# Targets of Violence: Evidence from India's Naxalite Conflict

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**Abstract**

This paper revisits the relationship between labour income shocks and civil conflict in the context of India's Naxalite insurgency. Exploiting variation in annual rainfall in a panel of district level fatal incidents between 2005 and 2010, I find that negative rainfall shocks: (i) increase Maoist violence against security forces, but only in those districts in which the Maoists have access to key mineral resources, (ii) increase Maoist violence against civilian collaborators, regardless of the resource environment. I argue that these results are consistent with a simple theoretical framework, in which negative labour income shocks are predicted to: (i) increase the number of rebel attacks against the government, but only if the rebels' tax base is sufficiently independent from local labour productivity; (ii) increase targeted violence against civilians to prevent them from being recruited as police informers or government collaborators. Hence, this paper shows that both the structure of the rebels tax base and the targets of violence shape the relationship between income shocks and violence.

## Introduction

The relationship between labour income shocks and civil conflict has become the subject of fierce academic debate. A number of studies point at a negative relationship between labour incomes and violence (Dube and Vargas, 2011; Miguel, Satyanath, and Sergenti, 2004). These results offer support for the opportunity cost theory, whereby reduced incomes lower the opportunity cost of participating in violent activities. However, this theory has been challenged in recent work that finds an insignificant or even a positive relationship between income shocks and conflict (Berman, Callen, Felter, and Shapiro, 2011; Ciccone, 2012). My paper argues that these conflicting results can be reconciled because the structure of the

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rebels' tax base is crucial in shaping the relationship between income shocks and conflict. I focus India's Naxalite conflict, which affects communities that are heavily dependent on rain-fed subsistence agriculture. In this context, I find that lower rainfall reduces violence against the government's security forces, but only in those districts where the rebels cannot tax mining activity. 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 a theoretical framework in which the opportunity cost channel is more important if the rebels have a source of funding that is independent from local labour market shocks.

This paper makes a second important contribution. In the context of India's Naxalite conflict, I find that lower rainfall tends to increase violence against civilians who collaborate with the Indian government. This result is important, because the existing literature on targeted rebel violence against civilians (e.g., Kalyvas, 2006) has not explored how local labour market shocks can drive changes in the intensity of such violence within a conflict over time. This result is consistent with a framework that tracks how labour market shocks could force rebels to strategically adept the level of intimidation against civilians. The framework developed in this paper will incoroporate both the role of the rebels' tax base and the forces that shape the strategic intimidation of civilians.

I consider a framework in which a rebel group needs to allocate its cadres strategically between either of two activities: (i) direct assaults on government troops, or (ii) the exercise of control over the civilian population. In the short run, the key objective of the rebels is to challenge the government. This enables them to promote their long term goals of control over territory and (future) economic rents. However, rebels must also confront the reality that civilians may act as police informants, thus restraining their capacity to attack the government. By staging targeted attacks against informers, the rebels can limit the incentive of civilians to help the government. How a rebel group manages its personnel depends on the economic environment. I assume that the rebels need to tax the local economy to compensate their recruits. In contrast, the government does not rely on local economic conditions to fund its payments to informers. In this sense, I focus on a conflict that is characterised by *asymmetric* taxation capacity.

What happens to rebel violence if a negative labour income shock hits a local conflict zone? As the government's tax base and the corresponding budget for paying informants is independent from local economic conditions, the negative labour income shock increases the willingness of the population to share information with the government. In response, the rebel group finds it optimal to boost the number of rebels devoted to targeting informers in order to deter collaboration. However, the rebel group's need to shift resources towards controlling the population comes at the expense of reducing its fighting capacity against the government. The extent to which the rebels can maintain direct fighting capacity now depends on the rebels' local tax base. If the rebels mainly rely on taxation of the local labour market, a negative income shock will hurt their tax base and they will not be able to boost recruitment. Only if the rebel group has access to sources of funding that are not correlated with local labour productivity, will it be able to exploit a negative labour income shock to boost its recruitment and thus stage more attacks against security forces. My paper presents evidence that is consistent with these theoretical results for a conflict that is of major concern to policy makers: India's Naxalite conflict.

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 4,900 lives over the 2005-2010 period. India's Naxalite conflict offers an interesting empirical context to study the relationship between income shocks, targeted violence, and the structure of the rebels's tax base. First, the Naxalite conflict affects a large number of districts and its actors have asymmetric financial capacities: while the rebels heavily rely on taxation of the local economy, the government can use a much broader tax base (Srivastava, 2009). Interestingly, the Naxalites operate in areas that include (but are not limited to) districts that produce key mineral resources. These mineral resources should make the rebels' local tax base more independent from local agricultural labour market conditions. Hence, variation in mineral resource wealth can be used to identify the differential impact of labour income shocks on violence, as required by the theoretical framework. Second, the Naxalite-affected communities are among the most marginalized groups in India, and they rely disproportionately on rain-fed subsistence agriculture (Planning Commission, 2008). In this context, exogenous variation in rainfall can be exploited to identify the impact of labour productivity shocks on the intensity of violence. Third, the Naxalite conflict has seen high levels of targeted violence against civilians, who account for more than one third of the total number of casualties (SATP, 2011). In this guerilla war, the support of the local population is the only factor that prevents security forces from clearing conflict zones.

To test the predictions from the theoretical framework, I collect a data set of annual casualty numbers at the district level between 2005 and 2010 from the South Asia Terrorism Portal (SATP). These conflict outcomes are combined with Kharif season (monsoon season) rainfall data, data on mineral resource wealth, and key socio-economic and environmental controls. Importantly, the data set allows for casualties to 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 identify attacks on civilian collaborators (members of mainstream political parties, members of vigilante groups, police informers, and surrendered Naxalites). In support of my empirical approach, I confirm that rainfall is positively associated with rice output in the Naxalite areas. This finding is consistent with qualitative sources that highlight the dependence of Naxalite-affected communities on subsistence agriculture (see section 5.1).

The key result of this paper is that violence against security forces only increases in response to negative rainfall shocks in those areas that have sufficiently high mining ouput. This finding is consistent with the idea that the rebels can only use a negative income shock to boost recruitment (and thus their fighting capacity against the government), if their tax base does not depend too much on local labour productivity. Furthermore, I find that lower Kharif rainfall boosts Naxalite violence against civilian collaborators, regardless of the resource environment. This finding is consistent with the idea that rebels use violence against civilians to counterbalance the increased appeal of collaboration after scanty rainfall. To shed further light on the underlying mechanism, I use detailed incident information to break down civilian casualties into three groups: civilian collaborators; other civilian targets; and untargeted civilian deaths. In support of the mechanism highlighted by this paper, my results are driven by targeted attacks on civilian collaborators. Strikingly, the results on untargeted civilian casualties follow exactly the same pattern as those for security force casualties: a negative rainfall shock boosts violence, but only if mining output is sufficiently high. Moreover, lower rainfall increases the number of reported "village meetings" and "people's courts". This result suggests that the Maoists try to strengthen their control over the local population when economic opportunities are poor.

