help non-aligned municipalities to compensate for the federal government's bias in the distribution of drought relief support. Regression discontinuity estimates in

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

columns (3) and (4) are consistent with these results.

Placebo Exercise

Finally, as a placebo exercise, instead of considering the definition of a radio network as in the Donos da Midia database, we construct 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

$$\begin{aligned} dd_{mt} = {} & \beta_0 + \beta_1 \cdot z_{mt} + \beta_2 \cdot na_{mt} + \beta_3 \cdot media\_rn_{mt} + \beta_4 \cdot z_{mt} \cdot na_{mt} \\ & + \beta_5 \cdot media\_rn_{mt} \cdot z_{mt} + \beta_6 \cdot media\_rn_{mt} \cdot na_{mt} \\ & + \beta_7 \cdot media\_rn_{mt} \cdot z_{mt} \cdot na_{mt} + \beta_8 \cdot share\_own_{mt} \\ & + \beta_9 \cdot share\_own_{mt} \cdot z_{mt} + \beta_{10} \cdot share\_own_{mt} \cdot na_{mt} \\ & + \beta_{11} \cdot share\_own_{mt} \cdot z_{mt} \cdot na_{mt} + \Gamma' X_{mt} + \eta_m + \phi_t + \varepsilon_{mt} \end{aligned} \quad (2.16)$$

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

Table 2.8 reports the results of our empirical specification in equation (2.16). 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 non-aligned municipalities receive 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 do radio networks who have central stations.

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 for political biases.

2.6 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 aligned to the federal government are significantly less likely 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 of radio networks for the dissemination of local information that is politically relevant.

We provide additional 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 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.

Appendix A: Figures and Tables

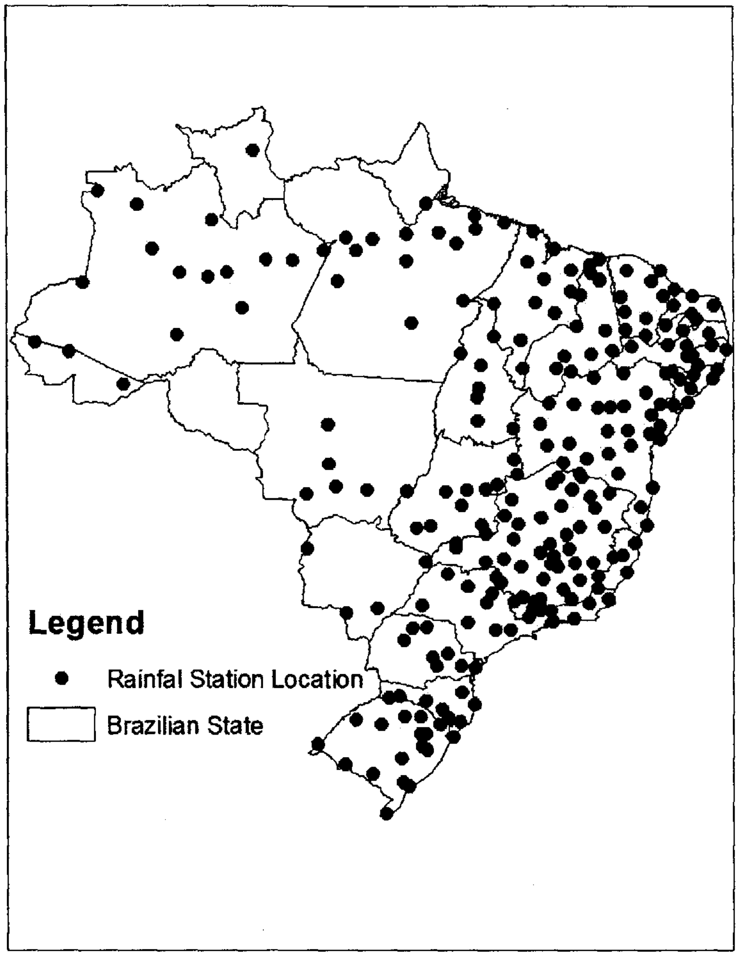


Figure 2-1: Rainfall stations

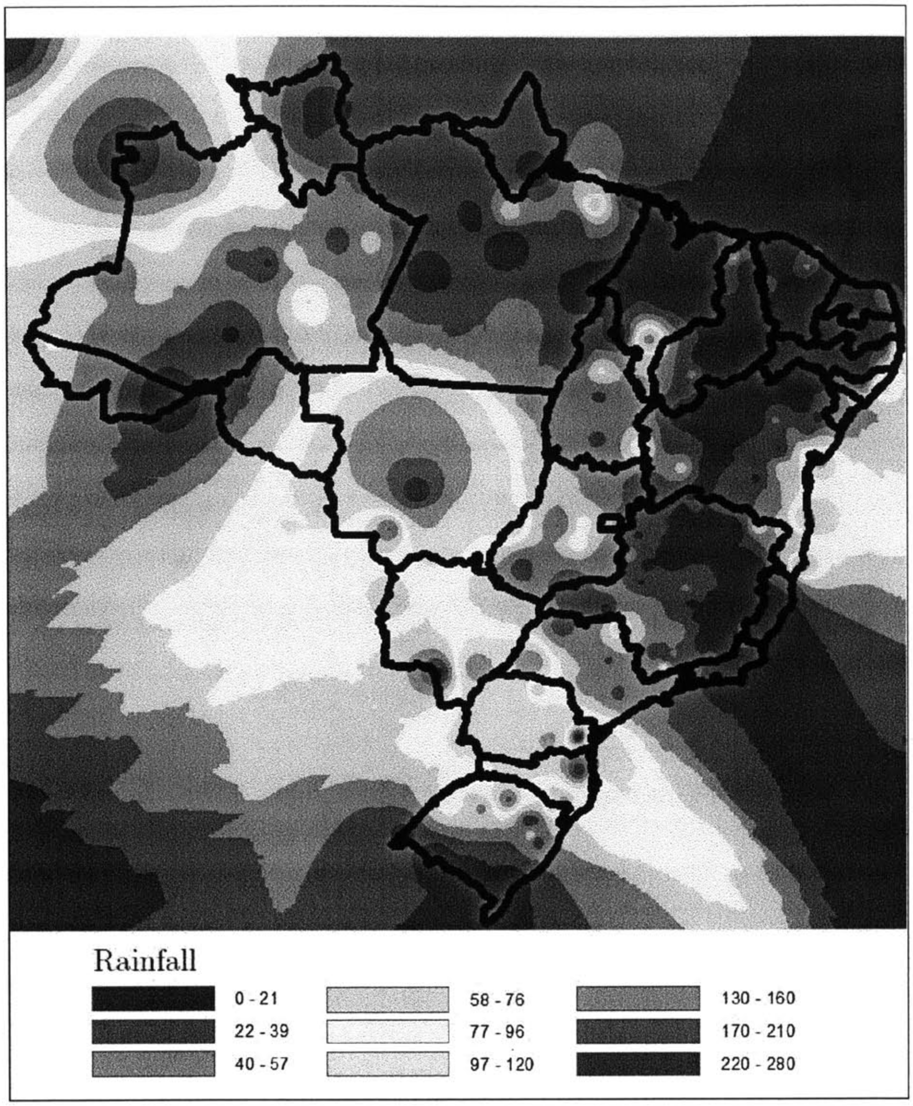


Figure 2-2: Example of rainfall interpolation

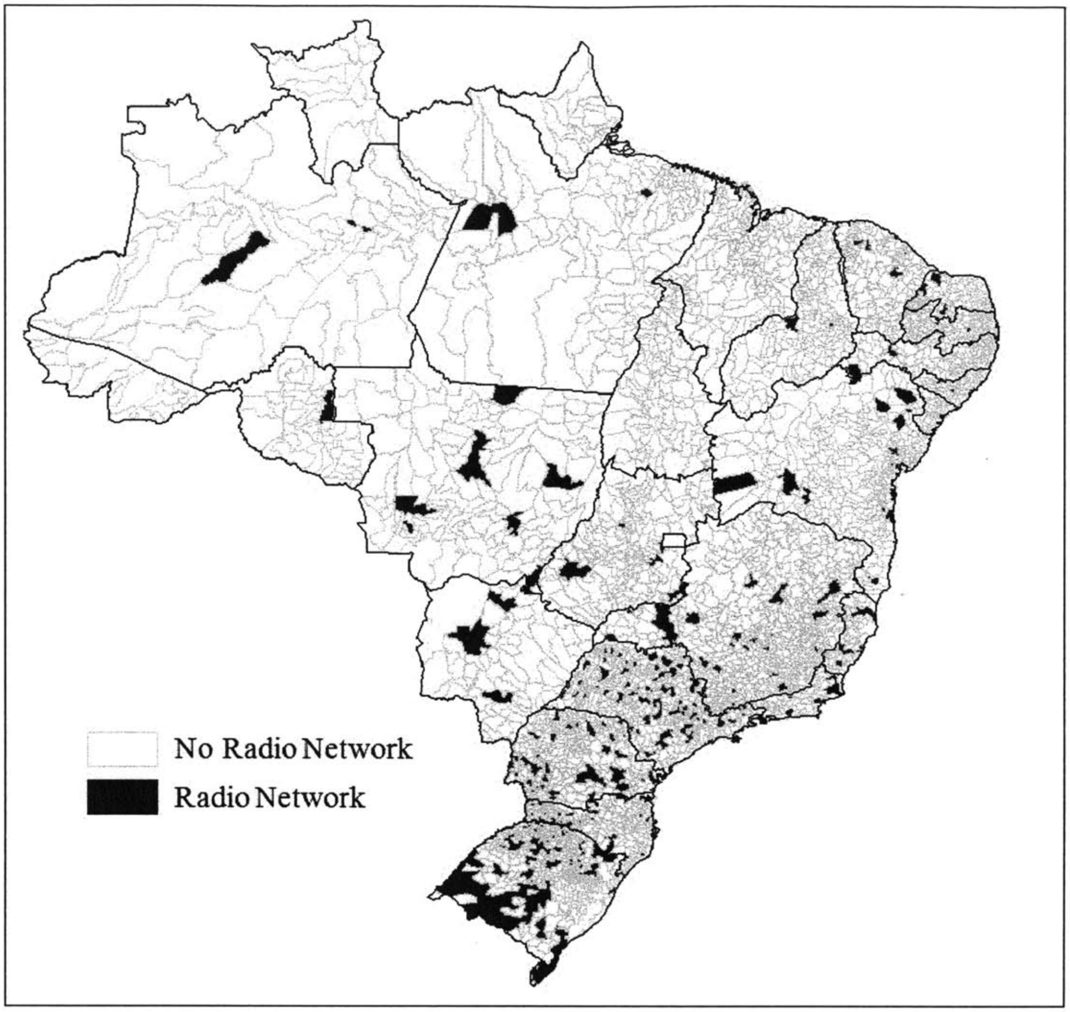
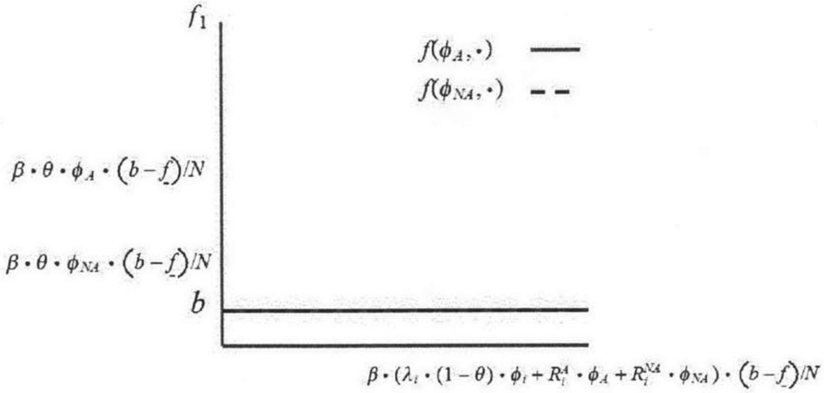
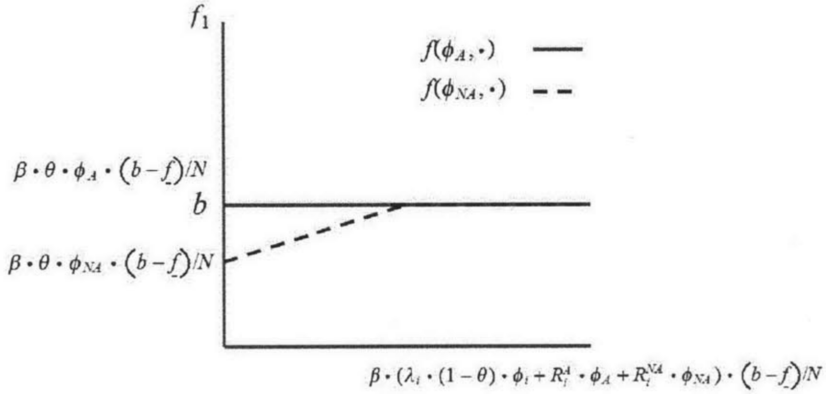


