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Abstract

This paper considers how shocks to rural incomes intensify violence in India's Naxalite insurgency. Using variation in annual rainfall in a panel of district level fatal incidents between 2005 and 2011, I find that deficient rainfall generally spurs targeted violence against civilians, but the number of Maoist attacks against security forces only increases in mining districts. This finding consistent with the idea that the relationship between income shocks and conflict depends on the type of targets and the revenue sources of the rebels. In particular, the fighting capacity of rebel groups against government forces could benefit more from negative rural income shocks if the group's resources are sufficiently independent from the agricultural economy, as is the case in mining areas.

Introduction

This paper considers the relationship between scanty rainfall and the intensity of civil conflict in the context of India's "Naxalite" or "Maoist" insurgency, which started in the sixties but has become particularly violent in recent years. The Naxalite-affected communities are among the most marginalized groups in India, and they rely disproportionately on rain-fed subsistence agriculture. It is precisely in such a context that we would expect naturally occurring, unpredicted changes in

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rainfall to matter most for incomes and conflict. I find that poor rainfall tends to increase Naxalite violence against government forces, but only in areas where mining activity is sufficiently important. In contrast, it spurs targeted attacks against civilians regardless of whether the district has mining activity. On the basis of these results, I argue that mining revenues can explain whether rebels versus security forces benefit from reduced local incomes, and which groups become the target of increased violence.

This paper contributes to a current academic debate about the mechanisms linking income shocks in underdeveloped areas to violent conflict. A number of studies have established a negative relationship between the incomes of the potential participants in the conflict and measures of the extent and intensity of violence (Dube and Vargas, 2013; Miguel, Satyanath, and Sergenti, 2004).[1] These results offer support for the opportunity cost theory, whereby the reduced incomes lower the opportunity cost for civilians of participating in violent activities.[2] However, this theory has been challenged in recent work that finds an insignificant or even a positive relationship between labour income shocks and conflict (Berman, Callen, Felter, and Shapiro, 2011; Ciccone, 2011). Berman et al. (2011) find that high unemployment is associated with reduced violence in the context of Afghanistan, Iraq, and the Philippines. The authors propose an information based theory as an alternative for the opportunity cost theory: when times are bad, anti-insurgency forces find it easier to gather information. I argue that these divergent results and theories can be reconciled once we consider the structure of the rebels' tax base. The information and opportunity cost channels could formally be quite close: in one theory, lower incomes benefit recruitment into violent activities and lead to an escalation of violence. In the other story, lower incomes benefit the state's security forces through increased information sharing, which drives insurgency violence down. It is clear that these channels can operate simultaneously. Also, which channel dominates can differ from context to context, depending on which side benefits disproportionately from a given economic shock. My paper will explore this idea in the context of India's Naxalite conflict.

To understand the interplay between information sharing and rebel recruitment, I investigate local

[1] Besley and Persson (2011) report similar findings for a wider range of income shocks and for a larger set of countries. Iyengar, Monten, and Hanson (2011) find that higher spending on employment programmes by the US military reduced labour-intensive insurgent violence in Iraq. In contrast, Crost, Felter, and Johnston (2013) find that development aid increased insurgency violence in the Philippines as rebels try to sabotage projects. Blattman and Miguel (2010) survey the broader conflict literature. Ross (2004) provides a survey of the literature on the relationship between civil war and natural resources (e.g. Collier and Hoeffler, 2000; and Elbadawi and Sambanis, 2000). Rohner and Morelli (2010) develop a model that links the geographical distribution of natural resources between ethnic homelands to the probability of conflict.

[2] See for example Chassang and Padro i Miquel (2009); Dal Bo and Dal Bo (2011).

agricultural shocks in India's Naxalite conflict. In this context, negative local income shocks should benefit the security forces disproportionately. The rebels are typically dependent on taxation of the local (mainly agricultural) economy, while security forces are funded at the state and national level. Hence, if local incomes fall, the rebels' income and their ability to attract new recruits (through the opportunity cost channel) could suffer. However, the degree to which the rebel's resources depend on local income shocks varies between different locations. Importantly, the Maoists are organized in local units with limited capacity to share these resources among each other. Only in certain districts, extortion of mining activity provides a source of income for the Left-Wing insurgents that is independent from the agricultural economy. I expect the rebels' ability to improve their fighting capacity against the government in response to poor rainfall to be strongest in these mining districts.

I collect a data set of annual casualty numbers at the district level between 2005 and 2011 from the South Asia Terrorism Portal (SATP) for eight Maoist affected states in India. These conflict outcomes are combined with Kharif season (monsoon season) rainfall data, data on mineral resource wealth, and key socio-economic and environmental controls. The conflict's casualties can be attributed to three categories: civilian deaths inflicted by Maoists, security force deaths inflicted by the Maoists, and Maoist deaths inflicted by the security forces. For civilian casualties, the raw SATP reports also provide information on the identity of the victim, which allows me to distinguish between targeted an untargeted attacks. In support of my empirical approach, I first confirm that rainfall deficiency reduces rice output in the Naxalite-affected districts.

The main results confirm differential effects of rainfall on the intensity of violence. I find that lower rainfall (weakly) reduces violence against the government's security forces, in the absence of mining activity. However, as the value of mining activity increases, I find that the relationship between rainfall and conflict reverses: lower rainfall boosts violence against security forces if the mineral resource wealth is sufficiently high. This result is consistent with the idea that the opportunity cost channel is more important if the rebels have a source of funding that is independent from local labour income shocks. Interestingly, targeted violence against civilians does not follow the same pattern. Violence against civilians increases in response to poor rainfall, regardless of the resource environment. This result is consistent with the use of violence to intimidate civilians into siding with the rebels. Poor agricultural conditions should increase the temptation of civilians to support the government, and the rebels may find it optimal to counter this attraction by increasing targeted violence against collaborators. A break-down of casualties by type of victim confirms that the large majority of victims belong to groups that collaborate with the Indian government against the rebels. In this interpretation, the ability of the government to benefit from information sharing depends on the success of the Maoists in suppressing such collaboration. My results on Police attacks on Maoists are mixed. While this type of violence generally increases after scanty rainfall (which is consistent with higher information sharing) the coefficient is not robustly significant. These results confirm the idea that the rebel recruitment (or opportunity cost) and information sharing channels operate at the same time, and the opportunity cost channel dominates when the rebels have an independent source of income, such as mining revenues.

The main results of the paper are robust to a number of changes to the specifications, including (a) controlling for other variables that could explain the differential impact of income shocks in mineral rich areas (which addresses the potential endogeneity of the interaction term); (b) comparing results between types of minerals (which all exhibit the same patterns); (c) controlling for differential effects of rainfall according to baseline police activity; or (d) comparing the main results from a Poisson model to alternative specifications.

India's Naxalite movement has been described by the Indian Prime Minister Manmohan Singh as "the single biggest internal security challenge ever faced by our country" (Economist, 25 Feb 2010). The conflict claimed at least 5,500 lives over the 2005-2011 period. The Naxalite conflict has also seen high levels of targeted violence against civilians, who account for more than one third of the total number of casualties (SATP, 2011). The particularly violent nature of this conflict demands a closer study of the strategic choice of targets of violence, and of the role of labour income shocks within a context of underdevelopment. Understanding in what ways labour income shocks affect the strategic dynamics of the conflict is crucial for the design of effective conflict resolution strategies. This paper is part of an emerging literature that contributes to this research agenda. It is well established that civil conflict hampers economic development, and previous work has suggested that the Naxalite conflict has indeed reduced economic growth in the affected states.[3] This consideration gains even more relevance because the districts affected by Naxalism are among India's poorest regions.[4] Given

[3]Collier and Hoeffler (2007), and Blattman and Miguel (2010) survey the extensive empirical literature on the consequences of conflict. Nilakantan and Singhal (2011) put the economic cost of India's Naxalite conflict at 12% of the state level economic output.

[4]Borooah (2008) and Ghani and Iyer (2011). Banerjee and Iyer (2005) suggest that the so-called "Red Corridor" of severely affected districts may owe its poor living standards to a colonial legacy of underinvestment in agriculture. In the context of Nepal's Maoist rebellion, the intensity of violence has also been linked to poverty (Murshed and Gates, 2007;

the particular developmental challenges faced by India's so-called "Red Corridor", the importance of understanding the logic of Naxalite violence can hardly be overstated. Gawende, Kapur, and Satyanath (2015) find that a decrease in the "greenness" of vegetation, which they instrument by rainfall shocks, increases Naxalite violence,[5] while Dasgupta, Gawende, and Kapur (2014), as well as Fetzer (2014) find that these effects are mitigated by the roll-out of a large public works programme (MNREGS) in Maoist-affected states. In contrast, Khana and Zimmermann (2014) argue that the introduction of MNREGS has boosted Naxalite violence because of the increased polarization of the civilian population between government and Maoist supporters. This set of very recent contributions confirm the importance of rainfall for fuelling Maoist violence (a result that was first highlighted in a working paper version of my current paper). They also suggest that recruitment and information sharing mechanisms are relevant for the Maoist conflict. My paper focuses on the interplay between these mechanisms, and argues that the presence of mineral resources affects the relative importance of these channels for different targets of violence.

The paper is organised as follows. First, I discuss the background of the Naxalite conflict. Second, I discuss how the rebel recruitment (or opportunity) channel and the information sharing channel link negative income shocks to different types of violence. Third, I describe the data used in this study. Fourth, I discuss the empirical strategy. Fifth, I discuss the main findings, I present key robustness checks, and I discuss a list of alternative interpretations of the main results. In a final section, I offer concluding remarks.

1 Background

1.1 Brief history

India's Naxalites owe their name to a small village in rural West Bengal, "Naxalbari", from which the movement has steadily spread since 1967. The Naxalbari uprising was triggered by the attack on a tribal villager by local landlords. The sympathisers of the uprising formed the All India Coordination Committee of Communist Revolutionaries, which promoted the "Allegiance to the armed struggle and non-participation in elections". Until today, these elements remain the corner stones

Do and Iyer, 2008). Focusing on the same conflict, Macours (2008) finds that rebel recruitment through abduction was more intensive in Nepalese districts that experienced fast growth in income inequality.

[5] They rely on a different dataset based on both the local and the English speaking press, which is limited to four states and ends in 2008. The data in this paper covers four additional states and three additional years.

of the Naxalite movement. The 1970-2000 period was marked by a high level of conflict between different Naxalite groups. However, in 2004, the two major Naxalite outlets merged to form the Communist Party of India (Maoist), or CPI (Maoist). This merger is believed to be one of the drivers of the recent growth in Naxalite violence. The merger alarmed India's policy makers, and marked a shift towards more direct confrontations between the state and the rebels (Kujur, 2008, 2009). The declared goal of the present CPI (Maoist) is still to overthrow the Indian state through armed struggle and to establish a liberated zone in the centre of India. The continuing popularity and strength of the Naxalite movement is perceived to stem from chronic underdevelopment in the affected communities (Borooah, 2008). Still, an important shift in the composition and centre of the movement has taken place in the course of the last decades: the Naxalite's current strongholds are among "Adivasi" or tribal communities (Kennedy and King, 2009), and much less among the landless labourers that drove the emergence of the movement in the late sixties.