The main results survive a variety of robustness checks, 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) relying on a dummy measure of mineral resource wealth (these results address limitations regarding the measurement of mineral resource wealth); (c) comparing the baseline results from a Poisson model to alternative specifications; (d) using rainfall as an instrument for rice production levels. Moreover, I argue in detail why my results are more consistent with a theory of "strategic intimidation" than with a theory of "violent appropriation".

The results of this paper matter for the design of conflict resolution strategies. By offering rewards that are conditional on collaboration, the government may want to exploit negative income shocks to boost collaboration and weaken insurgents. My results suggest that this strategy could mainly put civilians at risk of retaliation, as the rebels can strategically respond by boosting violence against civilians. Moreover, the structure of the rebels tax base could determine the extent to which mitigation of labour market income shocks undermines the recruitment efforts by the rebel group.

The paper is organised as follows. First, I discuss the existing literature. Second, I present a simple model that generates predictions regarding the impact of labour productivity shocks on different types of violence. Third, I discuss the background of the Naxalite conflict. Fourth, I describe the data used in this study. Fifth, I discuss the empirical strategy. Sixth, 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 Literature

This paper brings together recent work on the role of income shocks in conflict and research on the logic of violence against civilians. Several contributions in the conflict literature share the focus of my paper on labour income shocks. Dube and Vargas (2011) show that a fall in coffee prices led to increased violence in the Colombian civil war. Miguel, Satyanath, and Sergenti (2004) find that negative GDP shocks, as instrumented by rainfall growth, explain the onset of civil wars in Sub Saharan Africa.[1] Most of the theoretical arguments that link labour income shocks to violence rely on the idea that negative shocks reduce the opportunity cost of joining armed conflict.[2] Recent work by Berman, Callen, Felter and Shapiro (2011) qualifies this view. These authors find that high unemployment is associated with reduced violence in the context of Afghanistan, Iraq, and the Philippines. They argue that high unemployment could mainly facilitate information gathering by counterinsurgency forces. My paper suggests that the relationship between labour income shocks and violence against the government crucially depends on the structure of the rebels' tax base. Only if there are sufficiently strong external sources of funding, will the opportunity cost channel dominate the collaboration/information channel (which operates through the intimidation of civilians in my framework).

A growing body of research explores the targeting of the non-combatant population in civil conflict. The mechanism highlighted in this paper is close to the work of Kalyvas (2006), who links selective violence against civilians to incomplete control by rivalling parties.[3] Berman, Felter and Shapiro (2011) also consider the strategic interaction between governments, civilians, and rebels. These authors develop a model of retaliatory violence that is close to the framework presented in this paper, but they do not provide empirical evidence on such violence. This paper is one of the first empirical contributions to explore the causes of variation in targeted violence against civilians versus the government in a subnational panel.[4] In contrast to the existing literature, this paper explicitly links targeted

[1]While Ciccone (2012) finds that these results are not robust to respecifications, Besley and Persson (2010) 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. 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 to the type of conflict.

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

[3]Kalyvas (2006) argues that such violence is highest in areas with asymmetric, but incomplete control by the rivalling 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, the conflict data is not sufficiently rich to explore Kalyvas' argument directly (this would require detailed conflict information below the district level). However, the results are consistent with Kalyvas' framework, in that my findings could be driven by localities that are characterized by incomplete control within each of the affected districts.

[4]Ballcels (2010) considers direct violence against civilians in conventional civil wars. She finds a positive relationship between selective killings of civilians in the Spanish Civil War and pre-war political competition. Herreros and Criado (2009) analyze the deteriminants of two types of violence against civilians that reflect the distinction between "targeted" and "untargeted" victims that I make in this paper. These determinants

violence against civilians to labour income shocks. Apart from exploring a relationship that is interesting in its own right, this approach also enables me to overcome key endogeneity concerns.

This paper also contributes to the understanding of India's Naxalite insurgency. 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.[5] This consideration gains even more relevance because the districts affected by Naxalism are among India's poorest regions.[6] Given 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. While most of the existing work points to factors that explain the susceptibility of districts to Naxalite activity in the long run, these studies cannot account for the variation in the intensity of different types of conflict over time. However, understanding the dynamics of conflict and the strategic behaviour of its parties is crucial for the design of effective conflict resolution strategies. In a recent working paper, Gawende, Kapur, and Satyanath (2012) find that a decrease in the "greenness" of vegetation, which they instrument by rainfall shocks and interpret as a proxy for rural incomes, increases Naxalite violence.[7] Their results suggest that there is a negative relationship between Naxalite violence and labour income. However, the sign of this empirical relationship could be context-specific and it could stem from a large set of mechanisms. In an attempt to shed more light on the rebels' targeting strategies and to reconcile the conflicting findings in the broader conflict literature, this paper tests a more qualified hypothesis. I argue that the relationship between income shocks and Naxalite violence depends both on the targets of violence and the nature of the Naxalites' tax base. This paper is also the first contribution to focus on the drivers of targeted Naxalite violence against civilians.

include the degree of public order and the strenght of opposition groups, but the role of economic conditions is not explored in their analysis. Based on cross-sectional evidence from Sierra Leone, Humphreys and Weinstein (2006) argue that rebels who were driven by material incentives were more likely to abuse civilians in comparison to units that shared common goals and had a strong command structure. The role of mineral resources is developed in more detail by Weinstein (2005), who argues that mineral resource wealth leads to opportunistic rebellions. Azam and Hoeffler (2002) highlight that violence against civilians could also be motivated by military objectives, providing cross-country evidence. Further empirical work on violence against civilians includes Eck and Hultman (2007), and Restrepo and Spagat (2004).

[5]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.

[6]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; 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.

[7]These authors rely on a self-collected dataset that is based on both the local and the English speaking press. This data set is limited to four states and it ends in 2008, whereas my data set covers 8 states and ends in 2010 (covering six years after the merger of the main Maoist groups in 2004). The results of my paper hold in the subsample starting in 2007 (table 11), for which Gawende et al. indicate that their data match the SATP data very closely.

## 2 Theoretical framework

In this section, I present a simple, reduced form model that links labour productivity shocks to the strategic deployment of rebels against civilian or government targets. The main purpose of this model is to structure the subsequent empirical analysis. The framework combines key elements from four influential models in the conflict literature. It includes (1) a rebel group budget constraint (Dal Bó and Dal Bó, 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).

First, the model describes the market for rebels. 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.[8] 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. $\theta$ denotes labour productivity in a linear production function, 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 income 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 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:

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

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

$$F = pL + p\frac{R}{\theta} \tag{2}$$

The second market considered by the theoretical framework is the market for informants.

[8]This first part of my framework corresponds to a simplified version of the appropriation model proposed by Dal Bó and Dal Bó (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.

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.[9] 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.[10] There are three main justifications for this important assumption. First, the assumption could describe a reduced form relationship whereby citizens are more desparate 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.[11] These channels could reinforce each other: the threat of retaliation may 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 $\tau F$ as its first argument. $\tau$ 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 $\tau F$ and $\theta$. The returns to providing information to the government can now be described as follows:

$$i[X - C(\tau F, \theta(1-p))] \tag{3}$$

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:[12]

$$i^* = 1 \Leftrightarrow X > C(\tau F, \theta(1-p))$$

[9] 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 $\theta$. 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.

[10] 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 $\theta$).