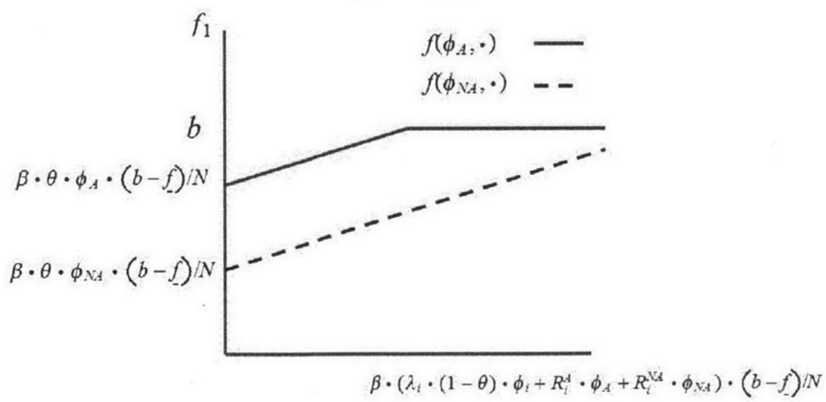
Figure 2-3: Municipalities where a radio network operates



(a) Case A



(b) Case B



(c) Case C

Figure 2-4: Cases of the model

Table 2.1: 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 2.2: 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 municipal state of emergency. All specifications include municipality fixed effects. Standard errors are clustered at the state level. * p<.1, ** p<.05, *** p<.01.

Table 2.3: Estimates on the 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 municipal 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 2.4: Estimates on the heterogeneous effects of network-connected radio stations by the size of their network coverage

	(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 municipal 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 2.5: 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 municipal 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 2.6: 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 municipal 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 2.7: Estimates on the effect of ownership and association to network-connected radio stations by politicians

	(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 municipal state of emergency. All specifications include municipality fixed effects. Standard errors are clustered at the state level. As politicians, we consider mayors, local councilors, and congressmen. * p<.1, ** p<.05, *** p<.01.

Table 2.8: 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 municipal 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.

Chapter 3

Mobilizing Investment Through Social Networks: Evidence from a Lab Experiment in the Field

3.1 Introduction

Sociologists and economists have repeatedly demonstrated the importance of social relationships in a variety of human interactions. Given that social interactions do matter, how can organizations, e.g., villages, firms or governments, harness existing social hierarchies to overcome inefficiencies in formal markets? In this paper, we identify social relationships within a society that permit maximal levels of cooperation. Specifically, by studying the behavior of pairs of participants in a simple sender-receiver investment game, [1] to which we add a third-party monitor or punisher, we mimic a co-investment or lending opportunity and shed light on how social networks affect the propensity for individuals to cooperate and enforce informal contracts.

The question of institutional and contract design is particularly important in developing countries. Without strong formal contracting institutions, social structures

[1]The two-party game is also called a *trust game* in the literature. We view the game as one that naturally mimics co-investment (helping another community member invest in an opportunity that has arisen), for instance.

(networks) are frequently used to mediate economic and political interactions. This is especially true in rural settings where social hierarchies are particularly salient. Common examples of network-based economic relationships include social collateral in microfinance and ROSCAs, informal risk sharing arrangements, and increased prevalence of family firms. While these particular arrangements have been studied at length, (see Feigenberg et al. (2010), Kinnan and Townsend (2010), and Bertrand and Schoar (2006) for recent analyses of each) less is understood about the optimal contract structure given network characteristics as inputs. For example, which members of society serve best as third party monitors or punishers and lead to the most efficient outcomes?

We play games modeled after Berg et al. (1995) and Charness et al. (2008) with experimental subjects from 40 South Indian villages. Specifically, we ran each experimental session directly in each of 40 villages and drew the subject pool from the village population. We start with a two-person game where a *sender* (S) transfers money to a *receiver* (R). The transfer increases in size before it reaches the receiver, who then decides how much to return to the sender. In some treatments, we add a third-party punisher (T). Instead of anonymizing participants, the senders, receivers and third parties (where applicable) all sit together to play each game, and are thus able to identify each other before transfer and punishment decisions are made. In one treatment the identifiable third party can levy costly punishments on the receivers (and hereafter we refer to such a third party as a *punisher*).

Because these are small villages, there is a high likelihood that any randomly chosen group of participants has non-trivial interaction outside the game, and we are precisely interested in how variation in the relative network position of the third party influences outcomes. In order to separate the mechanisms through which punishers affect experimental outcomes, we also include an experimental treatment with a third party who cannot punish (hereafter referred to as a *monitor*). In this treatment, the monitor merely observes the interaction between the sender and receiver. We combine the experimental results with household survey responses and village network data to determine how co-investment behavior is mediated by network and demographic characteristics.

We are mostly concerned with examining how the network position of a third party with a punishment technology affects the efficiency of the outcomes. Our experiments are designed to separate the effects of monitoring from punishment and to measure the causal effect of giving a punishment tool to different types of individuals in the village. The introduction of the third party may lead to ambiguous effects. The threat of punishment may induce the receiver to return more to the sender and, thus, the sender to transfer more to the receiver. However, the addition of a third party could also crowd out transfers from the sender to the receiver. [2]

We wish to study how the embedding of the sender, receiver and third party in the social network influences the efficiency of the interaction. For example, the eigenvector centrality of a node in a network can parametrize the extent to which an individual is important in an information transmission process. Nodes with higher centrality tend to both acquire more and propagate more information, and other nodes tend to have better information about the characteristics of central nodes. Viewing centrality as a reduced form measure of network-importance within each community, we ask what role the centrality of the third party plays in generating higher transfers. For instance, is it the case that when the third party is more central within the network we observe more efficient outcomes? We are also able to address how two categories of demographic characteristics of the judge influence outcomes: caste and whether an individual is a village elite.

To unpack the role of the third party punisher, we develop a simple model of the three-party game. We assume that the third party punisher has preferences over enforcing resource-sharing norms within the game and also has motives to build reputation with the other players in anticipation of interactions outside of the game. In the model, punishers can be of two types, high or low. High types receive utility from fair allocations within the game and are also willing to cooperate outside of the game, while low types do not receive utility from actions in the game and are not

[2]Crowd-out has been thoroughly documented in the experimental literature. Examples include Frey and Oberholzer-Gee (1997), Fehr and List (2004), and Fehr and Gächter (2002).

willing to cooperate outside of the game.

If the punisher's type is known with certainty ex ante, then only payoffs within the game affect the punishment decision. Low types never punish, and high types may punish cases where the receiver only returns small amounts. However, if there is uncertainty over the punisher's type, high types may use the game as a signaling opportunity. We show that this behavior increases the set of cases in which punishment occurs. In reaction to the equilibrium punishment strategies, we show that if the punisher's type is unknown, receivers and senders will behave more cautiously, and lower initial transfers will be sent, resulting in less efficient outcomes.

Because the network's ex ante information about the characteristics of peripheral individuals is less precise, the precision of information about a node's type is a natural way to model centrality. Thus, the model suggests that giving the ability to punish to a peripheral judge should result in more inefficient outcomes in the laboratory sessions relative to central judges.

Empirically, we find that on average, adding a punisher (or a monitor) to a two-party investment game, neither increases nor decreases sender transfers. However, the absence of a level effect masks tremendous heterogeneity in the response to changes in the game structure and in the ability for individuals to achieve more efficient outcomes. We find that network characteristics do interact with the game in meaningful ways. Most notably, as our model would predict, sender transfers increase substantially when the third party is central in the social network and is given the ability to punish. These findings are not consistent with an alternative model where sender and receiver exploit the presence of a central monitor to signal that they are a cooperative type. Relative to the two-party game, adding a punisher who is peripheral in the social network is detrimental to efficiency.

We identify three additional ways in which network characteristics impact the game. First, we corroborate other papers in the literature and find that sender - receiver pairs of close social proximity are able to achieve better outcomes in the two-person game than pairs of socially distant individuals. Second, we show that social proximity can also interact with the punishment technology in negative ways:

socially close sender - judge pairs result in lower sender transfers when the judge is given the ability to punish. This suggests that social closeness can be used to improve contracting outcomes, but it is important to consider the potential for collusion in institutional design. Third, in some games and specifications we find that the social importance of the sender is associated with lower sender transfers. While not robust to demographic controls, this third finding is possible support of the hypothesis that peripheral senders use the game as an opportunity to build reputation with the other players.

We show that our demographic characteristics of caste and elite status generally capture different dimensions of power within the village than our network measures. We define elites as *gram panchayat* members, self-help group officials, *anganwadi* teachers, doctors, school headmasters, or owners of the main village shop. Both high caste individuals and elites are afforded special status in their communities. However, in the data, the patterns of network centrality do not match (or even resemble) the patterns of demographic importance. Namely, having an elite or high caste individual as the third party does not significantly increase efficiency when given the ability to punish.

Note that our results differ from previous anonymous laboratory studies such as Charness et al. (2008), which finds that adding a punisher increases average sender transfers, and thus efficiency. We find that while adding an average punisher does not matter in our setting, the network characteristics of that punisher do matter. It is not surprising then that the same game played in an anonymous setting with strangers who have no chance of interacting in the future should produce different patterns when played with members of a tight-knit social network where individuals have a high probability of interacting in the future.

Our results take a step towards understanding how a community might enlist its own social fabric to overcome a lack of formal institutions. To our knowledge, no previous study has used high quality network data to analyze the play of investment games with third parties. Moreover, rural India is the type of setting where network effects should matter most for economic outcomes. Our results also highlight how social connections might have first-order effects when transplanting contracting institutions that work in the (anonymous) lab to the field.

3.1.1 Relevant Literature

Our baseline game builds from the literature started by the Berg et al. (1995) trust game. While the Nash equilibrium has zero transfers for anonymous partners, the authors find that senders make positive transfers and some receivers fully reciprocate. However, senders who transfer tend to lose money on average. Charness et al. (2008) add a third-party punisher and find that senders transfer more and receivers reciprocate to a greater degree than in the case without a punisher. Initial transfers are 60% higher when a punisher is present, significantly increasing total payoffs.

While most experimental games are played with anonymous interactions, a smaller subset of the social preferences literature examines how the outcomes of experimental games change as the ties between agents are manipulated within the experiment (e.g., Hoffman et al., 1996; Bohnet and Frey, 1999; Burnham, 2003; Charness and Gneezy, 2008).[3] Recently, researchers have begun to combine experimental games with existing network structures. Goeree et al. (2010) elicit peer networks of middle school students and run dictator games with the students and find that dictator offers can largely be explained by inverse social distance. Using networks of Harvard students and online dictator games, Leider et al. (2009) also find social distance effects and are able to disentangle different motivations for observed altruistic behavior. The closest paper to ours is Glaeser et al. (2000), who study the investment game with Harvard students. They elicit data on number of months that sender has known the receiver, number of friends they have in common, and demographic characteristics.

[3]Hoffman et al. (1996), Bohnet and Frey (1999), Burnham (2003), and Charness and Gneezy (2008) randomly give dictators fairness priming, information prompts, pictures of the receiver, or allow the dictator to see the receiver. All find allocations made by the dictator to increase under these treatments. Bohnet and Frey (1999) also add a treatment where both players visually identify each other and find that dictators are far more likely to split the surplus according to the "fair" 50-50 allocation rule. While these papers give importance evidence that familiarity (or a humanizing force) affects experimental outcomes, they fall short of being able to explain how realistic social dynamics interact with each participant's strategic behavior. In the developing country context, Fehr et al. (2008) and Hoff et al. (2009) use similar games to investigate how caste affects trust and co-investment in India.