1.2 Key characteristics

This section will introduce some key characteristics of the Maoist uprising, which are relevant both for the hypotheses tested in the empirical specification, and for the interpretation of the results: (i) the concentration of the conflict in marginalized, rural communities; (ii) the importance of civilian collaboration; (iii) taxation of the local economy by the rebels; (iv) the organizational independence of rebel units.

First of all, the Maoists operate in marginalized, rural communities that rely heavily on subsistence agriculture (Kennedy and King, 2009). While the party does have an urban presence and many of its top cadres joined the movement through its student activities (Kujur, 2008), the violence is clearly constrained to rural areas. The affected communities rely heavily on rain-fed subsistence agriculture.[6]

Second, Maoists and the Government clearly compete for civilian collaboration. The Government openly offers substantial rewards for tip-offs that lead to the death or arrest of Maoists.[7] State governments (possibly with the support of the Centre) have actively encouraged civilians to join militias or political movements (possibly under the umbrella of mainstream parties) that assist the

[6]Banik et al. (2004), Planning Commission (2008).

[7]"[The] Andhra Pradesh Police have included 650 new names to its hit-list of 1,200 Maoists. [...] The State has increased the reward amount on all these wanted Maoists and their leaders by nearly INR 162 million." (SATP, AP, 2007)

police (SATP, Chhattisgarh, 2007). States have also rolled out several programmes to encourage low ranking Maoists to surrender and provide information.[8] The Naxalite groups react to these attempts to elicit collaboration (or desertion) by explicitly threatening to kill or destroy the property of police informers. When the Maoists resort to violence against civilians, their punishments tend to be highly visible and brutal:

> "CPI-Maoist cadres killed two people, including a village head, at a [kangaroo court] in Jamui District after finding them "guilty" of helping the Police. [...]. "Their throat was slit by Maoists to send a message of harsh punishment to others," informed the Police." (SATP, Bihar, 2008)

As the government and the Naxalites fight over the affiliation of civilians, the vulnerability of the affected communities implies that adverse weather can alter the appeal of collaboration with either party:

> "After some 30 villages in Korchi area of Gadchiroli district defied the Naxal boycott of government-run employment-generation schemes, the revolt has spread to more drought-hit villages in the region, say high-level police officials. [... C]lusters of villages, gripped by a severe drought, had chosen to take on Naxalites rather than let go of an option for alternate employment. [The Police], however, didn't divulge the location of the villages which number over 20. This, he said, may prompt Naxalites to upset their plan." (Indian Express, April 2003)."

Third, while it is intuitive that the local population is sensitive to droughts, the strong entrenchment of the Maoists' in rural communities implies that the rebels also suffer from these circumstances. Given the rural nature of the conflict, the Naxalites extract income by charging "levies" on local economic activity (and agricultural output in particular) to fund their activities:[9]

> "ANI reports that the CPI-Maoist is collecting INR 10,000 from each farmer as 'tax' in the Jamatara District. The farmers are being forced either to pay up or to stop tilling their fields." (SATP Timeline, 2005)

[8] "Maharashtra Government announces an amnesty scheme for the Maoists. Those surrendering will be given a 'cash prize' immediately [...]." (SATP Timelines, Maharashtra, 2005)

[9] Srivastava (2009); TOI, 2011, "Extortnomics Maoists raise Rs 2000 crore every year".

In certain areas, mineral resources are an important component of the Naxalites' tax base in certain districts. On 20 May 2010, the Maharashtra Home Minister openly accused the mining industry of funding Left Wing Extremists (LWEs).(SATP 2010 Timeline). Newspaper reports provide anecdotal evidence on the modus operandi of the Naxals:

> "Early last year, the Maoists blasted pipelines of a leading steel company [...] in Malkangiri district. Within a month, the company's infrastructure in the same place was targeted again. [...] Then the attacks stopped. Police sources said this happened only after Rs 2 crore went into the Maoist purse. Illegal mining in states such as Orissa and Jharkhand is a rich source of revenue for the Maoists." (Times of India, 2011)

Fourth, the Maoists movement is decentralized. In theory, the main Maoist outlet (CPI Maoist) is an integrated party movement that is led by a secretary general. However, the reality of guerrilla warfare does not allow for significant organisational integration, as the CPI (Maoist) Central Committee highlights:

> "[t]he essential principle forming the basis of our Party structure is political centralisation combined with organisational decentralisation."[10]

Thus, the key military units operate at a lower level, in so-called "Sub-Zonal, Zonal, and District Commands".[11] Hence, the organization of Maoist groups follows the administrative boundaries of the districts. Local units can independently stage attacks and they focus on geographic areas that broadly correspond to districts analysed in this paper. Moreover, these local command units are closely linked to the local party organisations that play an important role in gathering financial support for the Naxalites. While locally collected levies are partially transferred to higher levels, the local units keep a substantial share of their revenues (Singh and Diwan, 2010).

The Indian state is engaged in the Maoist conflict with its Police forces, but has so far resisted calls to use the Army against the Maoists. The state-level police forces are supported by Central forces, but the official responsibility for maintaining law and order is held by the State governments. The State and Centre are also the most important levels of government for taxation, and it is worth

[10] "Strategy and Tactics of the Indian Revolution", Central Committee (P) CPI (Maoist), February 2005,Accessed on www.satp.org.

[11] "Resolutions of the 2nd Meeting of Central Regional Board", February 2005, and "Functioning of Military Commissions and Commands Coordination of Main, Secondary and Base Forces." . Accessed on www.satp.org.

pointing out that agricultural income is exempt from income tax. In this sense, there is an asymmetry in the conflict in terms of the sensitivity of the main actors (civilians, rebels, and the government) to local rural income shocks.

2 Mechanisms and framework

This paper will build on the characteristics of the Maoist conflict to explore the interaction between two mechanisms that are highlighted in the conflict literature (these hypotheses are derived formally in an online appendix):

1. **Information (collaboration with security forces):** When incomes decrease, civilians are incentivised to share more information with the government (the funding of which does not depend on local economic conditions). However, the rebels are crucially dependent on civilian support, and they could try to prevent increased information sharing through higher victimization of civilians.

2. **Opportunity (rebel recruitment):** Whether a rebel group benefits from a local income shock in terms of recruitment depends on the extent to which its resources are independent from these local shocks.

In other words, I argue that the information channel and opportunity cost channel operate at the same time, with the opportunity cost channel becoming relatively stronger when the rebels have an independent source of funding. In the context of the Naxalite conflict, mining revenues can provide an independent source of funding for the rebels. As the States who are responsible for running the police and centralize tax revenues, their operations do not depend directly on these local conditions. Given the organizational structure of the Maoists described in the previous section, local Maoist groups are severely constrained in their ability to share resources. This structure justifies an analysis at the district level. The results will distinguish further between different types of casualties to identify the type of attack. In a low-intensity guerrilla war like the Naxalite conflict, it is reasonable to assume that the number of casualties inflicted by each party is a proxy of the relative strength of that party (in terms of local recruits, for the Maoists, or in terms of the quality and number of local informants).

3 Data

This paper relies on violence data from the South Asia Terrorism Portal (SATP) between 2005 and 2011.[12] The SATP combines newspaper reports from the local and national English speaking press into daily incident summaries. These summaries typically provide the district in which the incident took place and the number of deaths on each side of the conflict (civilians, Maoists and security forces). In these reports, all civilian casualties are inflicted by the Maoists.[13] Based on this information, I construct variables for the number of casualties, for three categories (civilian, security forces and Maoists) at the district-year level.[14] As the number of casualties in a given attack varies considerably (and the exact number is not always confirmed), I will present the main results for a less noisy outcome measure: the number of fatal attacks inflicted by the Maoists or the Police. Descriptions of the incident can be used to further identify whether civilian casualties belong to groups that collaborate with the Government of India against the Naxalites. The analysis will be restricted to the 8 states that are confronted with Naxalite activity over the period under study.[15] One data limitation is that the number of Maoists casualties inflicted by security forces is largely based on police sources. It is possible that civilian casualties inflicted by the police are categorised as "Maoists", although this practice does not undermine the interpretation of "Maoist Casualties" as a measure of anti-insurgency activities. The type of casualties which is probably the least prone to misreporting are government casualties inflicted by the Maoists, as these are highly visible. Importantly, the subsequent empirical approach will be sufficiently flexible to account for the most plausible factors that could drive under-reporting of incidents (by including state-year fixed effects in a district level panel).

I focus on three minerals that are linked to Maoist activity: iron, bauxite and coal. For iron and bauxite, I use production data from 2000-2001 (Ministry of Mines). For coal, production data from 2001 is used (published by the Ministry of Labour and Employment). The constructed mineral output measure does not vary over time and is measured well before the start of the sample (in the

[12] www.satp.org, accessed in January 2011 (for 2005-2010), and October 2014 (for 2011).

[13] Security Forces regularly inflict casualties among the civilian population (e.g., Human Rights Watch, 2012). However, as it is hard to formally identify "Maoists", this category will undoubtedly include a certain number of civilian victims inflicted by the Security Forces.

[14] The data are based on three SATP sources: "Fatalities and Incidents of Landmine Explosion by Maoists: 2005-2011"; State Incident Time lines (2005-2011); Major Incidents. For 2005 and 2006, this data is further checked against daily terrorist incident reports published by the SATP. The reliance on these different data sources limits the risk of failing to identify incidents that involve casualties.

[15] Andhra Pradesh, Bihar, Chhattisgharh, Jharkhand, Karnataka, Maharashtra, Orissa and West Bengal (figure 1). All other Indian states suffered less than 5 Naxalite-related casualties during the sample period.

earliest year that uses 2001 census boundaries), in order to mitigate concerns about the endogeneity of mining activity to the observed violence.[16]

Rainfall data were collected from the Indian Meteorological Department (IMD), for the years 2004-2011. For several districts, rainfall data is not available, in particular for non-monsoon months. To address this problem I restrict my analysis to rainfall in the main monsoon season (June-September). This approach has the additional advantage of focusing on rainfall shocks that are directly linked to the main growing season for the dominant crop (rice), while rainfall outside of this season could have more ambiguous effects on agricultural productivity. The rainfall measure used in the empirical analysis captures rainfall deficiency, described as the percentage of rainfall below the long-run average. To confirm the validity of the use of rainfall as a proxy for rural incomes, annual rice production data were collected for the period 2004-2010 from the Indian Department of Agriculture and the Fertiliser Association of India.[17] These production data correspond to fiscal years and are assigned to the earlier calendar year. This approach ensures that the harvesting season during any fiscal year is assigned to the calendar year in which the crops were fed. Due to missing observations, the resulting rice production panel is unbalanced and incomplete.

As additional controls, I collect 2001 census data at the district level on population, the size of the tribal and scheduled caste population, literacy, and the share of the rural population. Furthermore, I collect forest cover and area data from the Ministry of Environment and Forest[18], as well as infrastructure data from the 2001 Census, and flood- and drought-proneness from the Indian Vulnerability Atlas (2001).