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

[12] In principle, the returns to becoming an informant should enter the labour market condition in equation 1. The online appendix provides a justification for this omission.

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.[13] 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:

$$W(\tau) = (1 - i^*(\tau F))(1 - \tau)F \tag{4}$$

The timing of the game is as follows:

1. Production and appropriation take place according to equation 1.

2. The rebel group chooses $\tau F$.

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 $\tau$ in anticipation of the informers' reaction. It can be seen immediately from the discontinuous objective function that the rebel group optimally chooses $\tau$ such that the returns to becoming an informant (expression 3) equal zero.

**Proposition 1:** In the Subgame Perfect Equilibrium, the rebel group sets $\tau^*$ 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 ($\frac{\partial (1-\tau^*)F}{\partial \theta} > 0$).

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

**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. 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. These predictions are tested in the context of India's Naxalite conflict.[14]

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.[15] 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.

# 3 Background

This section offers a brief history of the Naxalite conflict. In a second subsection, I put forward arguments for why India's Naxalite conflict provides an interesting testing ground for the hypotheses that were derived from the theoretical framework.

## 3.1 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 resulting movement gained the support from key members of the Communist Party of India (Marxist), which did not prevent the CPI(Marxist) from brutally repressing the peasant revolt in Naxalbari. The sympathisers of the uprising formed the All India Coordination Committee of

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

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

Communist Revolutionaries, which promoted the "Allegiance to the armed struggle and non-participation in elections". Until today, these elements remain the corner stones 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 (Kujur, 2009). The declared goal of the present CPI (Maoist) is to overthrow the Indian state through armed struggle and to establish a liberated zone in the centre of India.[16] In 2006, the Naxalite movement was famously described by the Indian Prime Minister Manmohan Singh as "the single biggest internal security challenge ever faced by our country".[17] The continuing popularity and strength of the Naxalite movement is perceived to stem from chronic underdevelopment in the affected communities (Borooah, 2008).

## 3.2 Key characteristics

There are several reasons for why the Naxalite conflict matches the theoretical framework very closely. First of all, information is important in this conflict. 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.[18] 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 police (SATP Timelines, Chhattisgarh, 2007). Finally, state governments have also rolled out several programmes to encourage low ranking Maoists to surrender and provide information.[19] In line with the theoretical framework, 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. Reports said that a group of armed Maoists killed Babuli village head Ashok Das and his close associate [...]. "Their throat was slit by Maoists to send a message of harsh punishment to others," informed the Police." (SATP Timelines, Bihar, 2008)

A second key characteristic of the Naxalite conflict is its asymmetric nature. The theoretical framework clearly assumes asymmetric reliance on local labour productivity. This

[16] This section is based on Kujur (2008) who provides a detailed overview of the organisational history of India's Maoist organisations.

[17] Economist, 25 Feb 2010, "Ending the Red Terror".

[18] "Times of India reported that 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 Timelines, Andhra Pradesh, 2007)

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

assumption seems reasonable for a large number of intra-state conflicts, including the Naxalite insurgency. The last quote (referring to "huge amounts spent on informers") reflects the fact that the Government (both at the state and the Union level) can draw from a large and stable tax base to fund anti-Maoist operations. In contrast, the Naxalites need to tax local economic activity (and agricultural output in particular) to fund their activities:[20]

> "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, Bihar, 2005)

The asymmetric nature of the conflict also requires that different Maoists groups operate independently. At first sight, this assumption could be too strong, as the main Maoist outlet (CPI Maoist) is in theory 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."[21] Thus, the key military units operate at a lower level, in so-called the "Sub-Zonal, Zonal/District Commands".[22] These 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). 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, we should observe a negative interaction of mining resource wealth and income shocks.

A third characteristic of the Naxalite conflict is that mineral resources are an important component of the Naxalite's tax base in certain districts. On 20 May 2010, the Maharashtra State Home Minister R. R. Patil openly accused the mining industry of funding Left Wing Extremists (LWEs).[23] 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. A guest house was set ablaze. A pump house,

[20] Srivastava (2009), and Times of India, 2011, (http://timesofindia.indiatimes.com/india/Extortnomics-Maoists-raise-Rs-2000-crore-every-year/articleshow/7498493.cms).

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

[22] "Resolutions of the 2nd Meeting of Central Regional Board", February 2005. Accessed on www.satp.org.

[23] SATP 2010 Timeline. See also Srivastava (2009) and The Economist (25 February 2010) for similar claims.

> control room and property worth several lakhs of rupees were damaged. 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)

In conclusion, civilian collaboration is important in this conflict, the tax bases of the government and the rebels are asymmetric, the rebels need to tax agricultural activity, but mineral resources provide variation in the structure of the rebels' tax base within this conflict. Hence, this setting offers an ideal testing ground for the hypotheses that were set out in the theoretical framework.

## 4 Data

This paper relies on violence data from the South Asia Terrorism Portal (SATP).[24] The SATP combines newspaper reports from the local and national English speaking press into daily incident summaries. These summaries typically provide the district (and sometimes village) 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.[25] 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.[26] Descriptions of the incident can be used to further identify whether civilian casulties belong to groups that collaborate with the Government of India against the Naxalites. The analysis will be restricted to those states that are confronted with significant Naxalite activity over the period under study.[27] 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).

Given that the number of casualties in a given attack varies considerably, I will present the main results for a less noisy outcome measure: the number of fatal attacks inflicted by the Maoists. One data limitation is that the number of Maoists casualties inflicted by security forces is based on (unverifiable) police sources. Of the three types of violence

[24] www.satp.org, accessed in January 2011.

[25] Security Forces regularly inflict casualties among the civilian population (e.g., Human Rights Watch, 2012). However, for political reasons, the SATP data do not systematically report such incidents. 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.

[26] The data are drawn from three sources which partially overlap: "Fatalities and Incidents of Landmine Explosion by Maoists: 2005-2010"; State Incident Timelines (2005-2010); Major Incidents. For 2005 and 2006, this data is additionally checked against daily terrorist incident reports published by the SATP (this additional check generated a limited number of changes compared to an earlier version of this paper, without altering the main results). The reliance on these different data sources further limits the risk of failing to identify incidents that involve casualties.

[27] Andhra Pradesh, Bihar, Chhattisghar, Jharkhand, Karnataka, Maharashtra, Orissa and West Bengal. All other Indian states suffered less than 5 Naxalite-related casualties during the sample period. The selected states are located on a map of India in figure 1 of the online appendix.

reported in the dataset, such security force violence against Maoists is probably the most prone to (systematic) errors. It is particularly plausible that civilian casualties inflicted by the police are categorized as "Maoists". However, none of the key results are based on this variable. With regards to civilian casualties, it is possible that news on Maoist violence does not reach newspapers if it occurs in isolated communities. However, the empirical strategy will be sufficiently flexible to account for the most plausible sources of such reporting bias. Moreover, as the theory considers "visible" violence against civilians, it is not unreasonable to focus on violence that is observed by the press. In particular, the main variable of interest (targeted attacks against collaborators) is based on casualties for whom the identity and circumstances of death are confirmed, making wrongful attribution to the Maoists less likely. The type of casualties which is probably the least prone to misreporting are government casualties inflicted by the Maoists, as these are highly visible.