They do not find any significant effects of similarity of demographic characteristics (e.g., same/different nationality/ethnicity of S and R) on behavior. They find that senders send more and receivers return a greater share if the pair has known each other longer or have more friends in common. Finally, they find that the sender differentially benefits from social status – having more friends makes the sender send less and the receiver send more.

Meanwhile, the network economics literature has developed a rich language to characterize the importance of an individual in the network via measure such as eigenvector centrality.[4] This centrality measures typically reflect a node's importance in transmission; more important nodes may be able to better punish others through reputational or social capital channels. Jackson (2008) provides a detailed discussion of the concepts. Empirical network papers employing eigenvector centrality include Hochberg et al. (2007), Banerjee et al. (2012), and Schechter et al. (2011).

Our paper makes several contributions to these literatures. First, we are exactly interested in studying a non-anonymous environment, wherein individuals have deep, preexisting relationships that influence the way they behave. Individuals are called often to interact with community members, sometimes in unanticipated circumstances: e.g., serving on a committee, PTAs, co-investing in a public good. Understanding how the variation in the network position of the actors influences the outcomes of these interactions is important and requires randomly matching individuals as well as obtaining detailed data on the underlying social network of the community. We are in the unique position of having detailed social network data in 40 villages so that we can analyze those nuanced network features suggested by theory to play a role in social interactions. Second, unlike dictator games or two-party interactions, we are specifically interested in questions of institutional design and the role for outside parties to monitor or mediate economic decisions. Our experimental treatments with third parties allow us to ask which network properties must a third party authority

[4] Degree is the number of neighbors a node has, eigenvector centrality is a recursively defined measure which defines the centrality of a node as proportional to the sum of its neighbors' centralities, and betweenness centrality computes the share of shortest paths between all pairs of nodes that pass through the node whose centrality we are measuring.

possess to generate efficient (or inefficient) behavior? Third, as rural village networks mediate most economic transactions in developing countries (and potentially substitute for more formal institutions or credit markets), it is crucial to understand how barriers to joint investment can be overcome in exactly these types of settings.

3.1.2 Structure of the Paper

The remainder of the paper is organized as follows. In section 3.2, we describe the experimental subjects, network and survey data sources and the experimental design. Section 3.3 provides a simple model of third-party punishment. In section 3.4 we present the results, and section 3.5 concludes.

3.2 Data and Experimental Design

3.2.1 Setting

Our experiment was conducted in 40 villages in Karnataka, India which range from a 1.5 to 3 hour's drive from Bangalore. We chose these villages as we had access to village census demographics as well as unique social network data set, previously collected in part by the authors. The data is described in detail in Banerjee et al. (2012) and Jackson et al. (2010).

The network represents social connections between individuals in a village with twelve dimensions of possible links, including relatives, friends, creditors, debtors, advisors, and religious company. We work with an undirected and unweighted network, taking the union across these dimensions, following Banerjee et al. (2012) and Chandrasekhar et al. (2012). As such, we have extremely detailed data on social linkages, not only between our experimental participants but also about the embedding of the individuals in the social fabric at large.

Moreover, the survey data includes information about caste and elite status. Here local leader or elite is someone who is a *gram panchayat* member, self-help group official, *anganwadi* teacher, doctor, school headmaster, or the owner of the main village shop. Finally, the survey data contains educational attainment as well as proxies for household wealth. We use information such as house size, electrification, building materials, and toilet amenities to construct a ranking within each village.

3.2.2 Experiment

Each participant played five to six total rounds of three experimental treatments.[5] Players were randomly assigned one of three roles in each round: sender (S) with endowment Rs. 60, receiver (R) with endowment Rs. 60, and third party (T) with endowment Rs. 100. A total of 14 surveyors moderated the experiments, each overseeing only one group of two or three participants at a time.

The baseline game (T1) is a two-player investment game with no third-party monitor or judge. The surveyors select two participants at random and assign them to roles of S and R. S can then make a transfer to R, which then triples in size. Finally, R decides how much of his or her wealth from the game to return to S. This transfer does not grow when sent by R. Ending balances are then recorded by the surveyors.

In the other two treatments, we add third parties who can either monitor or punish. Three players are randomly selected and given roles of S, R, and T. S and R then make the same transfer decisions as in T1. In T2, T watches the transfers take place, but does not take any additional action within the game. In T3, T observes the transfers, and further, has the option to spend his or her own resources to levy a monetary punishment on R. For every Rs. 1 spent by J, R loses Rs. 4.

Each participant played either 5 or 6 randomly ordered rounds of the experimental games, including 2 rounds each of T2 and T3. Half of participants played T1 once and the other half twice. Out of the 5 or 6 total rounds played, participants were each given their ending wealth values for one randomly-chosen round. Participants were given a fixed participation fee of Rs. 20 in addition to their earnings from the game. The average payoff from participating in the experiment was approximately

[5]We also attempted, albeit unsuccessfully, to implement a fourth treatment involving having (S, R) pairs interact in anticipation of a T who is not from their village by using a cellular phone.

Rs. 110, or approximately half to three-fourths of a daily agricultural wage.

In many settings individuals can choose the individuals with whom they interact. However, there are also plenty of real-world occasions when people find themselves needing to work together with a potentially diverse group of community members. Examples include PTA boards at schools, new business ventures, or new clients. Randomly matching individuals to pairs and triples of individuals in the lab we try to mimic some aspects of the latter types of relationships. Furthermore, in some cases, it is possible to choose the enforcement or governance structure of a group of individuals. Thus, our goal is to detect who is the best at filling the role of the leader or punisher. As such, randomly forming groups of individuals is instructive.

3.2.3 Norms

We designed our experiments to be able to separate between different possible response strategies receivers may be using. There may be natural focal points for how players choose to divide resources among themselves, which may also act as reference points that third parties use when deciding whether or not to punish.

In his behavioral economics survey paper, Rabin (1998) discusses several sharing norms prevalent in human behavior. We consider five natural possibilities for how the sender and receiver may choose to share resources. Suppose that the sender transfers τ_S rupees to the receiver. The transfer grows by a factor of α before reaching the receiver. Finally the receiver transfers τ_R back to the sender. We posit five possible norms that receivers could be playing in our experiment:

1. Keep the Entire Transfer: $\tau_R = 0$.
2. Keep the Surplus: $\tau_R = \tau_S$.
3. Split the Transfer: $\tau_R = \frac{\alpha\tau_S}{2}$.
4. Share the Pie: $\tau_R = \frac{(\alpha+1)}{2}\tau_S$.[6]
5. Return the Full Surplus: $\tau_R = \alpha\tau_S$.

[6] Solving $60 - \tau_S + \tau_R = 60 + \alpha\tau_S - \tau_R$ yields the result.

We chose the multiplier $\alpha = 3$ so that we could distinguish between all five cases. Thus, the norms as a fraction of the amount that reaches the receiver are (1) $\frac{\tau_R}{\alpha \tau_S} = 0$, (2) $\frac{\tau_R}{\alpha \tau_S} = \frac{1}{\alpha} = \frac{1}{3}$, (3) $\frac{\tau_R}{\alpha \tau_S} = \frac{1}{2}$, (4) $\frac{\tau_R}{\alpha \tau_S} = \frac{\alpha+1}{2\alpha} = \frac{2}{3}$, (5) $\frac{\tau_R}{\alpha \tau_S} = 1$.[7]

We look empirically for evidence that receivers play (some of) these norms in Section 3.4.1, and our model in Section 3.3.2 incorporates the idea that there is a finite set of norms that receivers may play.

3.2.4 Descriptive Statistics

Table 3.1 presents the descriptive statistics. In each village, 24 individuals between the ages of 18 and 45 were randomly invited to our experiment. All together, 960 individuals participated.[8] The average age is 30 with a standard deviation of 8.1 years. 61% of the participants are female, and the average education level is 8.14 with a standard deviation of 4.31.[9] About 63% of the participants are general or "otherwise backwards" (OBC) caste.[10] Finally, 20% of households have a leader.

Turning to network characteristics, the average social proximity between pairs (the inverse of the social distance) in our experiment is 0.31.[11] The maximum social distance, when it is finite, is 7, and the minimum is 1. 96% of pairs are reachable (there exists a path through the network connecting the two). The average degree (number of friends) is 9.84 with a standard deviation of 6.62, indicating that there is substantial heterogeneity in an individual's number of connections.

3.3 Framework

In this section, we first motivate the choice of the network characteristics –centrality and social proximity– on which we consider heterogeneous treatment effects on. Sec-

[7]Notice that if $\alpha = 2$, then we would not be able to separate between (2) and (3).

[8]See Banerjee et al. (2012) for an analysis of the diffusion of information about the game.

[9]This means that on average, an individual had attended 8th standard.

[10]There are three standard caste categories in India: general merit (GM); scheduled caste and scheduled tribe (SCST); and other backward caste (OBC). The SCST group is traditionally the most disadvantaged.

[11]Appendix 3.5 contains a glossary formally describing the network statistics used.

ond, we develop a simple model that captures the effect of the third party punisher's centrality, which is the main focus of our paper.

3.3.1 Network Characteristics

Rural villages in developing economies often must incorporate social relationships when designing and enforcing business activities. Since trust and informal authority alone must sustain these interactions, the network positions of the contracting parties could greatly affect the scope of joint investment and other productive activities. An important question is how the network relationships between agents impact economic outcomes. Moreover, it may be the case that agents choose members of society to serve as enforcers of contracting norms. As these parties themselves are embedded in the social network, it raises the question of which network characteristics effective judges possess. Given the innumerable ways in which networks may affect economic interactions, we employ two different types of network characteristics in our analysis. Two natural network measures are the centrality of each individual and the distance between any two individuals.

The main measure we are interested in is the centrality of the individuals. There are several reasons why centrality should matter in our experiments. We focus our analysis on the centrality of the third party. Note that the third party has to actively take a decision in T3 (either punish or not punish R). Thus, in T3, the third party may gain or lose reputation in the eyes of the other participants based on her punishment decision.[12] The bulk of our analysis uses the eigenvector centrality as the notion of network centrality in our analysis. Eigenvector centrality is a recursive notion of importance wherein an individual's centrality is proportional to the sum of each of her neighbor's centralities.

We are also interested in is that of the inverse social distance (or social proximity). Let γ_{ij} denote the minimum path length between individuals i and j, we define social proximity as γ_{ij}^{-1}. Social proximity is commonly used in the experimental networks

[12]This is not true in T2 because the third party merely is an observer. In T2 the third party's role is to potentially propagate information outside the experiment.

literature (e.g., Goeree et al. (2010); Leider et al. (2009)). We should expect that unregulated interactions between pairs of individuals should have more cooperative outcomes for those with high social proximity. The addition of a third party may cause efficiency to either increase or decrease depending on the social proximity of the parties involved. While a punisher might be better able to induce efficiency when the other two individuals are social far, social proximity between a punisher and sender might be detrimental for efficiency.

Finally, we also consider how demographic characteristics (e.g., caste and elite), which might confound with the network measures, interact with contracting between individuals. Two individuals belonging to the same caste group may operate much like social proximity. However, caste also has a power dimension. High caste individuals may be able to exercise power over low caste individuals. Moreover, being a member of the elite in a village could also affect the power dynamic between parties. The experimental predictions are similar to those for centrality. However, elites may be better at resource capture than network leaders.

Throughout the paper, we consider heterogeneous treatment effects based on network position. While these parameters are identified given our experimental design, it is important to use caution when interpreting the results. We caveat that networks are not randomly assigned. People who are central might differ from people who are peripheral on numerous dimensions. We supplement the networks data with covariates that might be correlated with centrality or social proximity such as wealth, leadership status in the community, and caste. We build a case that the network position is what matters by ruling out these other covariates as the key drivers of our findings.

3.3.2 Simple Model of Centrality and Punishment

We present a simple two-period model of the three-player game to focus on the effect of the third party punisher's centrality. In the first period, two players play the sender-receiver game and the third player acts as a punisher. In the second period, either the sender or receiver plays a coordination game with the punisher.

The first-period game represents our laboratory experiment, and the second-period coordination game represents the super-game individuals continue to play after they leave our experiment. Our framework captures incentives that individuals, and in particular the judge, may have to build reputation outside the lab.