As rainfall information is not recorded in certain districts and other districts were split over the 2001-2011 period, I merge neighbouring districts to create a balanced panel of violence outcomes and explanatory variables. [19] The resulting data set contains a balanced panel of 165 (merged) districts. The main sample used in the analysis includes all districts that experience at least one death or bomb attack between 2005 and 2011, limiting the sample to 86 districts.

[16]These data are available from www.indiastat.com. For iron and bauxite, I use production values expressed in nominal Rs. For coal, I use the average value (in nominal Rs) per tonne from the Indian Bureau of Mines (2000-2001).

[17]http://dacnet.nic.in/eands/AERC.htm. Rice production data were not available for three states (Chhattisgarh, Jharkhand, and West Bengal). Data from the Fertilizer Association of India were accessed on www.indiastat.com, for Jhakhand (2007-09) and Bihar (2008-09).

[18]Ministry of Environment and Forest, Govt. of India., "District-Wise Forest Cover", www.indiastat.com.

[19]207 districts are merged into 165 districts based on four criteria. First, 2001 census districts that were split during the 2001-2011 period are merged to their 2001 boundaries. Second, districts with missing rainfall information are merged with the closest district that has rainfall information available (based on the distance between district capitals). The mergers on the basis of the first two criteria are reported inthe online appendix.

Table 1: Summary Statistics (district-year level)

	Mean	Observations
Fatal attacks on security forces	0.65	602
(by Maoists)	[1.91]	
Targeted attacks on Civilians	1.85	602
(by Maoists)	[6.30]	
Fatal attacks on Maoists	1.03	602
(by the Police)	[2.60]	
Kharif season rainfall (mm)	1109	602
	[587]	
Rain Deficiency	0.11	602
(proportional difference below the long run average)	[0.15]	
Drought Dummy	0.32	581
(Deficiency>0.20)	[0.59]	
Rice production (kilo tonnes)	415,442	447
	[400,297]	

Notes: See text for a detailed data description. Table includes observations for 86 (merged) districts for 2005-11 as described in section 3. Rainfall data are from the Indian Meteorological Institute for 2004-11, rice output data cover 2005-10 (incomplete for 2010).

Tables 1 and 2 provide summary statistics for key variables. In the online appendix, maps are provided for the districts that see at least 1 casualty or bomb attack related to the Naxalite conflict (figure 2), which corresponds to the main sample of the paper. Maps are also presented for the number of targeted attacks on civilians over the 2005-2011 period (figure 3), the number of attacks on security forces over the same period (figure 4), and the logarithm of mineral output value (figure 5).

4 Empirical strategy

4.1 The relevance of Rainfall and subsistence agriculture

This paper employs rainfall shocks in the rice growing season as exogenous determinants of agricultural output (which could include forest resources as well). A wide range of papers have confirmed the importance of rainfall shocks for agricultural wages and productivity in the Indian context.[20] To further confirm the validity of interpreting rainfall shocks as productivity/income shocks, I first

[20]Recent contributions that use rainfall to explain political outcomes in India include Cole et al. (2012), Bholken and Sergenti (2010), and Sekhri and Storeygard (2010).

Table 2: Summary Statistics (district level)

	Sample (1)	Non-Mining (2)	Mining (3)
Mineral dummy	0.372		
	0.486		
Mineral Value (Rs/population)	826.96		2222.47
(Production)	[2692.37]		[4083.43]
Log(Mineral Deposit Value +1)	1.608		3.776***
(Rs/ population)	[2.245]		[2.193]
Population density	392.74	461.37	276.21***
	[33.02]	[46.06]	[35.14]
Literate population	58.43	57.93	60.08
(percentage)	[1.329]	[2.129]	[1.709]
Scheduled tribe population	18.33	13.50	26.49***
(percentage of population)	[2.16]	[2.47]	[3.64]
Scheduled caste population	15.53	16.29	14.25
(percentage of population)	[0.73]	[0.92]	[1.19]
Rural population	83.09	84.74	80.29
(percentage of population)	[1.20]	[1.18]	[2.47]
Telephone connection	39.08	36.26	43.84
(percentage of population)	[2.65]	[3.31]	[4.33]
Forest area	25.42	22.15	30.94**
(percentage of district area)	[2.04]	[2.56]	[3.17]
Flood prone	7.54	11.08	1.56***
(percentage of district area)	[1.64]	[2.42]	[1.03]
Drought prone	4.17	2.18	7.54
(percentage of district area)	[1.62]	[1.06]	[3.94]
Waste lands	15.56	16.55	14.98
(percentage of district area)	[1.25]	[1.53]	[2.18]
Pucca Road connection	49.08	52.68	43.03*
(percentage of district area)	[2.5]	[3.13]	[3.7]
NREGA Phase	1.52	1.61	1.38
(percentage of district area)	[0.08]	[0.10]	[0.13]
Number of Districts	86	52	32

Notes: District level observations for 86 affected districts. Mineral data are based on production of bauxite, iron and coal. Value of production data are collected from various government publications for 2000-2001 and 2001, as described in the text. Forest cover data are from Government publications. Socio-demographic and infrastructure data are from the 2001 census. Waste land data is from the 2000 Waste Land Atlas. Drought and flood proneness is based on the Indian Vulnerability Atlas 2001. In column 3, *** p<0.01, ** p<0.05, * p<0.1 for the t-test between column 2 and 3.

estimate a rice production function for the districts that were affected by Naxalite violence:

$$Log(Rice_{ist}) = \beta_1 RainfallDeficiency_{ist} + \mu_{is} + \theta_{st} + \phi_t * M_{is} + \varepsilon_{ist} \quad (1)$$

In this equation, β_1 captures the elasticity of rice production with respect to contemporaneous rainfall deficiency. The rainfall deficiency measure is expressed as the proportional difference, below the mean only, between Kharif rainfall and its long-run average. Hence, if rainfall is 30% below the mean, the Deficiency measure will be 0.30. It will be zero for rainfall above the mean. μ_{is} is a district fixed effect. θ_{st} and ϕ_{Mt} respectively represent state-year fixed effects and mineral wealth-year fixed effects, which are included to make this model directly comparable to the models used in the main tables.

Rice output data is consistent availability at the district level until 2009, and by far the most important agricultural crop in the conflict states, accounting for 80% of the cropped area in Jharkhand, 70% in Chhattisgarh, 69% in Orissa, and 46% in Bihar.[21] Unfortunately, no comprehensive data exists on the livelihoods of the marginalized and tribal communities that are affected by India's Naxalite conflict. Annual household surveys (inclusing NSSO) are not representative at the district level, and their respondents are unlikely to live in the conflict zones. As a result, *any* agricultural income measure at the district level is an imperfect proxy for the incomes of these rural communities. However, a variety of sources offer strong support for the use of rainfall in the rice growing season (Kharif) as a proxy for rural incomes in these vulnerable localities. Marginal farmers in these states rely heavily on rain-fed rice production and have no access to irrigation.[22] Qualitative sources confirm that the affected communities rely more heavily on rain-fed subsistence agriculture than on average. Tribal communities in Orissa's Naxalite districts are reported to derive approximately 60% of their income from subsistence rice cultivation (Patnaik and Nanda, 2011). For these subsistence farmers, price adjustments are not expected to alleviate productivity shocks. Banik et al. (2004) surveyed farmers in the Naxalite-affected districts Giridih (Jharkhand) and Purulia (West-Bengal). They found that only 21% of the sample households reported selling of rice during the survey year.

If β_1 is estimated to be negative and significant in equation 1, this lends credibility to my inter-

[21] Agricultural Department of Jharkhand, 2011; Directorate of Statistics, Government of Bihar, 2007; Rice Knowledge Management Portal, Chhattisgarh and Orissa, Rice Status Reports, 2010.

[22] "From June to January the main source of livelihood is small-scale rain-fed mono-crop cultivation in forest clearings, primarily of rice for self-consumption." (Kennedy and King, 2009)

pretation of the reduced form effects of rainfall deficiency as negative agricultural income shocks. If lower rainfall leads to lower average rice production at the district level, it is reasonable to assume that this relationship also holds for the incomes of the subsistence farmers in the Naxalite pockets. However, in the light of the clear limitations of the rice production data (it only serves as a proxy for local incomes, the data set is incomplete after 2009, and is compiled from various sources), the preferred specification focuses on the reduced form effects of rainfall.

4.2 Explaining violence

With its focus on how financial constraints shape the behaviour of existing rebel groups, the paper will naturally focus on the intensity of violence as its main outcome. To account for the fact that number of attacks is a count variable, I rely on a fixed effects Poisson Quasi-Maximum Likelihood model with robust standard errors at the district level.[23] The estimated model will be based on the following specification:

$$E(C_{ist}) = \mu_{is} exp(\beta_1 RainfallDef_{is,t-1} + \beta_2 RainfallDef_{is,t-1} * M_{is} + \beta_3 RainfallDef_{is,t-1} * Z_{is} + \phi_t * M_{is} + \nu_{st}) \quad (2)$$

The dependent variable C_{ist} is the number of attacks (or casualties) of a given type (security forces, collaborators, or Maoists) for a given district i in state s and in time period t. The coefficient β_1 represents the elasticity of the number of casualties in district i and year t with respect to district rainfall deficiency in the previous year (the Kharif harvesting season is at the end of each calendar year). It should be noted that the district-level fixed effects (μ_{is}) are multiplicative to rainfall shocks, which naturally makes districts with higher levels of violence more responsive to a given rainfall shock. As a result, the fixed effects explain all the variation in districts that do not see any casualties and these districts do not contribute towards the estimation of β_1.

The state-year effects ν_{st} can account for state-level policy variables that affect the number of casualties. As both economic policy and counterinsurgency strategies are devised at the state level and these policies vary widely between states (as discussed in section 1.3), ν_{st} accounts for a wide

[23] See Wooldridge (2002) for an introduction.

range of potentially relevant but unobserved determinants of violence. Similarly, the state-year effects could capture time-varying changes in the reporting procedures of violence (the SATP collects timelines per state).

Equation 2 includes the first lag of Rainfall Deficiency (as this is the main variable of interest), although all reported regressions will also include the contemporaneous rainfall variables and their interaction with mineral output as controls. Three factors suggest that a delayed impact of rainfall shocks is most relevant for my study: (1) the timing of the harvesting season, (2) the dynamics of the conflict, and (3) concerns about direct impacts of rainfall on conflict. The harvesting season for Kharif rice is during October-December. Hence, the consumption and investment opportunities of rural households at the beginning of the calendar year will critically depend on rainfall in the previous monsoon. Moreover, Rabi crop cultivation during the dry season (November-May) is very limited in the "Red Corridor", mainly because of underinvestment in irrigation facilities. As a result, Rabi production has only limited capacity to mitigate shocks to Kharif production, in particular in the tribal communities affected by the conflict. Moreover, successful Rabi (non-monsoon, spring) cultivation in still relies on sufficient residual soil moisture from the monsoon season (Joshi et al., 2002). Therefore, scanty rainfall during the Kharif season depresses both income and agricultural productivity during the next calendar year, even until the next Kharif harvest.[24] A second factor that suggests a delayed impact of rainfall is the conflict process itself. Increased rebel recruitment may take some time to translate into more attacks on the government, as attacks need to be planned and new recruits need to undergo training. Similarly, actual information provision (and the need for selective violence against civilians) could lag behind on the timing of becoming an informant. Finally, it is possible that contemporaneous rainfall has a direct impact on violence, apart from the income channel. In principle, rainfall shocks could make it harder (or easier) for rebels to seek refuge or stage attacks (Miguel et al., 2004). However, if the results are strongest for lagged rainfall, then such a direct impact is unlikely.