**Table 1: Summary Statistics**

Panel A (district-year level)

| | Mean | Observations |
|---|---|---|
| Civilian deaths | 1.96 | 1002 |
| (inflicted by Maoists) | (12.4) | |
| Maoist deaths | 1.60 | 1002 |
| (inflicted by Security Forces) | (7.6) | |
| Security force deaths | 1.30 | 1002 |
| (inflicted by Maoists) | (7.11) | |
| Attacks on security forces | 0.35 | 1002 |
| (incidents with at least one SF death inflicted by Maoists ) | (1.38) | |
| Attacks on civilian collaborators | 0.66 | 1002 |
| (incidents with at least one collaborator death inflicted by Maoists) | (3.7) | |
| Attacks on Maoists | 0.56 | 1002 |
| (incidents with at least one collaborator death inflicted by SFs) | (2.0) | |
| Kharif season rainfall (mm) | 1053 | 1169 |
| | (639) | |
| Kharif season rainfall (mm, logarithmic) | 6.81 | 1169 |
| | (0.54) | |
| Rice production (kilo tonnes) | 294,494 | 1026 |
| | (283,351) | |

Notes: See panel B.

| Panel B (district level) | | |
|---|---|---|
| Mineral wealth dummy | 0.25 | 167 |
| | (0.44) | |
| Mineral value (Million Rs/Lakh of the Population) | 120 | 167 |
| | (456) | |
| Log(Mineral value +1) | 4.62 | 42 |
| (conditional on positive production value) | (2.13) | |
| Population density (pop/km$^2$) | 419 | 167 |
| | (381) | |
| Scheduled tribe population (fraction of population) | 0.14 | 167 |
| | (0.17) | |
| Forest area (fraction of district area) | 0.20 | 164 |
| | (0.19) | |
| Scheduled caste population (fraction of population) | 0.15 | 167 |
| | (0.07) | |
| Literate population (percentage) | 62 | 167 |
| | (13) | |

Notes: See text for a detailed data description. Table A includes observations for 167 (merged) districts for 2005-10. Violence data are from the South Asia Terrorism Portal. Rainfall data are from the Indian Meteorological Institute for 2004-10, rice output data cover 2004-10 (but are incomplete for 2010). Table B includes mineral data for bauxite, iron and coal. Physical output data are based on various government publications between 2003 and 2005-2006, as described in the text. Output is evaluated at 2004-2005 prices. Forest cover data are from Government publications. Population data are from the 2001 census.

The theoretical framework focused on targeted violence against civilian collaborators. Table 2 confirms the importance of this type of violence. The table provides a break-down of civilian casualties by suspected motive of the killing, based on the descriptions in the SATP Timeline. For approximately 30% of casualties, a motive is not explicitly referred to.[28] Focusing on casualties for whom a motive is recorded, a large majority is referred to as (suspected) collaborators. Police informers (27%), members of mainstream political parties that oppose the Naxalites (28%), surrendered Naxalites (2%), and members of vigilante groups (10%) account for a total of 66% 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”. These are incidents in which the civilians were not the intended target of the attack. In line with the theoretical mechanism, the main focus of the paper will be on attacks on civilian collaborators.

[28] The break-down of casualty numbers is based on my own 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.

**Table 2: Motives for violence against civilians**

| | Civilian Casualties by Motive | | |
|---|---|---|---|
| Motive | Number | Percent | Percent (excluding unspecified) |
| *Collaboration* | | | |
| Suspected police informers | 452 | 22.11 | 26.68 |
| Surrendered Maoists | 29 | 1.43 | 1.71 |
| Members of political parties/ political activity | 470 | 22.99 | 27.74 |
| Members of vigilante groups | 175 | 8.56 | 10.33 |
| *(Collaboration total)* | 937 | 49.27 | 66.46 |
| *Other* | | | |
| Untargeted | 366 | 19.16 | 24.03 |
| Failure to pay levy | 35 | 1.71 | 2.07 |
| Punishment for crimes | 30 | 1.47 | 1.77 |
| Other motives | 96 | 4.70 | 5.67 |
| Unspectified | 350 | 17.12 | - |
| *Total* | 2,044 | 100 | 100 |

Notes: Civilian Casualties, covering 2005-2010. Based on author's coding of SATP incidents, as described in footnote 32.

Data on mineral output are obtained from the ministry of Labour and Employment.[29] I focus on three minerals which are linked to Maoist activity in the SATP incident lists: iron, bauxite and coal. For iron and bauxite, I rely on production data from 2005-2006. For coal, production data from 2003 are used. The constructed mineral output measure does not vary over time in order to mitigate concerns about the endogeneity of mining activity to the observed violence. To further reduce endogeneity, the mineral output is evaluated at India-wide prices for 2004-2005.[30] Naxalite extortion is often linked to illegal mining activity, which could depress the official output data in affected districts. These concerns

[29] These data are available from www.indiastat.com.

[30] Prices per tonne were calculated from the value of Indian mineral production, as reported in: Ministry of Mines, 2010, "Annual Report 2009-2010", Annexure 3.1; Ministry of Mines, 2009, "Annual Report 2008-2009", Annexure 3.1. Prices are deflated using the CPI (http://india.gov.in/outerwin.php?id=http://eaindustry.nic.in/).

are addressed by reporting key results for mineral production dummies (which should not capture any endogenous output responses on the intensive margin) and for an measures of mineral production from alternative sources.[31]

Rainfall data were collected from the Indian Meteorological Department (IMD), for the years 2004-2010. 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 crop growing season, while rainfall outside of this season could have more ambiguous effects on agricultural productivity. Monsoon rice (Kharif rice) accounts for the bulk of the rice production in the region under study (Prasad, 2006). To deal with missing rainfall data in the Kharif months, I will merge districts as described below.

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 Fertilizer Association of India.[32] These production data correspond to fiscal years (e.g. 1 April 2004- 1 March 2005) and are assigned to the earliest calendar year (in this example 2004). This approach creates the maximum overlap with the fiscal year and it ensures that the main harvesting season during any given 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 population, the size of the scheduled caste population and literacy. Furthermore, I collect forest cover and area data from the Ministry of Environment and Forest.[33]

As rainfall information is missing for several districts (even for monsoon months) and as certain districts were split over the 2001-2010 period, I merge districts to create a balanced panel of violence outcomes and explanatory variables. 207 districts are merged into 167 districts based on four criteria. First, 2001 census districts that were split during the 2001-2010 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).[34] Third, the largest urban districts (Bangalore, Kolkota and Mumbai) are dropped from the analysis. Fourth, for a small number of districts, rainfall is used of a district in a neighbouring state.[35] The resulting data set contains a

[31]This alternative measure is based on the US geological survey, which restricts itself to major producers.

[32]http://dacnet.nic.in/eands/AERC.htm, accessed in November 2012. 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 on November 2012, for Jhakhand (2007-2009) and Bihar (2008-2009).

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

[34]The mergers on the basis of the first two criteria are reported in the online appendix.