We start by describing the strategies and payoffs. We then describe the types of punishers. Finally, we characterize the subgame perfect equilibria of the two-period game where the second-period coordination game provides incentives for punishers to build up reputation in the first-period game.

Trust Game with Third Party Enforcement

In the first period, a sender (S), a receiver (R), and a judge (T) play the following game. At the beginning of the period, S receives an endowment E and decides how much to transfer to R, which we denote as τ_S. τ_S triples in value, and R receives $3 \cdot \tau_S$. Then, R decides how much to transfer back to S, denoted τ_R, and S receives τ_R. WLOG, we restrict R to play one of three different strategies: $\tau_R \in \{0, \eta_M \cdot \tau_S, \eta_H \cdot \tau_S\}$. R can follow the high norm, η_H, the intermediate norm, η_M, or can return nothing. We assume $\eta_H > \eta_M$.

We define d as the utility cost of a deviation from the high norm. We assume that this cost can take three exogenously determined values,[13] $d \in \{0, d_S, d_L\}$:

$$d = \begin{cases} 0 & \text{if } \tau_R = \eta_H \cdot \tau_S, \\ d_S & \text{if } \tau_R = \eta_M \cdot \tau_S, \\ d_L & \quad \text{otherwise,} \end{cases} \tag{3.1}$$

We call d_S a *small norm deviation* and d_L a *large norm deviation.*

Next, T receives an endowment M and decides whether to punish R. The punishment is a binary decision, has a cost c to T, and incurs a penalty of fixed size κ to R. An unpunished deviation from the high norm causes a disutility $\theta_T \cdot d$ to T, where $\theta_T \in \{0, 1\}$. This assumption captures the idea that Ts have heterogeneous

[13]Allowing for continuous τ_R and endogenous $d = d(\tau_S, \tau_R)$ does not change any of the intuition or conclusions of the model. We introduce this simplification for expositional clarity.

types and may experience utility from norm compliance.

The first period payoffs for all three players are as follows,

$$U_S = E - \tau_S + \tau_R, \tag{3.2}$$

$$U_R = 3 \cdot \tau_S - \tau_R - \kappa \cdot P, \tag{3.3}$$

$$U_T = M - \theta_T \cdot d \cdot (1 - P) - c \cdot P, \tag{3.4}$$

where it is worth noticing that the disutility that a T of type $\theta_T = 1$ experiences from a high norm deviation is increasing with the size of the deviation.

Additionally, we assume that $d_L > c > d_S$. Under such parameter constraints, in the absence of the second-period game, T would never have incentives to punish small deviations of the high norm in the first-period stage game.

Coordination Game

In the second stage, either S or R plays a coordination game with T:

	S or R		
	Action	Low	High
T	Low	$((1-\theta_T)\cdot L, 0)$	$((1-\theta_T)\cdot L, -\alpha)$
	High	$(-\alpha, 0)$	(β, β)

Payoffs satisfy $\alpha, \beta > 0$, $L > \beta$. Punishers with $\theta_T = 0$ never cooperate because playing *Low* is a dominant strategy. On the contrary, when $\theta_T = 1$, T cooperates when she expects the other player to also cooperate. In this case, (Low, Low) and $(High, High)$ are both Nash Equilibria in this static stage game. Consider an individual S or R who plays the above coordination game with T. Denote λ to be her belief that her counterpart T plays *High*. She will play *High* as long as $\lambda \geq \frac{\alpha}{\alpha+\beta}$. For future exposition, we denote $\frac{\alpha}{\alpha+\beta} = \gamma$.

Types of Players

For simplicity, we focus on the case where only T's have type heterogeneity. We denote π_T to be the prior that $\theta_T = 1$. This prior π_T is equal to the population share of high types. Additionally, we assume that T may be central or peripheral in the social network, and that individuals know the type θ_T with certainty for central Ts. In contrast, individuals have uncertainty about the type of peripheral Ts, and thus have a prior π_T over the probability that $\theta_T = 1$ for any given peripheral T. We assume that $\pi_T < \gamma$.

Timing

The timing of the two-period game is as follows,

- $t = 0$: Nature draws $T's$ type, θ_T, and whether she is peripheral or central
- $t = 1$: S, R and T play the trust game with third party enforcement,
  - S receives E and transfers τ_S,
  - R receives $3 \cdot \tau_S$ and transfers τ_R,
  - S receives τ_R,
  - T decides whether to punish R, and
  - period payoffs are realized.
- $t = 1.5$: S or R update π_T to form λ.
- $t = 2$: Either S or R play the coordination game with T,
  - S or R and T decide whether to play Low or $High$, and
  - period payoffs are realized.

Characterization of the Game

We look for subgame perfect equilbria, and characterize the game through backward induction.

Characterization of the Coordination Game in $t = 2$

As noted above, S or R's best response is to play $High$ as long as $\lambda \geq \gamma$. Thus, there are two possible cases, summarized in the following lemma.

Lemma 1 *If T is peripheral and $\lambda < \gamma$ or T is central and $\theta_T = 0$, then the unique stage-game Nash Equilibrium is S or R and T both play Low. However, if T is peripheral and $\lambda \geq \gamma$ or T is central and $\theta_T = 1$, then there exists a stage-game Nash Equilibrium such that S or R and T both play $High$.*

The proof is straightforward and omitted. Note that the stage game equilibrium where S or R and T coordinate on $High$ is the efficient static Nash Equilibrium of the stage game. We focus on the equilibrium of the two-period game where cooperation can be sustained, and consequently, where there are incentives for T to build up reputation in the first-period game.[14]

Characterization of T's Strategy in the Trust Game with Third-Party Enforcement

If nature draws $\theta_T = 0$, then $T's$ dominant strategy is to not punish regardless of τ_R. If nature draws $\theta_T = 1$, then we distinguish between the cases when T is central and when T is peripheral. When T is central, her type is already known and thus has no incentives to build reputation in the first period game. Given $d_L > c > d_S$, a central T's dominant strategy (when $\theta_T = 1$) is to only punish large deviations from the high norm.

The interesting case arises when T is peripheral and $\theta_T = 1$. In such a case, given that $d_L > c$, a peripheral T also punishes large deviations. However, T might also now have incentives to punish small deviations in the first stage in order to build reputation for the second period and separate from the $\theta_T = 0$ types.

When does such a separating equilibrium exist? The characterization of the third party's strategy in the period-one game is summarized in Lemma 2.

[14] In all subcases, (Low, Low) is also a Nash Equilibrium of the second period stage game.

Lemma 2 *Assume that* $d_L > c > d_S$, $d_S + \beta > c$, and $\pi_S, \pi_R \geq \gamma > \pi_T$, then given the second-stage equilibrium strategies in Lemma 1, there exists an equilibrium punishment strategy where: [15]

1. Any T with $\theta_T = 0$ never punishes, regardless of τ_R.
2. Central T with $\theta_T = 1$ only punish large deviations from the high norm.
3. Peripheral T with $\theta_T = 1$ punish large *and* small deviations from the high norm.

Proof 1 *See Appendix 3.5*

Characterization of the Sender's and Receiver's Strategies in the Trust Game with Third-Party Enforcement

There are three cases we should consider: a) when S and R face a central T with $\theta_T = 1$, b) when S and R face a central T with $\theta_T = 0$, and c) when S and R face a peripheral T of unknown θ_T. Lemma 3 characterizes the strategies of S and R in the period-one game.

Lemma 3 *Assume that $d_L > c > d_S$, $d_S + \beta > c$, $\pi_S, \pi_R \geq \gamma > \pi_T$, and $\eta_M > 1$. Then given the equilibrium punishment rule from Lemma 2:*

1. *If S and R face a central T of type $\theta_T = 1$, S transfers $\frac{\kappa}{\eta_M}$ to R and R transfers κ back to S.*
2. *If S and R face a central T of type $\theta_T = 0$, S transfers 0 to R and R transfers 0 back to S.*
3. *If S and R face a peripheral T of unknown type, S transfers $\frac{\pi_T \cdot \kappa}{\eta_L}$ to R and R transfers $\pi_T \cdot \kappa$ back to S.*

Proof 2 *See Appendix 3.5*

[15] There also exists a SPE where nobody ever cooperates in the second stage, and nobody ever punishes in the first stage.

The following proposition characterizes the strategies and outcomes of the separating equilibrium of the two-period game.

Proposition 4 *Assume that* $d_L > c > d_S$*,* $d_S + \beta > c$*,* $\pi_S, \pi_R \geq \gamma > \pi_T$*, and* $\eta_M > 1$*.*

1. *If* S *and* R *face a central* T *of type* $\theta_T = 1$*,* S *transfers* $\frac{\kappa}{\eta_M}$ *to* R *in the period-one game,* R *transfers* κ *back to* S*, and* T *does not punish* R*. In the period-two game,* S *or* R *and* T *play* $(High, High)$*.*

2. *If* S *and* R *face a central* T *of type* $\theta_T = 0$*,* S *transfers* 0 to R *in the period-one game,* R *transfers* 0 *back to* S*, and* T *does not punish* R*.* S *or* R *and* T *play* (Low, Low)*.*

3. *If* S *and* R *face a peripheral* T*,* S *transfers* $\frac{\pi_T \cdot \kappa}{\eta_H}$ *to* R *in the period-one game,* R *transfers* $\pi_T \cdot \kappa$ *back to* S*, and* T *does not punish* R*.* S *or* R *and* T *play* (Low, Low)*.*

It is worth noting that central Ts of type $\theta_T = 1$ are better able to provide incentives to cooperate than peripheral Ts, and hence, they enhance the efficiency of the two-period game outcome. While a central T of type $\theta_T = 1$ is able to induce a transfer $\frac{\kappa}{\eta_M}$, a peripheral T is only able to induce a transfer $\frac{\pi_T \cdot \kappa}{\eta_H}$, where $dfrac\kappa\eta_M > \frac{\pi_T \cdot \kappa}{\eta_H}$, since $\frac{\eta_H}{\pi_T} > \eta_H > \eta_M$.

Further, this implies that average sender transfers across all peripheral Ts will be lower than the average sender transfers across all central Ts. When T is central, the average transfer is $\bar{\tau}_S^{central} = \frac{\pi_T \cdot \kappa}{\eta_M}$ while $\bar{\tau}_S^{peripheral} = \frac{\pi_T \cdot \kappa}{\eta_H}$. Under our assumptions, $\bar{\tau}_S^{central} > \bar{\tau}_S^{peripheral}$.

3.4 Results

3.4.1 Pooled Equilibrium Play

Before analyzing the treatment effects and network effects, it is helpful to first observe the overall outcomes from the experimental sessions. The data include 1,988 total games, and Figure 3-1 shows the distribution of initial transfers from S to R observed in all games pooled together. Almost all transfers are made in increments of Rs. 5 or Rs. 10.[16] The modal transfer is 20, with the mean occurring at Rs. 28.5. A zero transfer is only observed in 13 of the games. The efficient transfer of Rs. 60 is observed 122 times (~6% of games).

Moving to the receiver's response, Figure 3-2 shows the pooled distribution of transfers from R to S as a fraction of the initial transfer from S to R. Note that most of the receivers transfer weakly less than the amount sent by the sender, leaving receivers with quantities at least as high as their initial endowments[17]. Only 5% of games ended with the receiver sending more back to the sender than was initially transferred. Also note that there are two transfer levels with notably high frequencies occurring at $\frac{\tau_R}{\alpha\tau_S} = \frac{1}{3}$ and $\frac{\tau_R}{\alpha\tau_S} = \frac{2}{3}$. These values correspond to norms 2 and 4, "keep the surplus" and "split the pie." The receivers seem to adhere to some notion of fairness as described in the norms of section 3.2.3. The mean level of $\frac{\tau_R}{\alpha\tau_S}$ is approximately 0.5. Note that while, on average, both S and R gain relative to their initial endowments, approximately 25% of senders are worse off in monetary terms than if they had played the static Nash Equilibrium, $\tau_S = 0$.

Figure 3-3 provides an alternate illustration of R's average response to S.[18] The graph plots a nonparametric approximation of $\frac{\tau_R}{\alpha\tau_S}$ as a function of τ_S. Surprisingly, very small initial transfers are rewarded with large return transfers (statistically indistinguishable from sending everything back). However, as $\tau_S > 20$ the overall relationship between initial transfer and amount returned is remarkably stable at approximately 0.5 in equilibrium.