To test the hypothesis that the impact of rainfall depends on the availability of mineral resources in the district, rainfall is interacted with the district level mining output in 2001. The inclusion of (historical) mining production-year effects guarantees that this regression is not just picking up changes that stem from the mere presence of minerals and that change over time (including changes

[24]In Jharkhand, the so-called "hungry season" runs from June to October, right until the Kharif harvest (PACS, 2009).

to the past, current, and anticipated value of mineral resources or changes in the government's efforts to protect mines). The main measure of mineral wealth used in the analysis is continuous variable, $log(mineralvalue+1)$.

A key endogeneity concern in equation 2 is the fact that the availability of mineral resources is not exogenous to the process that drives violence. The district-fixed effects and mineral-year fixed effects should address some of these concerns. Nevertheless, it remains possible that β_2 captures the differential effect of rainfall by any other variable that is correlated with the presence of mining activity. To account for this possibility, I also include interactions of rainfall with other key socio-economic variables at the district level (summarized in Z_{is}): the proportion of the tribal population, the proportion of the scheduled caste population, the proportion of literates, the percentage of the district area covered by forests, population density, the share of the rural population, the percentage of the district that is drought or flood prone, the share of households with an electricity connection, and the average share of villages with an all-weather road connection.

5 Results

The first column in Table 3 confirms that rainfall deficiency at the district level is negatively associated with rice production. This strong relationship could reflect the limited investments in agriculture that these districts have received ever since the colonial period (Banerjee and Saha, 2010; Banerjee and Iyer, 2005). While the rice production data do not overlap perfectly with the violence panel, the positive relationship between rainfall and rice output supports the hypothesis that rainfall affects the income of subsistence farmers in the Naxalite-affected states.

Columns (2)-(7) allow for an evaluation of the hypothesis that the impact of agricultural income shocks should differ by type of violence and by the structure of the rebel's tax base. The lagged rainfall variable is interacted with a continuous measure of mining production (at baseline) to test whether the impact of rainfall depends on the availability of mineral resources.

Strikingly, the impact of rainfall deficiency (i.e., a dry shock) on the number of fatal attacks against security forces is negative in the absence of mining resources, but becomes negative as mining output increases. The coefficient on the interaction term between rainfall and mining output is significant at the 1% level. These signs are consistent with the predictions from the model. The

Table 3: Main result (Poisson)

	Log(Rice t)	Attacks on Security Forces		Attacks on Civilians		Attacks on Maoists	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rain Deficiency t	-0.486**	0.251	0.278	0.169	0.068	-0.150	-0.162
	[0.194]	[0.609]	[0.602]	[0.391]	[0.414]	[0.791]	[0.755]
Rain Deficiency t	-0.050	-0.104	-0.147	0.167	0.182	-0.053	-0.153
* Log(Mineral Value)	[0.053]	[0.121]	[0.135]	[0.102]	[0.120]	[0.183]	[0.186]
Rain Deficiency t-1	0.130	-0.992*	-1.384*	1.368***	1.722***	0.346	0.391
	[0.231]	[0.578]	[0.770]	[0.414]	[0.478]	[0.609]	[0.895]
Rain Deficiency t-1	-0.111	0.522***	0.473**	0.061	0.048	0.146	0.129
* Log(Mineral Value)	[0.077]	[0.165]	[0.217]	[0.122]	[0.138]	[0.159]	[0.197]
Control interations			Y		Y		Y
Districts	86	59	59	69	69	65	65
Observations	430	413	413	483	483	455	455

Notes: District-year level observations, covering 2005-2011 (2005-2009 in column 1) for 86 districts. With the exception of Log(Mineral value), all interaction variables are demeaned. All regressions include district fixed effects, state-year fixed effects and Log(mineral value)-year fixed effects. Control interactions include: ST share, SC share, Forest area (share), population density, share of villages connected by paved roads, the share of the rural population, and the share of drought- and flood-prone areas in the district. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1.

coefficients for attacks in column (2) imply that a 10% deficiency shock[25] in the average *mining* district *increases* the number of deadly attacks on police forces by 20%.[26] In *non-mining* districts, a dry shock of the same magnitude *decreases* the number of deadly Naxalite attacks by 22%. These results are in line with the key argument of the theoretical framework: rainfall deficiency only spurs attacks against the government if mining output is sufficiently strong.

The relationship between rainfall and the number of targeted attacks against civilians is negative. The additional impact of mining activity is negative but insignificant. The coefficient of 1.4 on targeted attacks against civilians in Table 3 indicates that, for a 10% decrease in rainfall below the mean, the number of attacks on collaborators increases by 14% (in non-mining districts).

For the number of fatal Police attacks on Maoists, the main coefficients fail to gain significance in most specifications. The small effects are consistent with the hypothesis that the security forces are less dependent on local economic conditions for their fighting capacity against the Maoists. Still, the positive sign (similar to the positive sign for attacks on civilians) in combination with the negative sign on Maoist attacks could point at increased information sharing by civilians with the Police.

[25]The first column suggests that the corresponding decrease in rice production is 0.5%.

[26](-0.99 +5.8*0.52). A Wald test rejects the hypothesis that this elasticity is zero at the 5% level. At the sample mean of mining districts that have at least one police force casualty (0.9), this elasticity would imply that a 10% shock below the mean leads to 0.18 additional deadly attacks on security forces.

All these results are robust to the addition of interactions with key (demeaned) covariates, as shown in the even columns of table 3.[27]

Table 4: OLS Results

	Log(Rice t)	log(Attacks on Security Forces)		log(Attacks on Civilians)		log(Attacks on Maoists)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rain Deficiency t	-0.486***	0.088	0.081	0.358*	0.404*	-0.018	-0.012
	[0.157]	[0.138]	[0.140]	[0.213]	[0.217]	[0.186]	[0.184]
Rain Deficiency t * Log(Mineral Value)	-0.050	-0.017	-0.017	-0.002	0.001	-0.034	-0.044
	[0.043]	[0.031]	[0.030]	[0.056]	[0.056]	[0.055]	[0.053]
Rain Deficiency t-1	0.130	-0.048	-0.029	0.410*	0.475**	0.232	0.356*
	[0.185]	[0.146]	[0.148]	[0.213]	[0.212]	[0.180]	[0.186]
Rain Deficiency t-1 * Log(Mineral Value)	-0.111	0.095***	0.084*	0.029	-0.003	0.060	0.021
	[0.075]	[0.036]	[0.045]	[0.053]	[0.061]	[0.047]	[0.055]
Control interations			Y		Y		Y
Districts	86	86	86	86	86	86	86
Observations	430	602	602	602	602	602	602

Notes: District-year level observations, covering 2005-2011 for 86 affected districts (2005-2009 in column 1). All regressions include contemporaneous Rain deficiency measures. All regressions include district fixed effects, state-year fixed effects and Log(mineral value)-year fixed effects. Control interactions include: ST share, SC share, Forest area (share), population density, share of villages connected by paved roads, the share of the rural population, and the share of drought- and flood-prone areas in the district. Standard errors are spatially clustered (using a 250km radius with linearly decreasing weights) and robust to serial correlation. *** p<0.01, ** p<0.05, * p<0.1.

Table 4 confirms that the results go through in an OLS estimation in which the dependent variable is subject to a $log(x+1)$ transformation and using spatially clustered standard errors that are robust to serial correlation (with linearily decreasing weights in a 250km radius). The interaction effect between rainfall deficiency and mineral resource wealth for attacks on security forces, as well as the effect for attacks on civilian collaborators, mimic the earlier coefficients. The negative effect of rainfall deficiency on security force attacks in non-mining districts loses its significance, although its magnitude remains consistent. Compared to the Poisson results (where districts with only zeros are absorbed in the fixed effects), all districts contribute to the estimation of the OLS results.[28] In Table 10 (see online appendix), I confirm that the main results hold for two alternative rainfall measures: a drought dummy (for deficiency of more than 20% below the long-run mean in the Kharif season), and the logarithm of total rainfall. I also confirm that the results are robust to the use of a mineral

[27] To facilitate the interpretation of the main effects, the interaction variables are demeaned at their average value in non-mining districts.

[28] Results of a negative binomial regression are very close to the Poisson results reported here.

dummy measure or a measure of mineral deposits, rather than historical output (in table 11).

6 Interpretation

Table 5: Motives for violence against civilians

Motive	Number	Civilian Casualties by Motive Percent	Percent (excluding unspecified)
Collaboration			
Suspected police informers	606	23.44	32.06
Surrendered Maoists	52	2.01	2.75
Members of political parties/ political activity	465	17.99	24.60
Members of vigilante groups	145	5.61	7.67
(Collaboration total)	1268	49.05	67.09
Other			
Untargeted	366	19.16	24.03
Failure to pay levy	50	1.93	2.07
Punishment for crimes	45	1.74	1.77
Other motives			
Unspecified	695	26.89	-
Total	2,585	100	100

Notes: Civilian Casualties, covering 2005-2011. Based on author's coding of SATP incidents, as described in footnote 30.

The main results of table 3 can be reconciled through the interplay of a recruitment channel and information sharing channel. When rainfall is poor, civilians are tempted to share information with the police. However, the Maoists could strategically respond by increasing targeted attacks on civilians. I observe that rainfall deficiency leads to increased attacks on civilian targets. The need to use fighters to control the civilian population and information sharing with the police could reduce the fighting capacity of the rebels. I do indeed observe that poor rainfall (weakly) reduces Maoist violence against the Police in non-mining districts. However, this negative effect can be offset if the rebels benefit from lower local incomes. This counteracting channel will become more important the more independent the Maoists' tax base is from the rural economy. In the context of the Maoist conflict, mining resources provide an important source of funding that is unrelated to agricultural output. The results show a significant interaction term of mining production and rainfall deficiency for attacks on Security Forces. This finding is consistent with the interpretation that the rebel recruitment channel dominates the information sharing channel when the independent source of funding (mining output) is sufficiently large. The results for Police attacks on Maoists are consistent with increased information sharing and more attacks when rainfall is poor, although this relationship is not significant in most specifications. The weaker effects for Police attacks also confirm the idea that local economic conditions are more important for the strategic interaction between rebels and civilians on the one hand and the State (which is organized at a higher administrative level) on the other hand.