[35]This is the case for: Gumla Jharkhand (Jashpur, Chhattisgarh); Kishanganj Bihar (West Dinajpur,

balanced panel of 167 (merged) districts. I confirmed that the main results go through in the unmerged data set.[36]

Table 1 provides summary statistics for key variables. In the online appendix, maps are provided for the districts that see at least 1 casualty related to the Naxalite conflict (figure 2). The empirical strategy will focus on these districts. Maps are also presented for the number of civilian casualties over the 2005-2010 period (figure 3), the number of security forces casualties over the same period (figure 4), and the logarithm of the mining output value (figure 5).

# 5 Empirical strategy

## 5.1 The relevance of rainfall for subsistence agriculture

This paper employs rainfall shocks 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.[37] To further confirm the validity of interpreting rainfall shocks as productivity/income shocks, I first estimate a rice production function for the districts that were affected by Naxalite violence:

$$Log(Rice_{ist}) = \beta_1 lograin_{ist} + \mu_{is} + \theta_{st} + \phi_t * M_{is} + \varepsilon_{ist} \quad (5)$$

In this equation, $\beta_1$ captures the elasticity of rice production with respect to contemporaneous rainfall. $\mu_{is}$ is a district fixed effect. $\theta_{st}$ and $\phi_{Mt}$ 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.

The relevance of rice production data deserves some justification. The rice output measure was chosen because of its consistent availabity at the district level, and because rice is 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.[38]. Marginal farmers in these states often typically on rain-fed rice production, and even the success of irrigation usually depends on sufficient rainfall during the monsoon (Bameti, 2007).

West-Bengal); Pakaur Jharkhand (Maldah, West-Bengal). To avoid merging districts across state borders, these observations are treated independently.

[36]Results available on request.

[37]See Burgess et al. (2011) for one example. Cole et al. (2011) estimate a crop yield production function using historical Kharif season rainfall data and a wider set of districts and crops. In another contribution that relies on the income effects of poor rainfall, Bholken and Sergenti (2010) explain Hindu-Muslim violence by instrumenting income growth with rainfall growth at the state level. Sekhri and Storeygard (2010) rely on the relationship between rainfall and income at the district level in their study of climate shocks and violence against women.

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

While relying on rice production data has clear limitations, it is worth pointing out that *any* agricultural income measure at the district level is an imperfect proxy for the incomes of the rural communities affected by the conflict. Annual household surveys are not representative at the district level, and their respondents are unlikely to live in the conflict zones. Qualitative sources confirm that the affected communities rely more heavily on rain-fed subsistence agriculture than on average.[39] 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 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.

Therefore, if $\beta_1$ is estimated to be positive and significant in equation 5, this lends credibility to my interpretation of the reduced form effects of rainfall as agricultural productivity 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.[40]

## 5.2 Explaining violence

The main specification explains the number of attacks in different categories. To account for the fact that the number of casualties is a count variable, I rely on a fixed effects Poisson Quasi-Maximum Likelihood model with robust standard errors at the district level.[41] The estimated model will be based on the following specification:

$$E(C_{ist}) = \mu_{is} exp(\beta_1 lograin_{is,t-1} + \beta_2 lograin_{is,t-1} * M_{is} + \beta_3 lograin_{is,t-1} * Z_{is}$$
$$+\phi_t * M_{is} + \nu_{st}) \tag{6}$$

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 $\beta_1$ represents the elasticity of the number of casualties in district $i$ and year $t$ with respect to district rainfall 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 ($\mu_{is}$) 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

[39] Banik et al. (2004), Kennedy and King (2009), Planning Commission (2008).

[40] As a robustness check, the IV results in a linear model are provided in the appendix.

[41] See Hausman et al. (1984) and Wooldridge (2002) for an introduction to this model, and see Burgess et al. (2011b) for a recent application.

the variation in districts that do not see any casualties and these districts do not contribute towards the estimation of $\beta_1$.

The state-year effects $\nu_{st}$ 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), $\nu_{st}$ accounts for a wide 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 6 includes the first lag of the logarithm of rainfall (as this is the main variable of interest), although all reported regressions will also include the contemporaneous rainfall variables as controls.[42] 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 limited in the "Red Corridor", mainly because of underinvestment in irrigation facilities (Joshi et al., 2002). As a result, Rabi production has only limited capacity to mitigate shocks to Kharif production in this region. 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 is likely to depress both income and agricultural productivity during the next calendar year, possibly right until the next Kharif harvest.[43] 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 driven by 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 a mineral resource wealth variable to test the hypothesis that the marginal impact of rainfall shocks is decreasing in the availability of resources. The inclusion of mineral wealth-year effects guarantees that this regression is not just picking up other effects that stem from the presence of minerals and that change

[42] I include rainfall levels to account for the transitory nature of rainfall shocks, as suggested by Ciccone (2012).

[43] The impact on consumption could be even more persistent: Jharkhand's rural population faces a "hungry season" from June to October (PACS, 2009).

over time (including changes to the past, current, and anticipated value of mineral resources or changes in the government's efforts to protect mines). Two main measures of mineral wealth will be used in the analysis: a dummy measure and a continuous variable, $log(1 + mineralvalue)$.

A key endogeneity concern in equation 6 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 $\beta_2$ 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 and population density.

# 6 Results

## 6.1 Main findings

The first column in Table 3 confirms that rainfall at the district level is positively 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 (cf. section 1.4), 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.

**Table 3: Baseline results**

| | Log (Rice$_t$) | Attacks on Security Forces | | Attacks on Civilian Collaborators | | Attacks on Maoists | |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| $Log(rainfall_t)$ | 0.28** | 0.03 | 0.11 | -0.54 | -0.75* | 0.13 | 0.02 |
| | (0.13) | (0.35) | (0.37) | (0.38) | (0.40) | (0.46) | (0.45) |
| $Log(rainfall_t)$ * Log(Mineral value) | 0.01 | 0.01 | -0.03 | -0.01 | 0.05 | -0.11 | -0.03 |
| | (0.05) | (0.07) | (0.09) | (0.10) | (0.08) | (0.13) | (0.13) |
| $Log(rainfall_{t-1})$ | 0.02 | 1.11*** | 1.31*** | -0.98*** | -1.18*** | 0.27 | -0.10 |
| | (0.13) | (0.36) | (0.42) | (0.36) | (0.37) | (0.46) | (0.48) |
| $Log(rainfall_{t-1})$ * Log(Mineral value) | 0.00 | -0.58*** | -0.53*** | -0.13 | -0.15 | -0.22 | -0.24* |
| | (0.04) | (0.12) | (0.14) | (0.11) | (0.11) | (0.14) | (0.14) |
| $Log(rainfall_{t-1})$ * ST share | | | 1.15 | | -0.80 | | 2.05 |
| | | | (2.63) | | (1.84) | | (3.01) |
| $Log(rainfall_{t-1})$ * SC share | | | 2.11 | | -6.19 | | -1.16 |
| | | | (5.08) | | (4.14) | | (8.38) |
| $Log(rainfall_{t-1})$ * Literacy share | | | 0.0233 | | -0.0477** | | -0.0541** |
| | | | (0.0269) | | (0.0197) | | (0.0260) |
| $Log(rainfall_{t-1})$ * Forest share | | | -2.6028 | | 2.9149* | | 1.1072 |
| | | | (2.7998) | | (1.5926) | | (2.7690) |
| $Log(rainfall_{t-1})$ * Population density | | | -0.0009 | | 0.0021* | | 0.0015 |
| | | | (0.0015) | | (0.0012) | | (0.0011) |
| Observations | 415 | 354 | 348 | 378 | 61 | 366 | 366 |
| Districts | 80 | 59 | 58 | 63 | 63 | 61 | 61 |
| Estimation | OLS | Poisson | | | | | |

Notes: District-year level observations, covering 2005-2010 (2004-2010 in column 1). Column 1 includes the union of the districts included in column (2)-(7). Districts were merged as described in the text. Log(Mineral value) is calculated as Log(Mineral value+1). 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. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1.