The equilibrium punishments incurred by the judges in T3 can also teach us about the acceptable transfer norms in the participating villages. Figure 3-4 shows incurred punishments as a fraction of transfers returned from R to S. On the interval from 0 to 1, punishment is decreasing as a function of the fraction returned to the

[16]Participants could make transfers in increments of Rs. 1.

[17]At least before the punishment decision is made.

[18]We note that any relationship between player behavior and τ_S is endogenous. Therefore the plots in Figures 3-3 and 3-4 are descriptions of the equilibrium and are not causal effects. They ought to be interpreted with caution.

sender, as would be expected from a norm-enforcer. Returning nothing is associated with an average punishment amount of Rs. 10. This expected punishment declines dramatically as $\frac{\tau_R}{\alpha \tau_S}$ approaches 1. Above 1, punishment appears to be increasing, but is very noisy. In this range, punishment enforces an unfair outcome for receivers; their final payoffs are lower than their initial endowments.

These outcomes show that while players in the role of S tend to transfer amounts substantially greater than zero, most games are quite far from the efficient outcome. Further, sender transfers are quite heterogeneous. These outcomes also indicate the that receivers tend to focus on two of the norms from Section 3.2.3 and that when observed, punishment is decreasing in the size of the receiver's transfer, both of which are captured in our model. We next move to understand the extent to which the contracting structure and the social network can help S, R pairs to achieve more efficient outcomes and can help to explain the heterogeneity of game outcomes.

3.4.2 Treatment Level Effects

We begin by analyzing the game outcomes by treatment. Table 3.2 presents the payoffs and sender transfers by treatment. In each specification, the omitted treatment is the two-player game. Results in column 1 indicate that we cannot reject that the game in which T can only observe, but not punish, has different total payoffs than the baseline. However, the game in which T can both monitor and punish decreases total payoffs by Rs. 9.97. In game 3, the average punishment level is 8.28 and can mostly explain the decrease in payoffs. Columns 2 and 3 show the payoffs separated by S and R. The entire difference in total payoffs (column 1) across treatments is borne by R , which is again consistent with the monetary punishments eroding payoffs. Column 4 looks at how the initial τ_S, which is a measure of efficiency, responds to treatments. None of the treatments has statistically distinguishable effects relative to the baseline. Columns 5 to 8 indicate that results in columns 1 to 4 are robust to the inclusion of several controls.

In light of our model, there are two opposing effects that come into play when we add a third party who can punish. On the one hand, the punisher should be better able to enforce the return of larger transfers, in turn encouraging higher initial transfers. On the other hand, low centrality judges may try to build reputation by punishing, even for very small norm violations. This type of behavior could therefore completely offset the positive effect of the punisher. Further, the presence of a third party may crowd out any pro-social behavior observed in the two-party games.

Note that the Charness et al. (2008) games are played with anonymous agents, so the social proximity of agents is 0, the relative network centralities of players can be thought of as 0, and the value of future interactions in the supergame can also be thought of as 0. In contrast, our experiments are played in a non-anonymized environment in which agents are entirely socially connected. Our networks exhibit small-world phenomena; the average proximity of senders and receivers is high (.32). Individuals have many opportunities to interact with one another outside of our laboratory games. Consequently, any network effects on game behavior are likely to be extremely salient and influence the main effects in our data.Relative to our results, we can think of the Charness et al. (2008) data as coming from socially distant pairs and triples of individuals who all have extremely high centrality in the network and who have no reputation-building motives with one-another. Therefore, the anonymous, socially distant judge does not have any reputation-building incentives and only plays the role of norm enforcer. In our games, however, the judge has two separate incentives for intervening in the game, and the sign of the effect on overall efficiency is ambiguous.

3.4.3 Network Importance and Sender Transfers

We now address the central theme of our paper: how social networks affect the ability for participants in an investment game to cooperate, and how giving punishment technologies to central versus peripheral individuals affects the efficiency of outcomes. We focus on the play of the senders, as they determine the efficiency of the outcomes. Table 3.3 displays our main network findings. We consider measures of network importance (top of table) and measures of network proximity (bottom of table).

Centrality

The top portion of Table 3.3 shows how the transfers of the sender change with the eigenvector centrality of the players.[19] We center our exposition on the columns that include the network characteristics of the judge, because those allow us to measure the causal effect of introducing a punishment technology.

As a preview of our main result, Figure 3-6 provides evidence that more central judges are associated with higher transfers from S to R. Columns 2, 5, 8 and 11 of Table 3.3 confirm that, using two different measures of centrality, on average, the most central judge induces S to transfer approximately Rs. 3.0 more to R than the least central judge. Columns 3, 6, 9 and 12 indicate that the effect of judge centrality is only present in the treatment in which the judge has the ability to punish. In these specifications, the game with monitoring only is the omitted category. This result is in line with the theoretical prediction of the model that central judges are better able to provide incentives for cooperation. In the game with only monitoring, the judge does not take an action, and thus does not have any scope for building reputation. Our results confirm that this motive, which is captured in our model, is only present when the judge is given a punishment technology.

Moreover, we find that more central senders send less to receivers, a result which appears quite robust across all specifications with no demographic controls. While our simple model in 3.3.2 was not designed to capture reputation motives of the S and R, we can use the same logic to explain how the centrality of S affects transfers. If senders use their transfers to build reputation, we should observe that transfers are decreasing in the centrality of S because again, signals sent by peripheral individuals are more.

[19]We include specifications with different sets of controls, and we also evaluate the regressions with different measures of eigenvector centrality: centrality quartile and an indicator for high versus low centrality.

Proximity

While our biggest contribution is demonstrating the potential to employ high centrality third parties to possibly improve informal contracting outcomes, we also consider the role of social proximity in encouraging cooperation. It may not be especially surprising, but our results echo those of other related studies and suggest that social proximity does help to foster more efficient outcomes.

To preview of our results on social distance Figure 3-5 shows the total payoffs of S and R are increasing in sender-receiver social proximity. The bottom portion of Table 3.3 shows how the transfers of the sender change with the social proximity of the players. Columns 1, 4, 7 and 10 provide evidence that, in the two-party game (T1), an increase in the social proximity between S and R corresponds to an increased transfer from S to R. S transfers approximately Rs. 8 more to R if they are at distance one as opposed to being socially unconnected, though the coefficient is only marginally significant.

The rest of the columns, which include the social proximity between the punisher and both the sender and the receiver, reflect the results for the games where we introduce a punisher (T2 and T3). We also find evidence that in T3 as opposed to T2, social proximity between S and T induces the sender to transfer less to the receiver. This appears to provide evidence for collusion between the sender and the judge. A sender-judge pair at social distance one corresponds to the sender transferring between Rs. 10 and Rs. 12 less to the receiver than a sender-judge pair who are not socially connected. The effect is only present in T3 where the judge is able to take an action but not the case in T2 where the judge can only monitor and no in-game action is required. Overall, while social proximity may improve outcomes between S and R, it appears that social proximity between the players and the judge may also undermine the punishment institution.

3.4.4 Demographic Characteristics and Robustness

Because the social networks in these 40 study villages are not randomly assigned, it is natural to ask whether our network effects are driven by other demographic characteristics that happen to be correlated with network position. We take three approaches. First, we show that the demographic and network characteristics pick up different dimensions of variance in a principal component decomposition analysis. Second, we show that other demographic characteristics that may be correlated with the network such as caste or elite status cannot replicate the patterns observed with the network characteristics. Third, we show that our main networks results do not change even if we control for all available demographic characteristics.

Four of the demographic characteristics in our data, elite status, high caste, wealth, and education, may represent power or a notion of hierarchy in the study villages. Therefore, we check if these three variables are driving our observed centrality effects.

Principal Component Analysis

In Table 3.4, we present a principal component decomposition of the importance characteristics. The decomposition contains five different measures of importance: eigenvector centrality, elite status, high caste, wealth, and educational attainment. The five variables separate along three distinct dimensions. Caste, wealth and education are all key contributors to the first principal component, eigenvector centrality is the main constituent of the second principal component, and elite status appears to be its own dimension in the third principal component. This suggests that network centrality does have content distinct from the other demographic characteristics.

Even though these measures may be correlated, the principal component decomposition suggests that the demographic measures are distinct from network centrality..

Demographic Characteristics

Panel A of Table 3.5 presents results for sender behavior as a function of the elite status of the participants. While there is no detectable effect of elite status on transfers in the baseline two-player game (columns 1 and 4), elite status does weakly affect how the game is played in the treatments with third parties (columns 2, 3, 5, and 6). Columns 2 and 4 indicate that, in the pooled games with a third-party, senders who are elites send approximately Rs 2 less to receivers. Moreover, columns 3 and 6 suggest that such an effect is driven by T2. This gives some evidence that resources are perhaps directed towards elites who exhibit their power in the presence of third-parties that cannot punish them.

Importantly for our central result, whether the judge is an elite does not affect sender transfers in either of the treatments with a third party, which suggests that it is unlikely that the results on punisher centrality are driven by the fact that more central people might belong to the elite.

The effects of caste composition on sender transfers are displayed in Panel B of Table 3.5. Because we only have caste information for a subset of villages, our analysis is quite underpowered. However, the results certainly do not suggest that the presence of a high caste punisher contributes to the sender's transfer.

Education and proxies for wealth also cannot replicate the result that adding an important punisher improves game outcomes. We do not include the regression results here, but they are available upon request. (See discussion below).

Robustness to Controls

While Table 3.5 indicate that caste and elite status cannot explain the effects of the centrality of the judge and the social proximity of the sender and receiver, we explore an expanded set of possible importance and proximity measures in Table 3.6. In the table, we use the same regression specification as in Table 3.3, but we also include a full set of demographic controls, interacted with the treatment status where appropriate.

A natural covariate that might capture power relationships aside from elite status is wealth. To proxy for wealth, we construct a within-village ranking of households based on a principal component analysis of the size, construction materials, electrification, and type of toilet facilities in their homes. As one might expect, our wealth quantile ranking does correlate with the household's eigenvector centrality quantile.[20] Further, we include the educational attainment of the players in addition to our measures of elite status and caste.

Despite the positive relationship between centrality and the various other covariates that might capture power relationships, the results in Table 3.6 indicate that the effects of the centrality of the judge on sender transfers are robust to controlling for those covariates. The only effects that no longer survive when we add such controls is that of the sender's centrality.

Finally, note that we run these extended specifications using three different functional forms of eigenvector centrality as regressors. We continue to use the centrality quantile of each player in the village in columns 1 to 3, and an indicator for above-median eigenvector centrality in the experimental sample in columns 4 to 6. Additionally, we use the level of eigenvector centrality in columns 7 to 9. We find that the results are quite similar for all sets of specifications.

Evaluating Institutional Design

Finally, we can ask which combinations of contract enforcement mechanisms and network characteristics produce the most efficient sender transfers. Figure 3-7 plots sender transfers[21] for 10 different game configurations. Panel A includes two-party games (left-most in each grouping) and three-party games with monitors. Panel B includes the same two-party games (left-most in each grouping) alongside results from the games with punishers. We further consider cases where S and R are of close social proximity (left groupings) versus far social proximity (right groupings) and cases where the third-party judge is of high centrality (middle bar in each grouping)

[20]The wealthiest household has a centrality ranking 13 percentage points higher than the poorest household. The relationship is significant at all standard levels.

[21]Normalized by the average sender transfer across all of the games.

versus low centrality (right-most bar in each grouping). The bar charts illustrate many of our key networks results but also allow for comparisons between the three- and two-party games.

The bar charts reinforce the result that in the two-party game, outcomes are better when the sender and the receiver are socially close (although in this specification, the difference is not significant). Another striking pattern is that in the games with a monitor, neither social closeness nor judge centrality appears to affect sender transfers. When S and R are socially close, even in the games with a punisher, don't produce results different from the average transfer. However, the identity of the punisher is extremely important when S and R are socially far. In these cases, when the punisher is peripheral in the network, sender transfers are significantly lower than the two-party outcome. However, when the punisher is central in the network, transfers are marginally significantly higher than the two-party outcome.