To tie the results more closely to the above interpretation, table 5 provides a break-down of civilian casualties by suspected motive of the killing, based on the descriptions in the SATP Time Line. For approximately 27% of casualties, a motive is not explicitly referred to.[29] Focusing on casualties for whom a motive is recorded, a large majority is referred to as (suspected) collaborators. Police informers (32%), members of mainstream political parties that oppose the Naxalites (27%), surrendered Naxalites (3%), and members of vigilante groups (8%) account for a total of 67% of the casualties for which information on the motives of the attack is available. Strikingly, failure to meet extortion demands only accounts for 2% of the civilian casualties. The bulk of the remaining casualties fell victim to "untargeted attacks". The importance of targeted violence against civilians can be interpreted in the framework of Kalyvas (2006), who links selective violence against civilians to incomplete control by rivaling parties.[30]

In table 6, the main results are shown separately for attacks on civilian collaborators (as defined in table 5) and victims of "untargeted attacks". In support of the mechanism highlighted in this paper, the main results are specific to attacks on collaborators. In contrast, untargeted civilian killings follow the pattern of attacks on security forces. Reflecting the importance of violence against collaborators, the results on the number of civilian casualties match the pattern on collaboration casualties closely.

7 Robustness checks and alternative mechanisms

The results described earlier were robust to controlling for a range of socio-economic variables that could account for the differential impact of rainfall deficiency on Maoist attacks against the gov-

[29]The break-down of casualty numbers is based on the coding of incidents. For attacks in which a motive was not provided, the daily SATP reports were checked to rule out that information was lost in the process of compiling the event lines.

[30]Kalyvas (2006) argues that such violence is highest in areas with asymmetric, but incomplete control by the rivaling parties. The Naxalite conflict affects a large number of districts and each district will typically include areas that are rebel-controlled, government-controlled, and contested. Unfortunately, conflict data below the district level is required to explore Kalyvas' argument directly.

Table 6: Civilian Breakdown (Poisson)

	All attacks on Civilians	Targeted Attacks on Civilians	Untargeted Attacks on Civilians	Attacks on Collaborators
	(1)	(2)	(3)	(4)
Rain Defficiency t	0.360	0.387	1.404	-0.247
	[0.321]	[0.368]	[1.139]	[0.494]
Rain Defficiency t	0.040	0.055	-0.402	0.219**
* Log(Mineral Value)	[0.086]	[0.092]	[0.282]	[0.105]
Rain Defficiency t-1	0.717*	1.120***	-4.442***	1.637***
	[0.427]	[0.412]	[1.320]	[0.623]
Rain Defficiency t-1	0.107	0.074	0.844***	0.138
* Log(Mineral Value)	[0.096]	[0.104]	[0.293]	[0.144]
Districts	74	69	34	63
Observations	518	483	238	441

Notes: District-year level observations, covering 2005-2011 for 86 affected districts. All regressions include contemporaneous Rain deficiency measures. All regressions include district fixed effects, state-year fixed effects and Log(mineral value)-year fixed effects. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Mining correlation (OLS)

	Log(Attacks on Security Forces)		Log(Attacks on Civilians)		Log(Attacks on Maoists)	
	(1)	(2)	(3)	(4)	(5)	(6)
Log(Mineral Value)	0.054	-0.040	0.078*	-0.018	0.068	-0.002
	[0.040]	[0.036]	[0.046]	[0.046]	[0.044]	[0.039]
Log population	0.006	0.749***	0.152	1.118***	0.124	0.993***
	[0.157]	[0.196]	[0.220]	[0.337]	[0.171]	[0.257]
Controls		Yes		Yes		Yes
Observations	86	86	86	86	86	86

Notes: District observations for 86 affected districts (2005-11). The outcome measures are constructed as the total number of attacks in non-deficient rainfall years. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Interactions with baseline activity (Poisson)

	Attacks on Security Forces		Attacks on Civilians		Attacks on Maoists	
	(1)	(2)	(3)	(4)	(5)	(6)
Rain deficiency t-1	-1.410*	-1.152	1.080**	1.077*	0.957	1.874**
	[0.835]	[0.770]	[0.512]	[0.592]	[0.743]	[0.894]
Rain deficiency t-1 * Log(Mineral Value)	0.675***	0.617***	-0.019	-0.08	-0.005	0.013
	[0.176]	[0.203]	[0.111]	[0.113]	[0.167]	[0.181]
Baseline interaction	2005	2005-06	2005	2005-06	2005	2005-06
Number of dist	54	48	58	57	63	58
Observations	324	240	348	285	378	290

Notes: District-year level observations, covering 2005-2011 for 86 affected districts. Log(Mineral value) is calculated as Log(Mineral value+1). All regressions include contemporaneous Rain deficiency measures. All regressions include district fixed effects, state-year fixed effects and Log(mineral value)-year fixed effects. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1.

ernment in mining areas. A wide range of concerns are addressed by including interactions of rain deficiency with these controls. For example, one concern could be that mining districts have better roads or electricity provision, which facilitates the movement of security forces, and could make the Maoists more responsive. Similarly, on might be worried that mining areas tend to be located in wastelands, forested areas, drought prone regions, or flood prone ares. The impact of rainfall deficiency could be different in these areas because of the physical characteristics of the terrain or different agricultural practices. However, the interaction effect remains strong when interactions of these variables are added in Table 3.

7.1 Police activism

A key challenge to an interpretation based on the rebel's tax base is that security forces could operate differently in mining areas. For example, if there is more Police activity in mining areas, this could offer more opportunities for the rebels to respond to rainfall shocks with increased violence. It is unlikely that this mechanism drives the results, as the proportionality of the impact of rainfall shocks to the average levels of violence against the police is already accounted for by the multiplicative fixed effects in the Poisson model. I address this concern in two additional ways. First, in Table 7, I test whether mining output is correlated with the logarithm number of attacks (normalized by population) on security forces, civilian collaborators, or Maoist rebels in non-deficient years. There does not appear to be a significant relationship, which makes it unlikely that the Maoists respond differently to dry conditions in mining districts because of the higher security force presence. Table 8 includes controls between the baseline number of attacks and rainfall deficiency (measured in two years excluded from the sample: 2005 and 2005-06) for both attacks by the Maoists on security forces and attacks from security forces on the Maoists. The key interaction term remains robust to this control strategy.[31].

7.2 Violent appropriation

Table 5, 6, and the descriptive evidence discussed so far suggest that retaliation against collaborators is a key motive for violence against civilians. However, the results could still be consistent with appropriation theories (Dal Bo and Dal Bo, 2011; Dube and Vargas, 2013), if the true motive of targeted killings is not accurately recorded in the SATP reports. A negative relationship between shocks and violence could be observed if Maoists increase their appropriation activities in response to bad shocks and if violence is proportional to appropriation.[32] However, if the rebels strategically choose the extent to which they loot civilians, the presence of natural resources should mitigate the impact of negative productivity shocks on violence against civilians. I find no evidence of such a mitigation effect. Moreover, the SATP time lines provide a wealth of descriptive evidence on the importance of visible, lethal violence against informers, and because it is clear that the government tries to encourage collaboration (as discussed in the background section). While the Maoists clearly tax the local economy and they do this under the threat of violence, the violence that results from appropriation may have a different logic than the lethal violence that this paper investigates.

7.3 Heterogeneity between minerals

The mineral output measure is based on a the three major minerals in the Maoist-affected region: coal, iron ore, and bauxite. The main results account for common price movements by including year effects of the baseline production measure. However, this approach does not account for differential effects in the three main minerals. In column (1) of Table 9 I allow for the logarithmic output of

[31]A discussion of why the Police does not target mining areas is outside of the scope of this paper. Vanden Eynde (2015) argues that States had limited incentives to provide law and order in mining areas because of low royalties on legal mining activity

[32]In the context of India, Sekhri and Storeygard (2010) rely on a similar argument to explain why atrocities against scheduled castes increase in low-rainfall years. Miguel (2005) finds that extreme rainfall shocks lead to increased witch killings in Tanzania.

Table 9: Heterogeneity across Minerals (Poisson)

	Attacks on Security Forces		
	(1)	(2)	(3)
Rain deficiency t -1	-1.035*	-1.219**	-0.757
	[0.595]	[0.602]	[0.594]
Rain deficiency t -1 * Log(Mineral Value)	0.518***		
	[0.127]		
Rain Def t-1 * Log(Coal Value)		0.735***	0.780***
		[0.197]	[0.162]
Rain Def t-1 * Log(Iron Value)		0.457***	
		[0.132]	
Rain Def t-1 * Log(Bauxite Value)		0.739**	
		[0.361]	
Rain Def t-1 * Log(Metal Value)			0.302***
			[0.116]
Mineral specific trends	Y	Y	Y
Observations	413	413	413
Number of dist	59	59	59

Notes: District-year level observations, covering 2005-2011 for 86 affected districts. Log(Mineral value) is calculated as Log(Mineral value+1). All regressions include contemporaneous Rain deficiency measures. All regressions include district fixed effects, state-year fixed effects and Log(mineral value)-year fixed effects. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1.

each mineral to have its own year-effects. The results go through in this robustness check. If the differential impact of rainfall is driven by the rebels' access to funding, each of the three minerals should provide such an independent source of funding to the Naxalites. Table 9 confirms that the key results go through separately for iron ore, coal, and bauxite (column 2) In column (3), I combine iron ore and coal in a single "metal" value measure, to contrast it more clearly to coal. For both measures, there is a strong differential impact of rain deficiency. These consistent findings tie the results more closely to the interpretation that mining resources shape the financial constraints of the rebels, as this characteristic is common to the three minerals.

Conclusion

The stated long-term goal of insurgents such as the Naxalites is to overthrow the Indian state (Kujur, 2008). To organise this struggle, Maoist groups rely on both recruitment from and taxation of local communities. The communities affected by India's Naxalite are among the nation's poorest regions, and their local economies depend heavily on rain-fed subsistence agriculture. The Naxalites find their basis of support here. Recruitment from these communities is easier in times of comparative economic hardship as predicted by an opportunity cost mechanism. At the same time, civilians can be tempted to collaborate with the state when incomes are low, as suggested by an information sharing mechanism. To prevent this mechanism from undermining their fighting capacity, the rebels could strategically increase the targeting of civilians. Descriptive evidence of the conflict confirms that the visible punishment of collaborators is an important driver of Maoist violence against civilians. In the panel of annual attacks studied by this paper, poor rainfall is indeed found to increase targeted Maoist violence against civilians. At the same time, results for attacks on security forces are in line with a recruitment (or opportunity cost) mechanism: poor rain is associated with increased violence against the security forces. However, this result is specific to those districts that have sufficiently strong mining activity. I confirmed that this finding is not driven by one particular type of mineral. There is strong descriptive evidence of the importance of mining activity for the Maoists' revenues, and these results are consistent with the idea that negative labour income shocks only boost the rebels' fighting capacity through increased recruitment if the rebels have access to external sources of funding. In non-mining districts, poor rainfall depresses Maoist violence and increases Police violence, although these results are weaker. Combined with the evidence on targeted attacks against civilians, these signs provide further support for an information sharing mechanism.