Strikingly, the impact of rainfall on the number of fatal attacks against security forces is positive in the absence of mining resources, but becomes negative as mining output increases (mining districts account for 40% of the 58 districts with at least one security force death). 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 coefficients for attacks imply that a 20% negative rainfall shock in the average *mining* district *increases* the number of deadly attacks on police forces by 31%.[44] In *non-mining* districts, a negative shock of the same magnitude *decreases* the number of deadly Naxalite attacks by 22%.

The relationship beteween rainfall and the number of attacks on civilian collaborators is negative. The additional impact of mining actictivity is negative but insignificant. The coefficient of (-0.98) on civilian casualties in Table 3 indicates that, for a 20% decrease in log(rainfall),[45] the number of attacks on collaborators increases by 18% (in non-mining districts).[46] The contemporaneous effect gains significance at the 10% level, but is much smaller than the lagged effect. Nevertheless, the punishment of collaborators could be more "forward-looking" and respond more quickly to realised rainfall shocks than violence against security forces.

For Maoist deaths, the main coefficients fail to gain significance in most specifications. Out of the three violence measures, this measure could be the most prone to errors. Nevertheless, 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. Moreover, the signs are consistent with an interpretation in which the Maoists strengthen their position in response to negative productivity shocks, but they suffer an increasing number of casualties as a result of increasing the number of attacks they stage against the government.

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

To highlight the importance of accounting for the differential impact of rainfall shocks, table 4 shows the relationship between rainfall levels and violence, for the three types of violence that are of interest for this study. There is no relationship between rainfall and violence directed against the government's security forces. This result is consistent with the theoretical framework and the earlier results, which showed that the sign of this relationship depends on how the local mineral resource wealth.

[44] $(1.56 = (4.62 * 0.58 - 1.11))$. A Wald test confirms that the hypothesis of this elestacity being equal to zero can be rejected at the 5% level. At the sample mean of mining districts that have at least one police force casualty (6.3 attacks), this elasticity would imply that a 20% negative rainfall shock leads to 1.7 additional deadly attacks on security forces.

[45] A 20% shock is approximately the standard deviation of the residuals from a regression of log(rainfall) district fixed effects, state-year fixed effects and mineral-year-fixed effects. Relying on the unadjusted sample variation in log(rainfall), which is approximately 50%, the estimated impact is even larger.

[46] The first column suggests that the corresponding decrease in rice production is 6.6%. The 18% increase corresponds to 0.3 additional fatal attacks on civilian collaborators at the sample mean of 1.8 (conditional on the district having any such incidents).

**Table 4: Uninteracted rainfall effects**

| | Attacks on Security Forces | Attacks on Civilian Collaborators | Attacks on Maoists |
|---|---|---|---|
| | (1) | (2) | (3) |
| $Log(rainfall_t)$ | 0.12 | -0.59* | -0.25 |
| | (0.26) | (0.32) | (0.38) |
| $Log(rainfall_{t-1})$ | 0.07 | -1.26*** | -0.23 |
| | (0.37) | (0.28) | (0.36) |
| Observations | 354 | 378 | 366 |
| Districts | 59 | 63 | 61 |
| Estimation | | Poisson | |

Notes: District-year level observations, covering 2005-2010 (2004-2010 in column 1). Column 1 includes the union of the districts included in column (2)-(7). Districts were merged as described in the text. Log(Mineral value) is calculated as Log(Mineral value+1). 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. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1.

Table 5 repeats the main results using the number of casualties (instead of the number of fatal attacks) as the outcome measure. The coefficients are less precisely estimated in these specifications, which could reflect the fact that the "success" of Naxalite attacks in terms of the number of casualties varies substantially. As a result, the uninteracted lagged rainfall variable loses its significance for the number of security force deaths (column 1). Nevertheless, the interaction term of rainfall and mineral resource wealth remains negative and significant for this violence outcome. It is also interesting to note that the results for civilian casualties mimic those of collaboration casualties, implicitly highlighting the importance of victims who belong to collaborator groups.

The online appendix investigates the sensitivity of the main results to the choice of the econometric model in more detail. Table 9 (online appendix) further confirms that the key results go through in an OLS estimation in which the dependent variable is subject to a $log(1+x)$ transformation.[47] Section 6.3 discusses a number of important robustness checks.

[47] Relying on the OLS specification, I confirm that the main results are robust to spatial clustering of the standard errors (reported in square brackets). Results of a negative binomial regression are very close to the Poisson results reported here.

**Table 5: Baseline results for death variables**

| | Security Force Casualties | Civilian Casualties | Collaboration Casualties | Maoist Casualties |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $Log(rainfall_t)$ | -0.65 | 0.04 | 0.21 | 0.40 |
| | (0.54) | (0.44) | (0.51) | (0.61) |
| $Log(rainfall_t)$ * Log(Mineral value) | 0.08 | -0.10 | -0.19 | -0.21 |
| | (0.16) | (0.09) | (0.12) | (0.16) |
| $Log(rainfall_t)$ | 0.44 | -0.68** | -0.97* | 0.61 |
| | (0.62) | (0.30) | (0.52) | (0.63) |
| $Log(rainfall_t)$ * Log(Mineral value) | -0.41** | -0.09 | -0.03 | -0.26 |
| | (0.19) | (0.09) | (0.13) | (0.18) |
| Observations | 354 | 438 | 378 | 366 |
| Districts | 59 | 73 | 63 | 61 |
| Estimation | Poisson | | | |

Notes: District-year level observations, covering 2005-2010. Districts are merged as described in the text. All regressions include district fixed effects, state-year fixed effects and (log) mineral-year effects. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1.

## 6.2 Interpretation

The main results of table 3 are consistent with the idea that the rebels' tax base shapes the relationship between labour income shocks and conflict. If the rebels' tax base is sensitive to the rainfall shocks, the rebels may not be able to exploit a negative shock to increase recruitment. Their strategy to increase the intimidation of civilians forces them to shift personnel from attacks against the government to the monitoring of civilians.