These results suggest that when the contracting parties are socially close, they can sustain reasonably good outcomes without outside intervention. However, when the contracting parties are socially distant, third parties who have the ability to take punitive actions may improve outcomes, so long as that individual is chosen carefully. In our setting, the best outcomes with socially far contracting pairs occur when the individual with the punishment technology is socially important.

3.5 Conclusion

We conduct laboratory experiments in the field with non-anonymized participants from real-life social networks to understand how different contracting environments affect the outcomes of joint investment games. We use detailed network data to further analyze how the social network characteristics of participants interact with the contracting environments to shape final payoffs. Our games are played among individuals from rural Indian villages, who can fully identify each other, thus making all past and future interactions between the participants relevant for how they play our games.

We focus on the role for third-party punishers to improve outcomes and explore how the network centrality of the punisher impacts sender transfers. We find that the punishment technology can help to improve outcomes, but only when the punisher is central in the social network. We show that the monitoring function of the third party cannot explain our results, nor can other demographic characteristics which may be stand-ins for importance in the community. Our findings are consistent with the model we develop where socially peripheral punishers may use their actions in the game to build reputation about their types in anticipation of future interactions outside of the game.

Our results provide a first analysis of how the local social network interacts with institutional design and informal contracting. However, we have only scratched the surface of this problem. Futher work is neccesary to take these ideas from the laboratory and put them into practice.

Appendix A: Glossary of Network Statistics

In this section we briefly discuss the network statistics used in the paper. Jackson (2008) contains an excellent and extensive discussion of these concepts which the reader may refer to for a more detailed reading.

Path Length and Social Proximity

The *path length* between nodes i and j is the length of the shortest walk between the two nodes. Denoted $\gamma(i,j)$, it is defined as $\gamma(i,j) = \min_{k \in \mathbb{N} \cup \infty} [A^k]_{ij} > 0$. If there is no such walk, notice that $\gamma(i,j) = \infty$. The *social proximity* between i and j is defined as $\gamma(i,j)^{-1}$ and defines a measure of how close the two nodes are with 0 meaning that there is no path between them and 1 meaning that they share an edge. In figure 3-8, $\gamma(i,j) = 2$ and $\gamma(i,k) = \infty$.

Vertex characteristics

We discuss three basic notions of network importance from the graph theory literature: degree, betweenness centrality, and eigenvector centrality. The *degree* of node i is the number of links that the node has. In figure 3-9(a), i has degree 6 while in (b) i has degree 2. While this is an intuitive notion of graphical importance, it misses a key feature that a node's ability to propagate information through a graph depends not only on the sheer number of connections it has, but also how important those connections are. Figure 3-9(b) illustrates an example where it is clear that i is still a very important node, though a simple count of its friends does not carry that information. Both betweenness centrality and eigenvector centrality address this problem.

The *betweenness centrality* of i is defined as the share of all shortest paths between all other nodes $j, k \neq i$ which pass through i. This is a normalized measure which is useful when thinking about a propagation process traveling from node j to k as taking the shortest available path.

The *eigenvector centrality* of i is a recursive measure of network importance. Formally, it is defined as the ith component of the eigenvector corresponding to the maximal eigenvalue of the adjacency matrix representing the graph.[22] The intuition for its construction is that one may be interested in defining the importance of a node as proportional to the sum over each of its network neighbor's importance. By definition the vector of these importances must be an eigenvector of the adjacency matrix and restricting the importance measure to be positive means that the vector of importances must be the first eigenvector. Intuitively, this measure captures how well information flows through a particular node in a transmission process. Relative to betweenness centrality, a much lower premium is placed on a node being on the exact shortest path between two other nodes. We can see this by comparing figure 3-9(b), where i has a high eigenvector centrality and high betweenness, to (c), where i still has a rather high eigenvector centrality but now has a 0 betweenness centrality since no shortest path passes through i.

[22]The adjacency matrix A of an undirected, unweighted graph G is a symmetric matrix of 0s and 1s which represents whether nodes i and j have an edge.

Appendix B: Supplemental Discussion of Model

Proof 3 (Proof of Lemma 2) *Consider the case where peripheral Ts with $\theta_T = 1$ do not punish small deviations. In this case, there is a pooling equilibrium where both types of peripheral Ts do not punish small deviations. Consequently, there is no update about the type of peripheral Ts, λ=θ_T, and their payoff in the period two game is* 0*. Alternatively, consider the case where Ts with $\theta_T = 1$ do punish small deviations. In this case, there is a separating equilibrium between both types of peripheral. Thus, there is an update about the type of peripheral Ts with $\theta_T = 1$, $\lambda = 1 > \gamma$, and their payoff in the period two game is β. Accordingly, peripheral Ts with $\theta_T = 1$ would like to separate from peripheral Ts with $\theta_T = 0$ when the benefits outweigh the costs, that is if $d_S + \beta > c$.*

Proof 4 (Proof of Lemma 3) *In case a), R anticipates that she is punished only if she transfers* 0*. The payoff of such a strategy is $3 \cdot \tau_S - \kappa$. On the contrary, R can avoid being punished if she transfers $\eta_M \cdot \tau_S$, consequently receiving a payoff of $(3 - \eta_M) \cdot \tau_S$. Accordingly, R transfers $\eta_M \cdot \tau_S$, as long as $\tau_S \leq \frac{\kappa}{\eta_M}$. Otherwise, R transfers* 0 *and anticipates a punishment of κ. In anticipation of R's strategy, WLOG S decides whether to transfer* 0 *or to transfer κ.* [23] *If S transfers $\frac{\kappa}{\eta_M}$, she receives a payoff of $E - \frac{\kappa}{\eta_M} + \kappa$. Otherwise, S transfers* 0 *and receives a payoff of E. Thus, S transfers $\frac{\kappa}{\eta_M}$ as long as $\eta_M > 1$.*

In case b), when there is a central T of type $\theta_T = 0$, the solution is trivial. R expects no punishment regardless how much she sends back to S, and consequently, she transfers 0 *to S. In anticipation, S transfers* 0 *to R.*

In case c), there is a peripheral T, who is of type $\theta_T = 1$ with probabilityπ_T and of type $\theta_T = 0$ with probability $(1 - \pi_T)$. Consequently, R anticipates that with probability $(1 - \pi_T)$ she receives no punishment regardless how much she sends back to S. Additionally, R expects that with probabilityπ_T she will receive a punishment if she transfers either 0 *or $\eta_M \cdot \tau_S$ back to S, but no punishment if she transfers $\eta_H \cdot \tau_S$. Using the fact that $\eta_M \cdot \tau_S$ is a dominated strategy relative to transferring* 0 *and a*

[23] S's optimization problem has a corner solution.

similar reasoning to the central T with $\theta_T = 1$ case, R transfers $\eta_H \cdot \tau_S$, as long as $\tau_S < \frac{\pi_T \cdot \kappa}{\eta_H}$. Otherwise, R transfers 0 and anticipates an expected punishment of $\pi_T \cdot \kappa$. Moreover, S transfers $\frac{\pi_T \cdot \kappa}{\eta_H}$ as long as $\eta_H > 1$. Otherwise, S transfers 0.

Appendix C: Figures and Tables

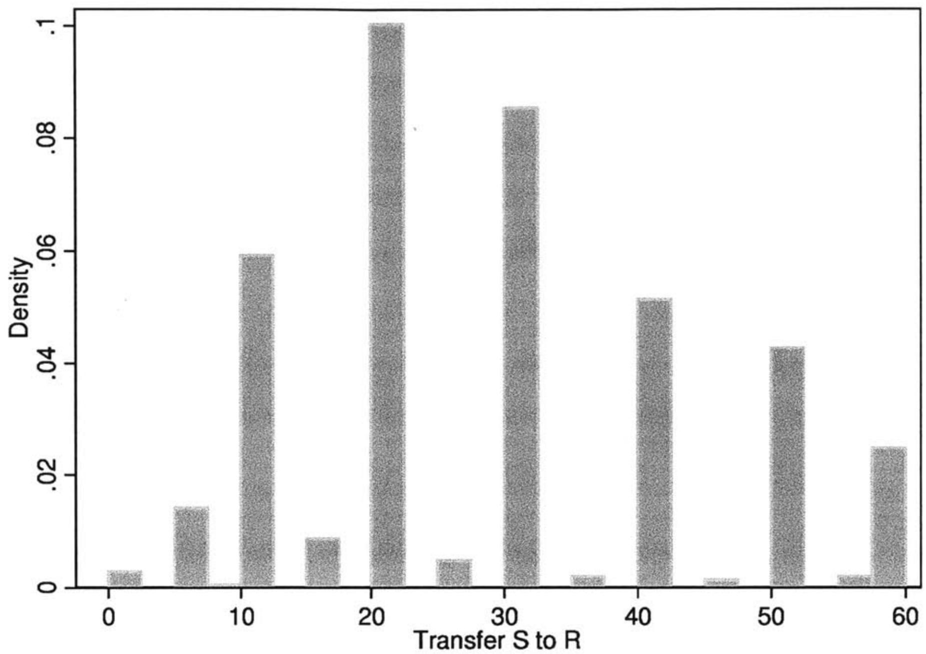


Figure 3-1: Distribution of transfers from sender

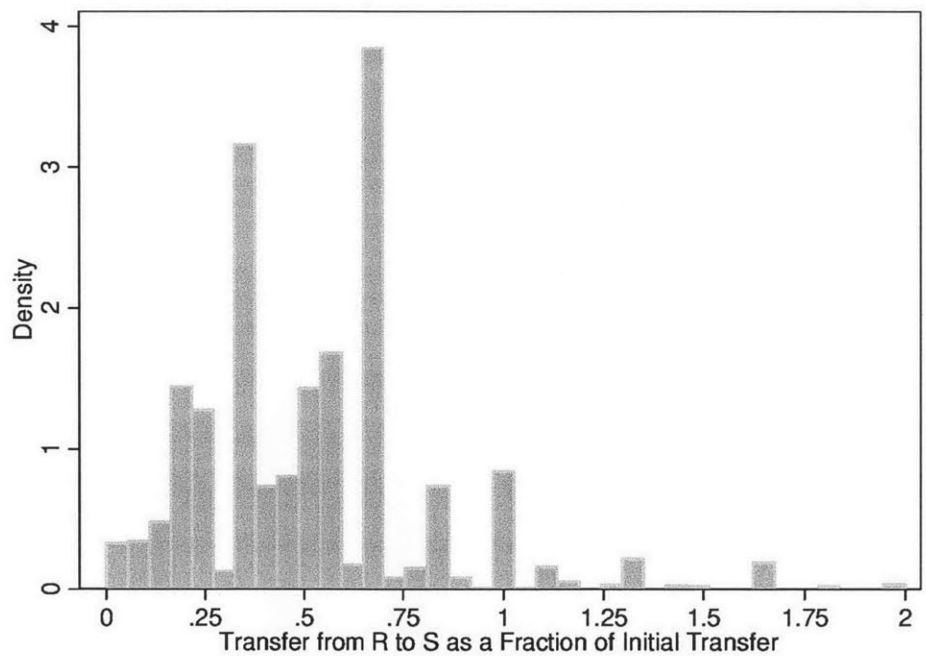


Figure 3-2: Distribution of transfers from receiver to sender as a fraction of the initial transfer