Taken together, the results of this paper illustrate how that the police collaboration and rebel recruitment mechanisms operate at the same time and can explain how income shocks affect the intensity of violence against different targets. Furthermore, the results are consistent with the idea that access to an exogenous source of funding, as mineral resources for India's Maoist, could make the rebel recruitment (or opportunity cost) mechanism more powerful and determine the sign of the relationship between local income shocks and rebel violence. The Indian Maoists are a particularly interesting case to understand how these channels operate, as the Maoists are organized in geographically independent units and have a relatively simple local tax base. Still, the idea that the structure of the rebels' tax base shapes the balance between opportunity cost and information sharing channels could have broader applicability in the literature, which has reported conflicting findings on the relationship between labour income shocks and violence.

The findings of this paper have implications for the design of conflict resolution policies. Some policies aim to mitigate negative income shocks in an attempt to block rebel recruitment through the opportunity cost channel. Examples include local infrastructure provision, investments in agriculture, and subsidised rainfall insurance. This paper suggests that these policies may be particularly effective at restraining rebel's fighting capacity against the government in mineral-rich areas. In mineral-poor areas, the structure of the rebels' tax base already prevents the rebels from benefiting from negative income shocks in the absence of mitigation policies. Conditional mitigation could activate the information sharing mechanism and benefit the security forces. However, an important observation is that offering rewards or services that are conditional on collaboration might also increase strategically targeted violence against civilians. In India's Naxalite conflict, government agencies encourage civilian collaboration through a variety of policies. The retaliatory violence observed in this paper could reflect the fact that the civilian population is not sufficiently protected against reprisals. In such an environment, a real danger of policies that aim to attract civilian collaboration is that they increase the vulnerability of the population to attacks by insurgents. The logic of such targeted violence against civilians deserves more attention from both policy makers and researchers, in India's Naxalite conflict and beyond.

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Online Appendix for Targets of Violence

A.1 Theoretical Framework

A simple model

The theoretical framework will describe the interaction between a local Maoist group and the civilan population.[33] The purpose of the model is to structure the subsequent empirical analysis. The context of the model is one in which a locally-entrenched rebel group is fighting a government that has access to a broad tax base, as is the case in India's Naxalite conflict.

First, the model offers a reduced form description of the labour market for rebels. In line with the Naxalite's recruitment from rural communities, Rebels tax the economy and their income is given by:

$$B = p[\theta(L-F)+R]$$

The revenue function assumes that a fixed fraction p of economic output is collected as a "tax" (or looted) by the rebels.[34] Total agricultural output is given by $\theta(L-F)$, in which F indicates the number of people fighting for the rebels, and L stands for the total labour endowment in the economy. θ denotes labour productivity in a linear production function,[35] while R stands for an alternative source of funding that does not depend on agricultural productivity, e.g. mineral resources. The rebel group uses its revenues to pay fighters. It is assumed that their total income is divided equally among the rebels, so that the rebel wage equals $\frac{B}{F}$. As fighters are drawn from the agricultural sector, their reservation wage is equal to the agricultural output they forgo: $(1-p)\theta$. To simplify the analysis, I

[33] The framework combines key elements from four influential models in the conflict literature. It includes (1) a rebel group budget constraint (Dal Bo and Dal Bo, 2011), (2) information provision by civilians and the possibility of rebel retaliation (Berman et al., 2011b), (3) asymmetric taxation capacity (Besley and Persson, 2011), and (4) the strategic allocation of rebels (Azam, 2006).

[34] This first part of my framework corresponds to a simplified version of the appropriation model proposed by Dal Bo and Dal Bo (2011). However, I do not directly equate appropriation to violence. The assumption that p is a fixed fraction of output simplifies the analysis. The model can incorporate a general appropriation function $p(F)$ without changing the results qualitatively. However, additional assumptions on the form of the cost function $C(\tau F, \theta(1-p))$ are needed to guarantee the existence of $\overline{R}$ in proposition 3.

[35] Throughout the paper, I interpret changes in θ as "labour income shocks" (or more precisely, "labour productivity shocks"), but the model can still offer a reduced form description any local shock that hits potential rebel recruits (e.g., consumption shocks, which are empirically often equivalent to labour income shocks). One drawback of the labour market formulation is the implicit assumption of full employment. The relationship between the decision to join a rebel movement and the budget constraint of the rebel group could have been modeled alternatively by relying on a participation equation similar to 6.

assume that the population consists entirely of 'pure' subsistence farmers: the non-rebel population does not benefit from R, and the model does not account for agricultural prices. The participation constraint requires that the wage paid by the rebel group is higher than the reservation wage. In the labour market equilibrium, this condition holds with equality:

$$\frac{p}{F}[\theta(L-F)+R] = (1-p)\theta \tag{3}$$

The above condition implies that the returns to agricultural work equal the returns to becoming a rebel. The equilibrium condition can be rewritten as:

$$F = pL + p\frac{R}{\theta} \tag{4}$$

The second market considered by the theoretical framework is the market for informants. It is assumed that a certain share of the population, which could include both fighters and civilians, exogenously receives valuable information. Therefore, they can be hired to act as informants for the government. Informants receive payments X that are not responsive to labour productivity.[36] This assumption reflects the asymmetric nature of the conflict: the government's tax base is assumed to be independent from local economic conditions. Moreover, the government is non-strategic in this simplified model.[37] There are three main justifications for this important assumption. First, the assumption could describe a reduced form relationship whereby citizens are more desperate to complement their incomes when harvests are poor, and therefore more tempted by the government's reward X. Second, citizens must devote time to inform the government, which may hamper their productive capacity. Third, the rebel group may destroy the economic output of citizens in retaliation for passing on information.[38] These channels could reinforce each other: the threat of retaliation may

[36]Counter-insurgency methods can be brutal (Weinstein, 2007). Hence, X could also include non-punishment by the government. Similarly, the rebels could offer rewards for collaboration. The crucial assumption of the model is that the appeal of collaboration with the government is decreasing in θ. This assumption is credible if the government has access to a budget that is independent from local economic conditions or if the rebels are less constrained in their capacity to destroy the output of informers.

[37]There are multiple justifications for this assumption. In line with the asymmetric setting of my framework, the government could take strategic decisions (i.e. the choice of X) at a level that is higher than the local conflict zone considered by the model. Lack of local information or economies of scale may make if hard for the government to tailor its strategy to local conditions. Alternatively, if the government and the rebel group move simultaneously, there could be competition over informers (in which rebels match higher rewards with higher intimidation). In the equilibrium, the rewards offered by government could be limited by its budgetary capacity or its willingness to pay for information (which are independent from θ).

[38]The timing of the game, which will be introduced below, is only fully consistent with the first and third interpretation.

force informants to hide and to give up economic production. Higher retaliation capacity may also increase the share of output destroyed by rebels. These relationships are captured by the cost function $C(\tau F, \theta(1-p))$. The cost function includes the retaliation capacity τF as its first argument. τ stands for the fraction of rebels who are employed to control and monitor the population ($0 \leqslant \tau \leqslant 1$). In this function, it is assumed that $C_1 > 0$, $C_2 > 0$, $C_{1,2} \geqslant 0$. . The timing of the game is such that the potential informants move after the rebel group. The decision to provide information is based on observed τF and θ. The returns to providing information to the government can now be described as follows:

$$i[X - C(\tau F, \theta(1-p))] \tag{5}$$

The decision of the informed population to collaborate with the government is denoted by $i = 1$, $i \in \{0,1\}$. The optimal decision rule of the informed population is now given by:[39]

$$i = 1 \Leftrightarrow X > C(\tau F, \theta(1-p)) \tag{6}$$

An important implicit assumption of this model is that violence against civilians is not counter-productive in the sense that it spurs civilian resentment against the rebels. While this is clearly a simplification, the alienation stemming from the targeted violence described by the model should be much weaker than for untargeted terror attacks. Moreover, the civilian decision maker described in the model does not suffer from rebel violence in equilibrium (the appendix offers further interpretation of the purpose of violence in this model).

Finally, the rebel group strategically chooses how to allocate its fighters. The objective function is increasing in the number of fighters who are not involved in controlling the population. These are the fighters whom the rebel group can use to achieve its long-term goals, such as the control of territory or future sources of income.[40] These rebels have the capacity to carry out direct attacks on the government (i.e. the security forces). However, it is assumed that the capacity of the rebels to attack the government disappears if the informed population decides to share its information with the government. This is captured by the following objective function:

[39] In principle, the returns to becoming an informant should enter the labour market condition in equation 3. The online appendix provides a justification for this omission.

[40] The idea that the rebel group has long term goals for which it needs to recruit fighters is also central to Beber and Blattman (2013), Berman et al. (2009 and 2011) and Azam (2006).

$$W(\tau) = (1 - i(\tau F))(1 - \tau)F \tag{7}$$

The timing of the game is as follows:

1. Production and appropriation take place according to equation 3.
2. The rebel group chooses τF.
3. The informed population decides whether to provide information: $i \in \{0, 1\}$.
4. The pay-offs are realised:
   - For the rebel group: $W = (1 - i)(1 - \tau)F$
   - For the informed population: $U^i = (1 - p)\theta + i(X - C(\tau F, \theta(1 - p)))$
   - For all other individuals: $U = (1 - p)\theta$

The model is solved by backward induction. The rebels maximise their objective function with respect to τ in anticipation of the informers' reaction. It can be seen immediately from the discontinuous objective function that the rebel group optimally chooses τ such that the returns to becoming an informant (expression 5) equal zero.

Proposition 1: In the Subgame Perfect Equilibrium, the rebel group sets τ^* such that individuals are indifferent between working as informants or not. The informants choose $i^* = 1$ if $\tau < \tau^*$ and $i^* = 0$ if $\tau \geqslant \tau^*$.

The following propositions describe the comparative statics of the allocation of fighters with respect to productivity shocks.

Proposition 2: For $R = 0$, a productivity shock does not affect the size of the rebel group. A negative productivity shock increases the number of rebels engaged in controlling civilians ($\frac{\partial \tau^* F}{\partial \theta} < 0$). A negative productivity shock decreases the number of rebels engaged in conflict with the government ($\frac{\partial (1-\tau^*)F}{\partial \theta} > 0$).

Proposition 3: For $R > 0$, a negative productivity shock increases the size of the rebel group. A negative productivity shock increases the number of rebels engaged in controlling civilians

$(\frac{\partial \tau^* F}{\partial \theta} < 0)$. A negative productivity shock can lead either to an increase or a decrease in the number of recruits fighting the government. There exists an $\overline{R}$ such that for $R < \overline{R}$, $\frac{\partial (1-\tau^*)F}{\partial \theta} > 0$ and for $R > \overline{R}$, $\frac{\partial (1-\tau^*)F}{\partial \theta} < 0$.

Proof See Online Appendix.

It seems reasonable to assume that violence against civilians is increasing in the number of rebels who control the civilian population $(\tau^* F)$, whereas violence against the government is increasing to the number of rebels who can focus on insurgency activities, $(1-\tau^*)F$. Under these assumptions, the model yields easily testable predictions.

Underlying these results is the implicit assumption that the fighting capacity of the Maoists is increasing in the number of fighters. This assumption (which is common to most "opportunity cost" models) seems reasonable in the context of the Naxalite conflict. Most Maoist attacks on the government involve a substantial number of fighters,[41] and bombs are mainly used to create initial confusion, after which the rebels attack the security forces with guns. As for targeted violence against civilians, successful attacks require information gathering to identify the target, a group that carries out the actual attack, and in the case of public trials a larger group of fighters who control other villagers.