The main results also indicate that lower rainfall results in more violence directed against civilian collaborators, regardless of the presence of mineral resources. This finding is consistent with the theoretical model developed in Section 2. Negative economic shocks could boost the willingness of civilians to collaborate with the government. Hence, the rebel group may find it optimal to increase its punishments of civilian collaborators or defectors in order to discourage civilians to pass on information to the government. By killing civilians in targeted attacks, the Maoists could show that they have invested in sufficient retaliation capacity to locate and punish informers. In line with this interpretation, the communication of the Maoists in the SATP Timelines underlines the importance that the Maoists attach to motivating civilian deaths. To justify attacks on civilians, the rebels often leave notes on the bodies of victims, they hold public trials, or they even contact the press directly. Moreover, they often rely on brutal execution methods to add further visibility to their attacks against civilians. The following quote illustrates how droughts affect the alliances between Naxalites and the civilian population:

> "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. Special Inspector General of Police [...] Gupta told The Indian Express yesterday that clusters of villages, gripped by a severe drought, had chosen to take on Naxalites rather than let go of an option for alternate employment. Gupta, 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)

**Table 6: Types of violence against Civilians**

| | Civilian Casualties | Civilian Casualties (Collaboration) | Civilian Casualties (Untargeted) | Reports of village meetings and people courts |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $Log(rainfall_{t-1})$ | -0.68** | -0.97* | 0.97 | -10.57* |
| | (0.30) | (0.52) | (0.90) | (5.65) |
| $Log(rainfall_{t-1})$ * Log(Mineral value) | -0.09 | -0.03 | -1.34*** | 0.92 |
| | (0.09) | (0.13) | (0.39) | (1.17) |
| Contemporaneous rainfall controls | Yes | Yes | Yes | Yes |
| Observations | 438 | 366 | 204 | 80 |
| Districts | 73 | 61 | 34 | 20 |
| Estimation | Poisson | | | |

Notes: District-year level observations, covering 2005-2010 (2007-2010 in column 4). Districts were merged as described in the text. See text and 2 for the coding of civilian casualties in columns (1)-(4). With the exception of Log(Mineral value), the interaction variables are demeaned. All regressions include district fixed effects, state-year fixed effects and (log) mineral-year effects. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1.

In Table 6, the main results are shown separately for killings of civilian collaborators 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 exactly 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.

In order to explore the theoretical mechanism further, I construct a variable that counts the number of incident reports that mention "village meetings" or "people's courts" organised by the Maoists.[48] This variable can be interpreted as a crude measure of the level of control the Naxalites exercise over the local population. In line with the theoretical framework, this variable follows the same pattern as the violence directed against civilian collaborators: rainfall and the degree of control that the rebels exert over civilians appear to be inversely related. This patterns is consistent with a strategic reallocation of rebel effort towards controlling civilians, depending on economic conditions and the corresponing appeal of collaboration.

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,[49] 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.

## 6.3 Alternative explanations and robustness checks

### 6.3.1 Violent appropriation

Table 2 and the descriptive evidence discussed above suggest that retaliation against collaborators is a key motive for violence against civilians. However, the results could still be consistent with appropriation theories (Dal Bó and Dal Bó, 2011; Dube and Vargas, 2011), 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.[50] However, if the rebels strategically choose the extent to which they loot civilians, the presence of natural resources should mitigate the impact of negative produc-

[48] The SATP Timelines do not systematically report these incidents before 2007.

[49] "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)

[50] 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. This interpretation seems at odds with the fact that many victims of Maoist violence are in fact tribals. Miguel (2005) finds that extreme rainfall shocks lead to increased witch killings in Tanzania. While the author argues that income shocks are at the heart of the underlying mechanism, it is unclear whether these murders are driven by appropriation.

tivity shocks on violence against civilians. I find no evidence of such a mitigation effect. In an alternative framework, the population could be tempted to resist the payment of levies in times of economic hardship. Still, this mechanism would interpretationally be very close to the current framework: when rainfall is poor, the rebels are forced to strategically reallocate fighters in response to increased resistance of the local population. In a zero sum conflict environment, such resistance is tantamount to collaboration. The major interpretational difference with the current framework is that the appropriation channel does not require any direct involvement of the government. The reason why I favour the collaboration interpretation in this paper is that the SATP timelines provide a wealth of descriptive evidence on the importance of visible, lethal violence against informers (as discussed in section 6.2), and because it is clear that the government tries to encourage collaboration. Moreover, the results on "village meetings and people's courts" (6) are more consistent with strategic monitoring and intimidation than with violent appropriation. 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.

#### 6.3.2 Incapacitation and precision of attacks

Berman *et al.* (2011a) find that higher unemployment inhibits insurgent attacks against security forces.[51] These authors hypothesise that high unemployment makes civilians more willing to share information with counterinsurgency forces. They also argue that the resulting incapacitation effect might force rebels to switch towards less precise attacks that inflict more "collateral damage". In my analysis, it is impossible to distinguish incapacitation from a strategic shift of fighters away from attacking the government. Only in non-mining districts, I find a positive impact of rainfall on the number of deadly attacks. Also, there is no significant impact on the number of Maoist casualties. The theoretical framework offers an explanation of why the incapacitation effect could be limited: the rebels may effectively prevent collaboration by increasing violence against civilians. Furthermore, the empirical findings are consistent with the hypothesis that any incapacitation effect could be outweighed by the opportunity cost channel if the rebel group has access to external sources of funding. In principle, a negative relationship between rainfall and civilian casualties could also be the result of a change in violence technology and decreased attack precision. However, such a collateral damage interpretation cannot explain the impact of rainfall on *targeted* civilian casualties. Moreover, the results on *untargeted* civilian casualties in Table 6 show that colleteral victims follow the same pattern as attacks against the government. Hence,

[51] My paper complements the findings of this closely related study in three ways. First, it overcomes reverse causality concerns by relying on an exogenous source of variation in labour income (i.e. rainfall). Second, it presents evidence on retaliatory violence which further underlines the crucial role of police informers. Third, my paper also suggests how the conflicting findings in this strand of literature can be reconciled by taking the structure of the rebels' tax base into account.

shocks to attacks against the government does not seem to affect the precision of these attacks. In contrast, incapacitation would imply that the precision of attacks would decrease as the number of attacks decreases (as in Berman *et al.*, 2011a).

**Table 7: Robustness checks: alternative interactions with rainfall**

| | Attacks on Security Forces | | | | Attacks on collaborators | | |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| $Log(rainfall_{t-1})$ | 1.04** | 0.44 | 1.12*** | 1.38*** | -0.95** | -1.19*** | -1.07*** |
| | (0.46) | (0.38) | (0.35) | (0.39) | (0.41) | (0.27) | (0.38) |
| $Log(rainfall_{t-1})$ *Log(Mineral value) | -0.57*** | | -0.52*** | -2.39*** | -0.14 | | -0.18* |
| | (0.12) | | (0.16) | (0.61) | (0.11) | | (0.10) |
| $Log(rainfall_{t-1})$ *Log(Mineral value)*ST share | | | -0.47 | | | | 0.56 |
| | | | (0.45) | | | | (0.38) |
| | | | 1.50 | | | | -0.67 |
| $Log(rainfall_{t-1})$ *ST Share | | | (1.82) | | | | (1.54) |
| $Log(rainfall_{t-1})$ *Flood prone | -0.07 | | | | 0.14 | | |
| | (0.35) | | | | (0.66) | | |
| $Log(rainfall_{t-1})$ *Mineral USGS | | -2.30*** | | | | -0.24 | |
| | | (0.78) | | | | (0.57) | |
| $Log(rainfall_{t-1})$ *Coal dummy | | -1.67*** | | | | -0.71 | |
| | | (0.63) | | | | (0.54) | |
| $Log(rainfall_{t-1})$ *(05 attacks on Maoists) | | | | -0.42*** | | | |
| | | | | (0.13) | | | |
| Contemporanous rainfall controls | Yes | Yes$^{\dagger}$ | Yes | Yes | Yes | Yes$^{\dagger}$ | Yes |
| Observations | 378 | 378 | 378 | | 354 | 354 | 354 |
| Districts | 63 | 63 | 63 | | 59 | 59 | 59 |
| Estimation | Poisson | | | | | | |

Notes: District-year level observations observations, covering 2005-2010. Districts were merged as described in the text. Interaction variables are demeaned (except for mineral wealth and 2005 incidents). All regressions include district fixed effects, state-year fixed effects and (log) mineral-year effects. Standard errors are clustered at the district level. ($^{\dagger}$) Contemporaneous rainfall effects in columns (2) and (6) include the interaction of rainfall$_t$ with a dummy for coal or iron/bauxite wealth. *** p<0.01, ** p<0.05, * p<0.1.