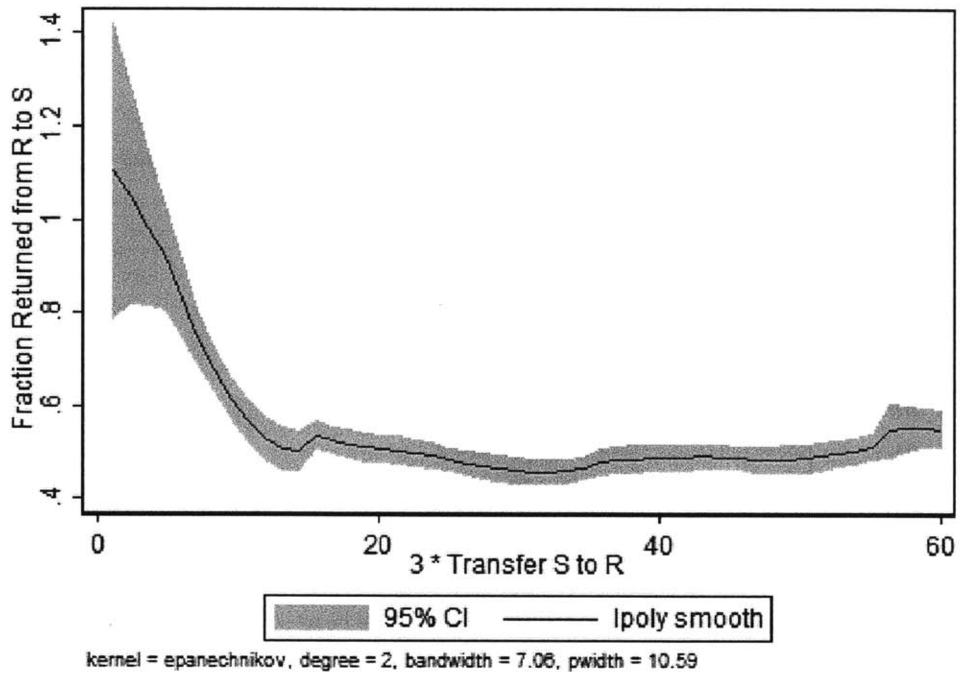


Figure 3-3: Fraction returned from R to S as a function of the transfer S to R

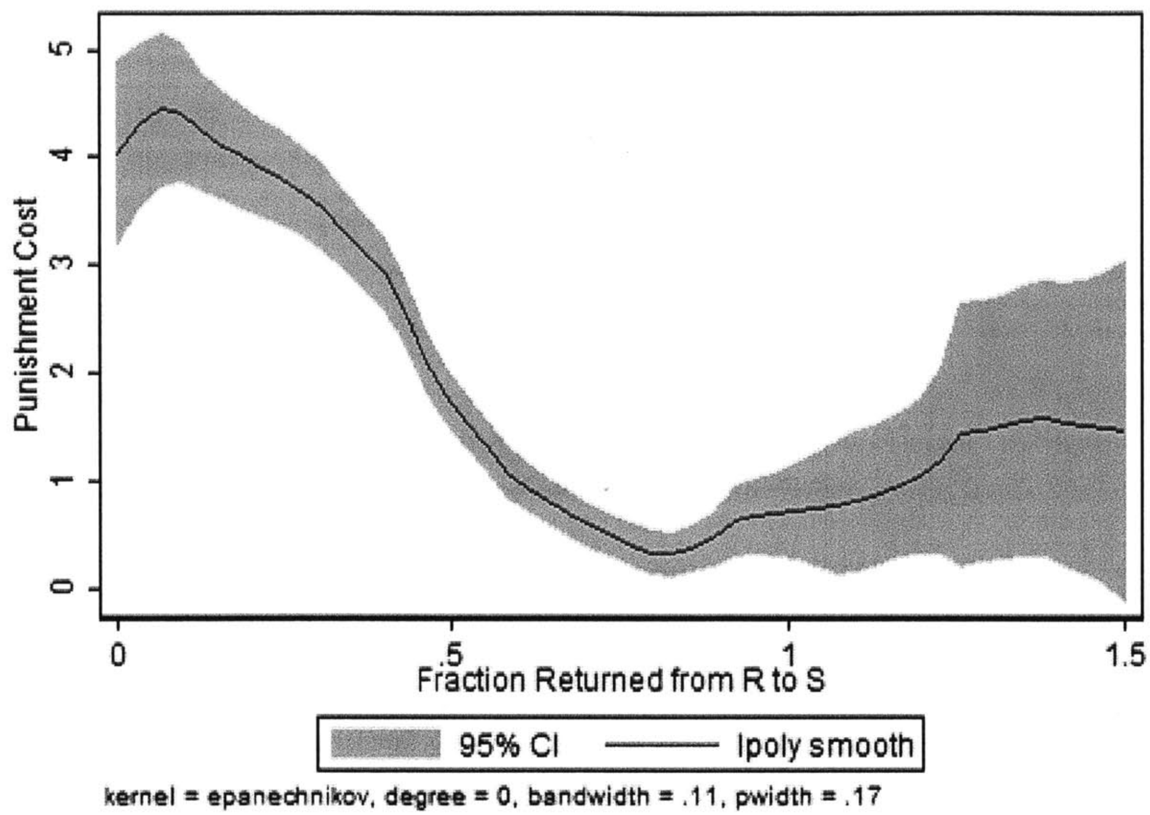


Figure 3-4: Punishment cost paid by T by fraction returned from R to S

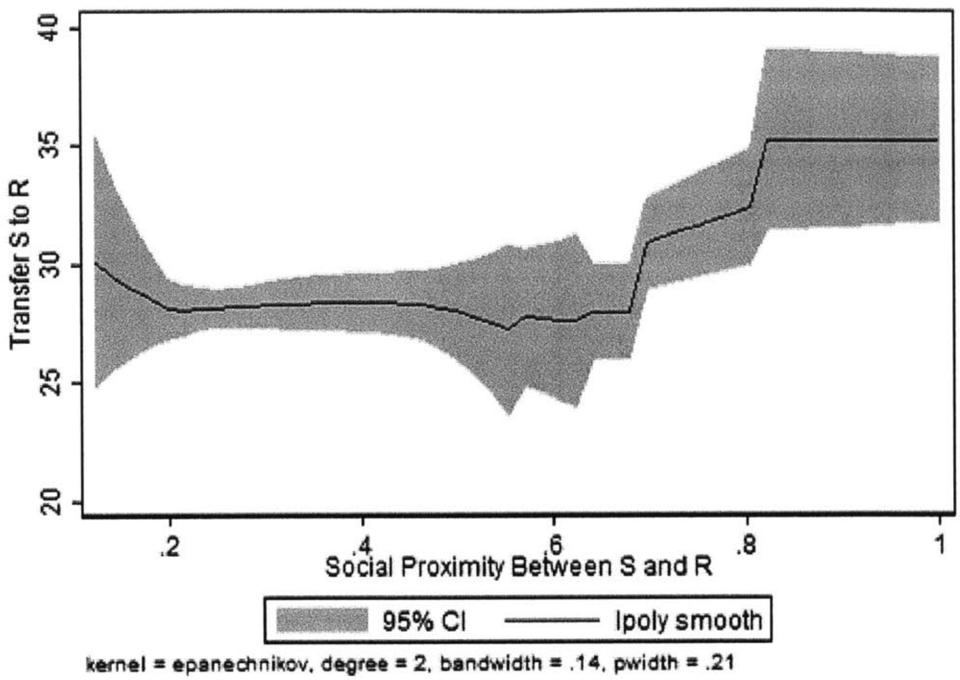


Figure 3-5: Total payoff of S and R as a function of social proximity between S and R

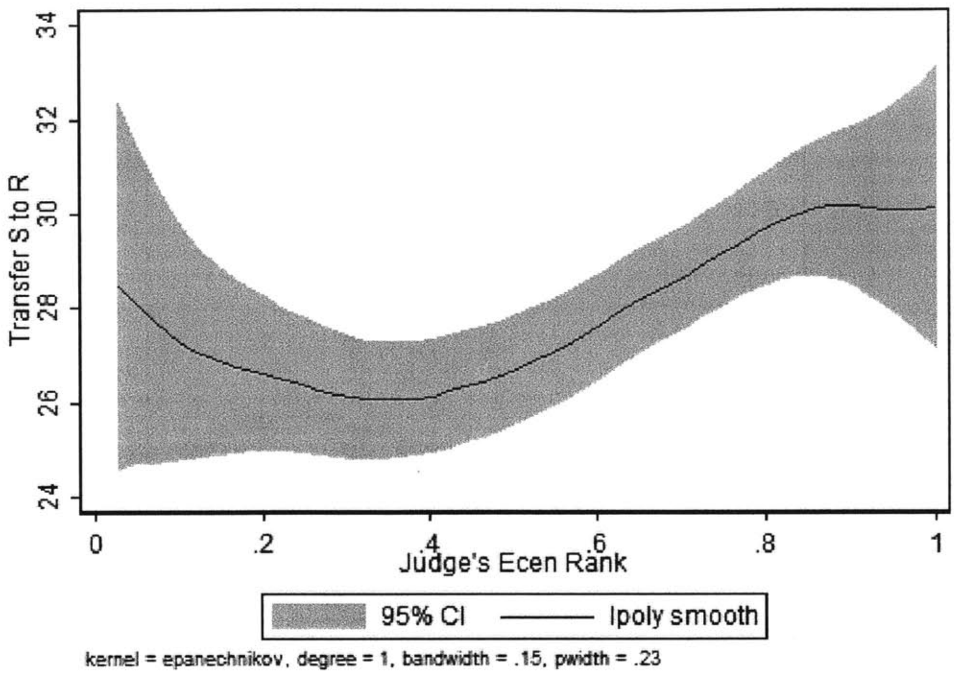
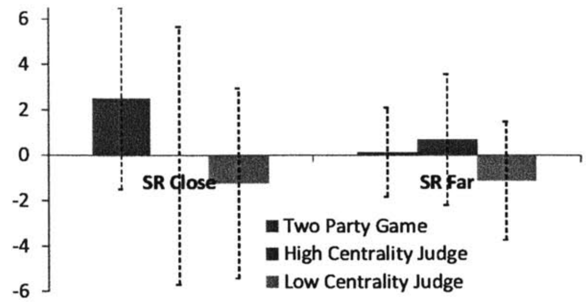


Figure 3-6: Transfer from S to R as a function of the percentile of the eigenvector centrality of T.

(a) Panel A: Third-Party Monitors



(b) Panel B: Third-Party Punishers

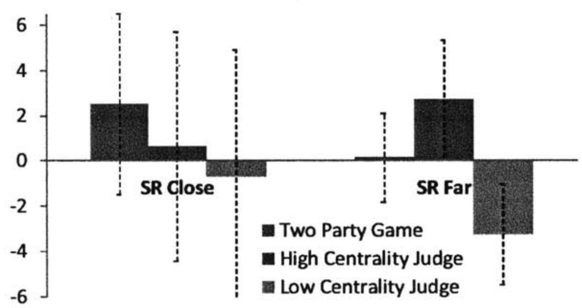


Figure 3-7: Normalized Sender Transfers by Game and Punisher Characteristics

Note: In all bar charts, the y-axis represents the average transfer from the sender to the receiver, normalized by the average transfer size. In each grouping, the left-most bar shows transfers in the two-party game, the middle bar shows transfers in the three-party game with a judge of high centrality, and the right-most bar shows transfers in the three-party game with a judge of low centrality.

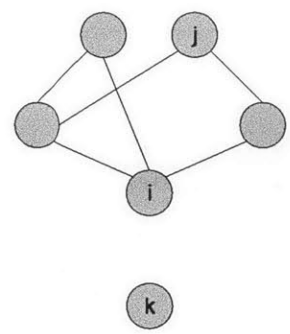


Figure 3-8: Path lengths i, j and i, k

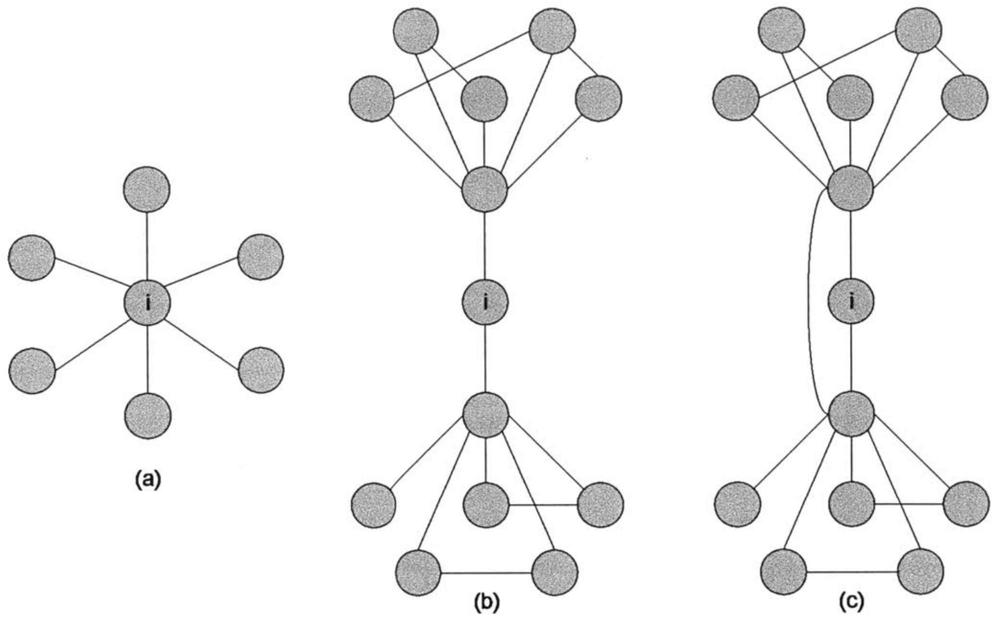


Figure 3-9: Centrality of node i

Table 3.1: Summary statistics

Age	29.95	8.14
Female	0.61	0.49
Education	8.14	4.31
High Caste	0.63	0.48
HH has a Leader	0.20	0.40
Average Proximity b/w Pairs	0.31	0.17
Average Reachability b/w Pairs	0.96	0.20
Average Degree	9.84	6.62
Average Eigenvector Centrality	0.02	0.04
Average Betweenness Centrality	0.00	0.01