First, violence against civilians is negatively associated with productivity shocks, regardless of the resource environment. Violence against the government should be increasing in productivity, unless the rebel group has access to fixed sources of funding that do not depend on local labour market economic conditions (e.g., mineral wealth). In that case, the rebel group can exploit a negative productivity shock to boost recruitment and stage more attacks. This model will inform the subsequent empirical analysis, in which I will explore how the relationship between rural incomes and violence changes depending on the availability of mining resources.[42]

It should be emphasised that the theory does not preclude a certain degree of sharing of resources or the existence of independent sources of funding other than mineral resource revenues. As long as R is higher in mining districts and theta remains in the budget function of the rebels, we should observe a negative interaction of mining resource wealth and income shocks.

[41] "75 Central Reserve Police Force personnel and a State Policeman were killed in an attack by about 1,000 CPI-Maoist cadres in Dantewada district." (SATP Timelines, Chattisgarh, 2010)

[42] The result that F does not depend on θ in the absence of R also follows from a similar model by Fearon (2005).

The model can be extended to microfound the targeting of civilians further. In such an extended model, the rebel group could kill informers to prove that they have fighters devoted to monitoring and retaliation activities.[43] Without investments in monitoring capacity, the rebel group might be able to kill civilians, but it will fail to target informers. Hence, by observing the number of successful hits against police informers, the population can observe both the strength and monitoring capacity that the rebels invested in.

Proof of Proposition 1 and 2

From expression 6 and the objective function of the rebel group, it can easily be derived that:

$$\frac{\partial(\tau^{*}F)}{\partial\theta} = -\frac{C_2}{C_1}[(1-p)] < 0$$

The number of fighters deployed against civilians does not depend on R. While changes in R change both τ^* and F, (τ^*F) remains constant as the indifference condition 6 does not depend on R. However, the impact on the number of fighters employed against the government depends on R. In particular, the relationship between the total number of fighters and labour productivity is given by:

$$\frac{\partial F}{\partial\theta} = -p\frac{R}{\theta^2} \leqslant 0$$

It follows that the comparative statics for the number of fighters deployed against security forces is given by:

$$\frac{\partial(1-\tau^{*})F}{\partial\theta} = -p\frac{R}{\theta^2} + \frac{C_2}{C_1}(1-p) \lesseqgtr 0$$

In the special case of $R = 0$, it is trivial that:

$$\frac{\partial(1-\tau^{*})F}{\partial\theta} = \frac{C_2}{C_1}(1-p) > 0$$

[43] This model is described in the online appendix.

More generally, we can find an $\overline{R}$ such that:

$$p\frac{\overline{R}}{\theta^2} = \frac{C_2}{C_1}(1-p)$$

$$\frac{\partial(1-\tau^*)F}{\partial\theta} < 0 \Leftrightarrow R > \bar{R}$$

The comparative statics results described above require interior solutions. In particular, L needs to be sufficiently large to rule out a corner solution in which the entire population has joined the rebel group (and the derivative of interest is not defined). In particular, let $\tilde{L} = p\widetilde{L} + p\frac{\overline{R}}{\theta}$. If $L > \tilde{L}$, we know that $F(\overline{R}) < L$. Similarly, the comparative statics may not be defined if $\tau = 1$. This corner solution can be ruled out by choosing X sufficiently small.■

A Microfoundation of Violence against Civilians

In this section, I present an extension of the baseline model that links violence against civilians more explicitly to the retaliation capacity of the rebel group. It is assumed a fraction $\alpha_1 + \alpha_2$ of the population receives valuable information. Implicitly, the model in the main body already incorporated this assumption. Fraction α_1 of the population is non-strategic and always provides information to the government. Fraction α_2 receives valuable information and chooses to pass on this information, depending on the costs and benefits associated with this action. A fraction $1-\alpha_1-\alpha_2$ does not receive any information. These informer types are hidden. It is assumed the government pays X for valuable information that is provided by the "opportunistic informants” α_2. The collaboration of the α_2 population is assumed to be critical. The rebel group will lose its fighting capacity if and only if the α_2 population passes on information to the government.

In contrast to the earlier model, the population does not directly observe τF. Instead, it observes the number of non-security force killings by the rebel group among the α_1 informers, which is a monotonically increasing function of τF, $K(\phi\tau F)$, with $0 \leqslant \phi \leqslant 1$. For $\phi = 1$, $K(\phi\tau F)$ perfectly reveals the minimum investment in retaliation capacity. This extension microfounds the targeting of civilians. In particular, the rebel group now kills non-strategic informers to show that they have fighters devoted to retaliation activities. The ability to target α_1 informers also reflects monitoring capacity. Without investments in monitoring capacity, the rebel group may be able to kill civilians, but it will fail to target only informers. It is assumed that the types are revealed after the killing, so that the population can derive both the strength of the rebels devoted to controlling civilians and their monitoring capacity.[44]

The timing of the altered game is as follows:

1. Nature draws:
    - The informant types in the population, with probabilities α_1 for unconditional informers, α_2 for opportunistic informers, and $1-\alpha_1-\alpha_2$ for the remaining population.
2. Production, rebel recruitment, and appropriation take place according to 3.[45]
3. α_1 informers provide information to the government.
4. The rebel group chooses τF and ϕ.
5. The α_2 population:
    - Observes the number of killings of α_1 informers: $k = K(\phi\tau F)$
    - Decides to provide information $i \in (0,1)$.
6. The pay-offs are realised:

[44]It seems reasonable to assume that investments in retaliation capacity coincides with an investments in $(1-\tau)F$. Therefore, in principle, the rebel group could show its retaliation capacity based on $(1-\tau)F$. Nevertheless, an increasing function $H(\varphi(1-\tau)F))$, which could correspond to attacks against the government, would not work. While high retaliation capacity could imply a low value of H, an arbitrarily low H can also be achieved at no cost by just reducing φ.

[45]In principle, the collaboration decision should enter the labour market condition derived in (3) for opportunistic informers. However, there are two justifications for treating this market separately. First, under the assumption that the costs to becoming an informant do not depend on rebel status, the same returns to becoming an informant would be added to both the rebel wage and the agricultural wage and would not affect the equilibrium condition. Second, there are no opportunistic informants in equilibrium as long as X is sufficiently small (which guarantees that there exists a τF that makes the returns to collaboration equal to zero). Therefore, the functions describing the rebel market can depend on the returns to collaboration without altering the equilibrium results. However, if X is large, there could be an equilibrium with opportunistic collaborators and a break-down of the rebels' fighting capacity. The analysis does not consider this parameter range.

- The rebel group's pay-off: $W(\tau) = (1 - i^*)(1 - \tau)F$
- The pay-off of the α_2 population is given by: $(1 - p)\theta + i(X - C(\tau F, \theta(1 - p)))$

This game is essentially a simultaneous game that is preceded by a stage in which the rebel group shows its minimum retaliation capacity $\phi\tau F$. The subgame perfect equilibrium will specify optimal strategies in the simultaneous game and the optimal revelation of minimum capacity, $\phi\tau F$, in the first stage.

Proposition A.1: In the Subgame Perfect Equilibrium, the rebel group sets $\tau^* F$ so that 5 holds with equality. It sets $\phi^* = 1$, killing $K(\tau^* F)$ civilians. The informants choose $i^* = 1$ if $k < K(\tau^* F)$ and $i^* = 0$ if $k \geqslant K(\tau^* F)$.

Proof The existence of the equilibrium is a corollary of proposition 1. Consider a strategy in which $i = 0$ for at least one $\widetilde{k}$ such that $\widetilde{k} < K(\tau^* F)$. It is clear that the rebel group will optimally set $\widetilde{\tau} < \tau^*$ in response to this strategy. It will make sure that $\widetilde{k} = K(\widetilde{\tau} F)$. However, for $\tau < \tau^*$, the optimal strategy for the population is to set $i = 1$. A strategy whereby $i = 0$ for $\widetilde{k} = K(\tau^* F)$ cannot be optimal, as the technology of killings is such that $\widetilde{k}$ can only be achieved for $\tau \geqslant \tau^*$. Given that $\tau \geqslant \tau^*$, it is optimal to choose $i = 1$.

The comparative statics are identical to those of the simpler model.

A.2 Full list of merged districts

The districts that were merged as described (in the data section) are reported in the form "original district (merged district)": Nalgonda (Rangareddy), Banka (Bhagalpur), Arwal (Patna), Begusarai (Khagaria), Gaya (Aurangabad Bihar), Gopalganj (Siwan), Jamui (Munger), Jahanabad (Patna), Kaimur (Rohtas), Lakhisarai (Munger), Madhepura (Saharsa), Nalanda (Patna), Nawada (Patna), Saran (Bhojpur), Sheikhpura (Munger), Sheohar (Sitamarhi), Sapaul (Saharsa), Vaishali (Patna), Kishanganj (Purnia), Bokaro (Dhanbad), Chatra (Hazaribagh), Dumka (Deoghar), Garhwa (Palamu), Godda (Deoghar), Gumla (Ranchi), Jamtara (Deoghar), Khuti (Ranchi), Kodarma (Hazaribagh), Latehar (Palamu), Lohardaga (Ranchi), Pakaur (Deoghar), Sahibganj (Deoghar), Saraikela (Purbi Singhbhum), Singhbhum (Purbi Singhbhum), Simdega (Ranchi), West-Midnapore (Medinipur), Bargarh (Sambalpur), Bhadrak (Jajapur), Baudh (Sonapur), Kendrapara (Jagatsinghapur), Nabarangapur (Koraput), Hingoli (Washim).

A.3 Maps

Figure 1: Affected states

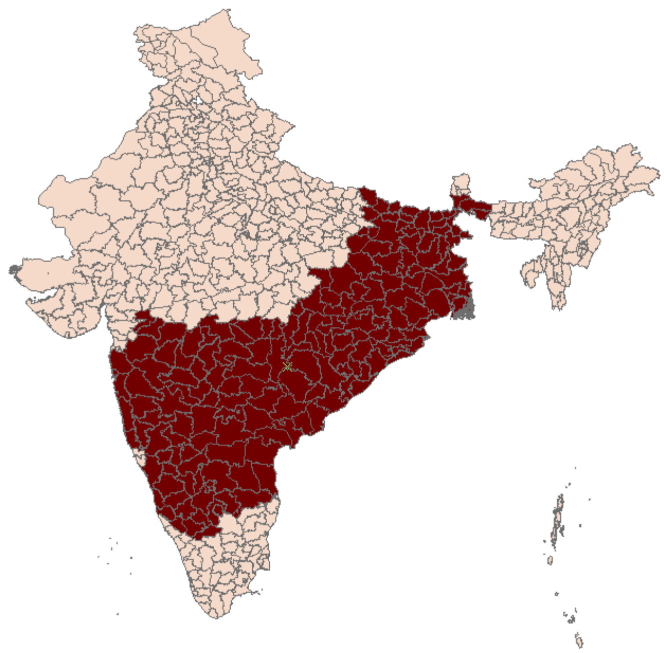
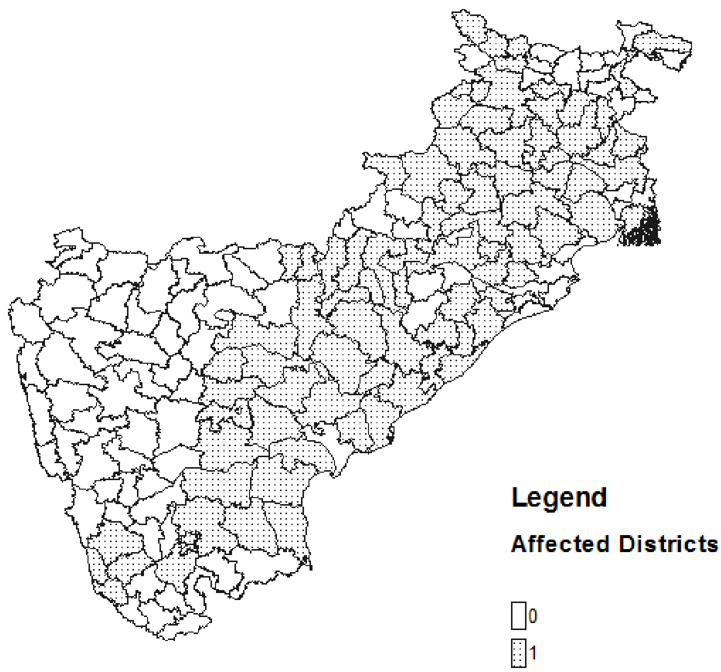
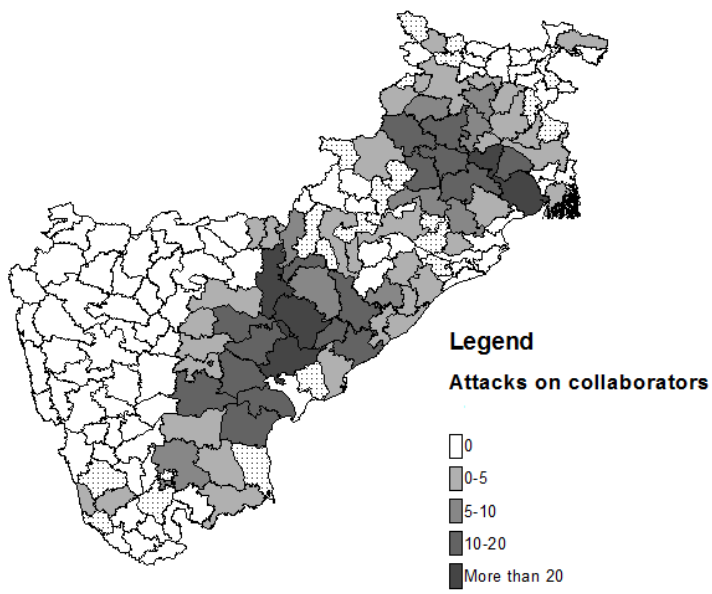


Figure 2: Affected Districts and main sample (within affected states)



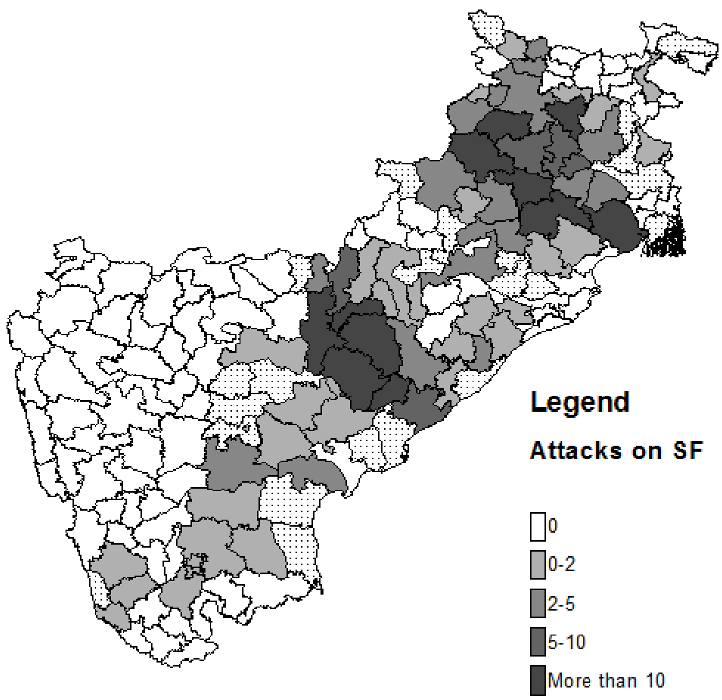
Notes: Affected (merged) districts see at least one casualty of any type in the SATP Timelines or bomb attack in the SATP Bombing Timelines between 2005 and 2011. These districts form the main sample for the analysis.

Figure 3: Targeted Attacks on Civilians



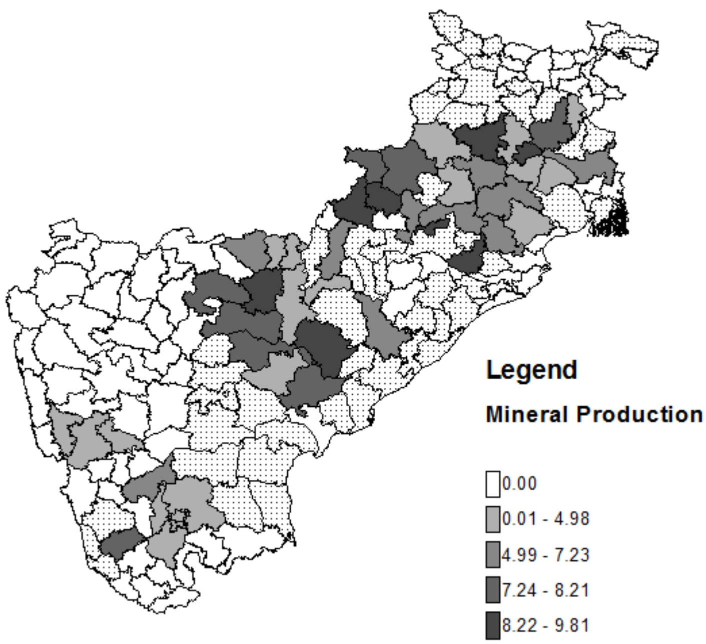
Notes: Total number of Maoist attacks on collaborators (per merged district) between 2005 and 2010. The background of dotted districts shows the main sample from Figure 2.

Figure 4: Attacks on SF



Notes: Total number of Maoist attacks on Security Forces (per merged district) between 2005 and 2010. The background of dotted districts shows the main sample from Figure 2.

Figure 5: Mineral production



Notes: Logarithm of mineral production value, measured in 2000-2001, as described in the text. The background of dotted districts shows the main sample from Figure 2.

A.4 Alternative specifications

Table 10: Robustness to alternative rainfall measures (Poisson)

	Attacks on Security Forces		Attacks on Civilians		Attacks on Maoists	
	(1)	(2)	(3)	(4)	(5)	(6)
Drought t-1	-0.518*		0.271**		-0.066	
	[0.205]		[0.113]		[0.178]	
Drought t-1 * Log(Mineral Value)	0.168***		0.036		0.026	
	[0.050]		[0.039]		[0.044]	
Log(Rain t-1)		0.762**		-0.875***		-0.159
		[0.314]		[0.216]		[0.384]
Log(Rain t-1) * Log(Mineral Value)		-0.248***		-0.027		-0.107
		[0.082]		[0.063]		[0.087]
Number of dist	59	59	69	69	65	65
Observations	413	413	483	483	455	455

Notes: District-year level observations, covering 2005-2011 for 86 affected districts. Drought is defined as a 20% deficiency shock in the Kharif season. Log rainfall takes the total rainfall over the Kharif season. All regressions include contemporaneous rainfall measures. All regressions include district fixed effects, state-year fixed effects and Log(mineral value)-year fixed effects. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1.

Table 11: Alternative mining measures (Poisson)

	Attacks on Security Forces		Attacks on Civilians		Attacks on Maoists	
	(1)	(2)	(3)	(4)	(5)	(6)
Rain Deficiency t-1	-0.878	-0.496	1.542***	0.858**	-0.276	0.134
	[0.691]	[0.607]	[0.446]	[0.379]	[0.679]	[0.659]
Rain deficiency t -1	2.222**		0.046		1.791*	
* Production Dummy	[0.963]		[0.765]		[0.976]	
Rain deficiency t-1		0.579**		0.351		0.315
* Log(Deposit Value)		[0.237]		[0.214]		[0.240]
Observations	413	413	483	483	455	455
Districts	59	59	69	69	65	65

Notes: District-year level observations, covering 2005-2011 for 86 affected districts. Log(Mineral value) is calculated as Log(Mineral value+1) for all relevant minerals. All regressions include contemporaneous rain deficiency, district fixed effects, state-year fixed effects and mineral-year fixed effects (âtrendsâ) using the log-transformation. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1.

Table 12: Lagged Dependent Variable (GMM)

	Log(Attacks on Security Forces) (1)	Log(Attacks on Civilians) (2)	Log(Attacks on Maoists) (3)
Rain deficiency t	0.110	0.546***	0.107
	[0.226]	[0.203]	[0.321]
Rain deficiency t	0.027	-0.067	-0.061
* Log(Mineral Value)	[0.043]	[0.042]	[0.079]
Rain deficiency t-1	0.059	0.530**	0.491*
	[0.177]	[0.251]	[0.275]
Rain deficiency t-1	0.137***	-0.040	-0.018
* Log(Mineral Value)	[0.050]	[0.059]	[0.067]
Rain deficiency t-2	0.092	0.354	0.123
	[0.158]	[0.235]	[0.266]
Rain deficiency t-2	0.093	-0.065	-0.095
* Log(Mineral Value)	[0.080]	[0.067]	[0.085]
DV Lags	2	2	2
Observations	430	430	430
Districts	86	86	86

Notes: District-year level observations, covering 2005-2011 for 86 affected districts. The affected range refers to the years used to define a sample of affected districts for the subsequent regressions. LDV results (2 lags) are estimated using GMM. All regressions include district fixed effects, state-year fixed effects and Log(mineral value)-year fixed effects. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1.

Table 13: Uninteracted Rain deficiency (Poisson)

	Log(Rice t)	Attacks on Security Forces	Attacks on Civilians	Attacks on Maoists
	(1)	(2)	(3)	(4)
Rain deficiency t	-0.562***	0.07	0.646*	-0.23
	[0.162]	[0.526]	[0.338]	[0.694]
Rain deficiency t-1	-0.009	0.37	1.436***	0.836
	[0.229]	[0.474]	[0.439]	[0.530]
Districts	86	59	69	65
Observations	430	413	483	455

Notes: District-year level observations, covering 2005-2011 for 86 affected districts. All regressions Log(mineral value)-year fixed effects. Standard errors are clustered at the district level. include district fixed effects, state-year fixed effects and *** p<0.01, ** p<0.05, * p<0.1.