Table 3.2: Sender behavior and total payoffs

	Total Payoffs	Payoff S	Payoff R	Transfer S to R	Total Payoffs	Payoff S	Payoff R	Transfer S to R
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Game w/ Monitoring	0.838	1.354	-1.180	-0.0270	2.054	0.843	0.624	0.655
	(2.735)	(1.386)	(2.247)	(1.320)	(2.769)	(1.371)	(2.516)	(1.345)
Game w/ Monitoring	-9.969***	1.839	-12.47***	-1.117	-9.248***	1.545	-11.29***	-0.641
and Punishment	(2.580)	(1.525)	(1.927)	(1.208)	(2.628)	(1.754)	(2.314)	(1.247)
Controls	No	No	No	No	Yes	Yes	Yes	Yes
Observations	1,988	1,986	1,986	1,987	1,984	1,982	1,982	1,983
R-squared	0.229	0.164	0.096	0.216	0.245	0.177	0.109	0.235

Note: Standard errors are clustered at the session level. Columns (1) to (4) only include round fixed effects. Columns (5) to (8) include controls for sequence of games in session, order of game, round, and surveyor fixed effects. * p<.1, ** p<.05, *** p<.01.

Table 3.3: Sender's transfers and network characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
J Centrality		3.121*	-1.277		3.180*	-1.462		2.786***	1.107		2.879***	1.055
		(1.791)	(2.256)		(1.749)	(2.128)		(0.924)	(1.163)		(0.907)	(1.132)
J Centrality · Punishment			8.643***			9.094***			3.186**			3.447**
			(2.948)			(2.917)			(1.524)			(1.521)
S Centrality	-5.088**	-2.066	0.229	-5.576**	-1.616	0.692	-2.879**	-1.248	-0.0887	-3.046**	-0.999	0.126
	(2.472)	(2.083)	(2.733)	(2.336)	(2.059)	(2.747)	(1.303)	(1.081)	(1.446)	(1.280)	(1.073)	(1.468)
S Centrality · Punishment			-5.357			-5.391*			-2.690			-2.601
			(3.289)			(3.236)			(1.645)			(1.644)
R Centrality	-1.122	1.122	3.047	-1.448	0.831	2.902	-1.455	0.948	1.645	-1.510	0.714	1.504
	(3.383)	(2.004)	(2.740)	(3.171)	(2.004)	(2.782)	(1.495)	(0.902)	(1.377)	(1.450)	(0.883)	(1.402)
R Centrality · Punishment			-3.791			-4.122			-1.470			-1.699
			(3.321)			(3.480)			(1.704)			(1.770)
Social Proximity S & R	7.834	2.893	-0.384	8.220*	3.059	-0.627	7.706*	2.884	0.942	7.787*	3.127	0.847
	(4.708)	(2.996)	(4.298)	(4.499)	(3.174)	(4.452)	(4.057)	(2.775)	(3.964)	(3.995)	(2.948)	(4.123)
Soc. Prox. S & R · Punish.			7.505			8.202			5.104			5.681
			(5.751)			(5.856)			(5.624)			(5.716)
Social Proximity S & J		-1.550	5.567		-1.424	5.255		-1.735	4.374		-1.628	4.025
		(2.679)	(4.514)		(2.635)	(4.427)		(2.568)	(4.129)		(2.536)	(4.118)
Soc. Prox. S & J · Punish.			-12.82**			-12.25**			-11.09**			-10.50**
			(5.397)			(5.134)			(5.054)			(4.908)
Social Proximity R & J		-3.756	-0.398		-3.832	-1.189		-4.374	-1.722		-4.464	-2.553
		(2.818)	(3.779)		(2.750)	(3.820)		(2.803)	(3.756)		(2.755)	(3.822)
Soc. Prox. R & J · Punish.			-6.208			-4.680			-4.946			-3.338
			(4.839)			(5.032)			(4.942)			(5.134)
Game with Punishment		-1.096	2.874		-0.939	2.127		-1.070	2.874		-0.900	2.132
		(1.079)	(3.059)		(1.088)	(2.969)		(1.071)	(2.379)		(1.082)	(2.255)
Controls	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No
Eigen. Centrality Measure	Quant.	Quant.	Quant.	Quant.	Quant.	Quant.	H-L	H-L	H-L	H-L	H-L	H-L
Observations	672	1,173	1,173	675	1,174	1,174	672	1,173	1,173	675	1,174	1,174
R-squared	0.331	0.346	0.357	0.312	0.332	0.343	0.333	0.351	0.359	0.314	0.337	0.345

Note: In columns (1), (4), (7) and (10) only the game with no judge is included, and in columns (2), (3), (5), (6), (8), (9), (11) and (12) only games with any judge are included. Standard errors are clustered at the room level. All specifications contain village fixed effects due to small samples of caste and co-household observations. Controls include block, order round , and surveyor fixed effects. In columns (1) - (6), the centrality measure is the eigenvector centrality percentile within the village. In columns (7) - (12), the centrality measure is an indicator for above-median eigenvector centrality in the experimental sample. * $p<.1$, ** $p<.05$, *** $p<.01$.

Table 3.4: Principal component decomposition of importance measures

	Principal Components		
	1st PC	2nd PC	3rd PC
Centrality Quantile	-0.0207	0.7639	-0.1986
Elite	0.3516	0.2717	0.8931
High Caste	0.5711	0.1428	-0.326
Wealth Quantile	0.6113	0.1174	-0.2363
Education	0.4196	-0.5554	0.0299
Eigenvalue	1.6034	1.2217	0.8881

Note: The columns represent the 1st, 2nd, and 3rd principal components in a principal component decomposition. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 3.5: Sender's transfers, elite status, and caste

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A						
Judge's HH Elite		0.458	0.622		0.309	0.343
		(1.202)	(1.548)		(1.179)	(1.508)
Judge's HH Elite · Punishment			-0.387			-0.137
			(2.171)			(2.164)
Sender's HH Elite	0.167	-1.856*	-3.022**	0.250	-1.716*	-3.112**
	(1.481)	(0.973)	(1.298)	(1.499)	(0.978)	(1.347)
Sender's HH Elite · Punishment			2.275			2.723
			(2.056)			(2.081)
Receiver's HH Elite	1.472	1.428	1.407	1.331	1.389	1.433
	(1.763)	(0.900)	(1.396)	(1.723)	(0.900)	(1.375)
Receiver's HH Elite · Punishment			0.0926			-0.0197
			(2.146)			(2.184)
Game with Punishment		-1.332	-1.718		-1.128	-1.636
		(1.042)	(1.110)		(1.052)	(1.131)
Controls	Yes	Yes	Yes	No	No	No
Observations	699	1,240	1,240	702	1,241	1,241
R-squared	0.326	0.325	0.326	0.309	0.312	0.313
Panel B						
J High Caste		1.366	2.650		0.990	3.748
		(3.615)	(4.819)		(2.994)	(3.493)
J High Caste · Punishment			-1.240			-4.108
			(5.717)			(5.296)
S High Caste	1.935	-2.448	1.740	3.431	-3.075	1.918
	(3.967)	(3.864)	(5.319)	(3.938)	(3.611)	(5.617)
S High Caste · Punishment			-7.679			-9.131
			(7.058)			(7.446)
R High Caste	1.867	-4.183	-3.516	1.967	-4.283	-3.880
	(3.318)	(3.830)	(4.313)	(2.833)	(3.856)	(4.422)
R High Caste · Punishment			-1.047			-0.874
			(5.872)			(6.257)
Game with Punishment		-2.779	3.306		-2.986	5.625
		(3.480)	(6.009)		(2.908)	(6.234)
Controls	Yes	Yes	Yes	No	No	No
Observations	178	171	171	179	171	171
R-squared	0.413	0.368	0.379	0.259	0.301	0.325

Note: In columns (1) and (4) only the game with no judge is included, and in columns (2), (3), (5), and (6) only games with any judge are included. Standard errors are clustered at the room level. All specifications in Panel A contain room fixed effects, while specifications in Panel B contain village fixed effects. This is because of the small sample size in the caste regressions. Columns (1) - (3) include controls for block, order round , and surveyor fixed effects. Columns (4) - (6) include round fixed effects. *** p<0.01, ** p<0.05, * p<0.1

Table 3.6: Robustness to demographic controls and eigenvector centrality measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
J Centrality		3.908*	-0.230		3.090***	1.546		30.06*	-9.211
		(2.003)	(2.577)		(0.998)	(1.298)		(16.89)	(26.13)
J Centrality · Punishment			9.476***			3.349*			71.90**
			(3.273)			(1.695)			(28.92)
S Centrality	-4.553*	-1.327	1.387	-2.595*	-0.881	0.437	-25.17	-7.332	-9.746
	(2.598)	(2.240)	(2.875)	(1.413)	(1.163)	(1.524)	(18.05)	(13.84)	(14.88)
S Centrality · Punishment			-5.240			-2.647			5.089
			(3.494)			(1.707)			(23.88)
R Centrality	-1.349	1.226	3.412	-1.268	1.087	1.965	-19.28	11.16	26.28
	(3.482)	(2.150)	(3.005)	(1.525)	(0.981)	(1.520)	(22.86)	(15.41)	(16.52)
R Centrality · Punishment			-4.203			-1.742			-31.41
			(3.451)			(1.800)			(25.36)
Social Prox. S & R	8.921*	2.655	0.698	8.675**	2.687	1.918	8.171*	2.182	1.416
	(4.900)	(3.036)	(4.397)	(4.336)	(2.879)	(4.120)	(4.371)	(2.760)	(3.858)
Soc. Prox. S & R · Punish.			5.510			3.490			2.366
			(6.179)			(5.976)			(5.745)
Social Prox. S & J		-1.357	5.652		-1.220	5.017		-1.395	6.324
		(2.922)	(4.813)		(2.849)	(4.405)		(2.711)	(4.568)
Soc. Prox. S & J · Punish.			-11.94**			-10.28*			-12.42**
			(5.951)			(5.514)			(5.822)
Social Prox. R & J		-4.473	-0.584		-4.978	-1.943		-3.617	-0.603
		(3.044)	(4.162)		(3.024)	(4.129)		(2.868)	(3.822)
Soc. Prox. R & J · Punish.			-7.269			-5.504			-5.452
			(5.195)			(5.335)			(4.803)
Game with Punishment		-1.142	2.836		-1.133	3.527		-1.178	3.571
		(1.116)	(4.839)		(1.105)	(4.379)		(1.119)	(4.156)
Basic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eigen. Centr. Measure	Quant.	Quant.	Quant.	H-L	H-L	H-L	Level	Level	Level
Observations	641	1,111	1,111	641	1,111	1,111	641	1,111	1,111
R-squared	0.330	0.363	0.382	0.332	0.368	0.384	0.330	0.363	0.380

Note: In columns (1), (4), and (7) only the game with no judge is included, and in columns (2), (3), (5), (6), (8), and (9) only games with any judge are included. Standard errors are clustered at the room level. All specifications contain village fixed effects due to small samples of caste and co-household observations. All specifications include controls for block, order round , and surveyor fixed effects. In columns (1) - (3), the centrality measure is the eigenvector centrality percentile within the village. In columns (4) - (6), the centrality measure is an indicator for above-median eigenvector centrality in the experimental sample. Columns (7) - (9) use the eigenvector centrality level. * p<.1, ** p<.05, *** p<.01.

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