#### 6.3.3 Police activism

A third alternative explanation for the main results relies on the activities of the police forces. Mining activity may attract a greater police presence, which offers more opportunities for the rebels to respond to rainfall shocks with increased violence against police forces. This explanation seems unlikely to drive the results, as higher police activity in mining district would mainly lead to higher levels of violence against the security forces in any given year.[52] 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. Nevertheless, it remains possible that mining activity attracts types of police activity which shape the incentives for rebels to stage attacks in response to a productivity shock. Column (7) in Table 7 presents one way to account for this possibility. I measure the salience of police activity by the number of incidents in which the Maoists suffered casualties in the baseline year (2005). If my results are driven by the differential impact of rainfall in districts with higher police activity, the coefficient on the interaction term of rainfall and baseline Maoist casualties could pick up the differential effect of mineral resource wealth. However, the coefficient on the interaction of rainfall and mineral wealth retains both its magnitude and significance.

#### 6.3.4 Mining activity

In spite of the strong descriptive evidence on the importance of mines for the Maoists' income, mining activity could influence the conflict through alternative channels. The Maoists campaign against mining activity on the grounds that mines lead to pollution and the displacement of the tribal population. Rebel groups in mining regions are thought to bank on the wide-spread resentment against mining activity (Kujur, 2009), although certain authors emphasise that only a small number of communities are directly affected by displacement and pollution (Kennedy and King, 2009). The first order effect of grievances against mines should operate through average levels of violence, which are accounted for by the fixed effects. However, rebel groups could be more effective in recruiting from mining regions because of two additional reasons. First, it may be that a given rainfall shock has a larger impact on agricultural productivity of potential recruits as a result of environmental degradation or displacement. While the analysis cannot fully rule out this possibility, the estimated rice production function in Table 3 failed to pick up a differential effect of rain on agricultural output. As a second channel, grievances against mines could offer intrinsic rewards to individuals who join the Maoists. At first sight, these channels are different from the budget constraint mechanism that was presented in the theory, but the main difference could be one of interpretation. First, if the impact of rainfall shocks is more severe when mining activity is stronger, this could affect the communities who are considered for recruit-

[52] Violence against police forces is not limited to mining districts: these districts only account for 40% of the districts that see any police casualties.

ment (for instance, the tribal population) more than the tax base of the rebel group. Hence, this channel could formally be equivalent to the mechanism proposed earlier. Similarly, the grievance against mines could create an additional pull factor which makes the rebel group's budget constraint less dependent on local economic conditions. In this sense, the grievance mechanism could still be understood within my theoretical framework.

It is possible to test the importance of the interaction between the tribal population and mining activity explicitly. If the conflict between mines and rural communities mainly affects tribal groups (Kujur, 2009), one could expect the grievance effect of mines to be stronger in tribal areas. To test this hypothesis, I include a triple interaction of mineral wealth, the share of the tribal population, and rainfall in the baseline model. The coefficient on the triple interaction term should be negative and significant (for fatal attacks on security forces), if the impact of mining activity mainly operates through the grievances of the tribal population. However, the coefficient on the triple interaction is insignificant (see Table 7 in appendix, columns 2 and 6).

#### 6.3.5 Accounting for floods

My analysis so far does not explicitly account for the incapacitation effect of floods. Floods could destroy output and capital used by rebel groups, which subsequently leads to a decrease in violence. Yet, this interpretation cannot fully explain the observed heterogeneity in impacts between mining and non-mining regions. In an attempt to further confirm that my findings result from the impact of rainfall shocks on the opportunity cost of conflict, I allow for the impact of rainfall to be different in flood-prone areas (table 7, columns 1 and 5).[53] The results confirm that these districts are not driving the main findings.

#### 6.3.6 Alternative mining measures

Table 8 includes a dummy measure for mining activity and confirms that the key results go through. The mineral variable employed in the main analysis was constructed using various sources. To assess if any bias was induced by using 2005-2006 production data for bauxite and iron, Table 7 (columns 3 and 6) presents results for an alternative measure of bauxite and iron mining, published by the US Geological Survey.[54] This survey does not provide district-level information on coal mining. Therefore, a dummy for coal mining activity is added in a separate interaction term. The key results go through in this alternative specification: the two coefficients are negative and significant. The fact that the results hold for *both* groups of major minerals *seperately* provides additional support of the mechanism that this paper emphasizes, which should not depend on the type of mineral.

[53] As defined by the Indian Vulnerability Atlas (2006).

[54] U.S. Geological Survey, 2007, "2005 Minerals Yearbook India", p.13.

Table 8: Robustness check: a dummy mining measure

| | Attacks on Security Forces | | Attacks on collaborators | | Attacks on Maoists | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $Log(rainfall_t)$ | -0.39 | -0.31 | -0.65 | -0.85* | 0.26 | 0.30 |
| | (0.49) | (0.50) | (0.40) | (0.45) | (0.46) | (0.44) |
| $Log(rainfall_t)$ | 0.96 | 0.75 | 0.08 | 0.28 | -0.74 | -0.58 |
| * Mineral dummy | (0.65) | (0.68) | (0.51) | (0.47) | (0.66) | (0.70) |
| $Log(rainfall_{t-1})$ | 0.69* | 0.93* | -1.22*** | -1.35*** | 0.18 | -0.18 |
| | (0.39) | (0.52) | (0.36) | (0.38) | (0.46) | (0.47) |
| $Log(rainfall_{t-1})$ | -2.14*** | -1.87** | -0.22 | -0.14 | -0.97 | -1.06 |
| * Mineral dummy | (0.68) | (0.83) | (0.47) | (0.53) | (0.77) | (0.69) |
| $Log(rainfall_{t-1})$ | | 0.10 | | -1.28 | | 3.06 |
| * ST share | | (2.91) | | (1.91) | | (2.99) |
| $Log(rainfall_{t-1})$ | | -0.23 | | -4.84 | | 1.06 |
| * SC share | | (5.19) | | (4.11) | | (8.21) |
| $Log(rainfall_{t-1})$ | | 0.01 | | -0.04* | | -0.05* |
| * Literacy share | | (0.02) | | (0.02) | | (0.02) |
| $Log(rainfall_{t-1})$ | | -3.26 | | 2.60 | | -0.51 |
| * Forest area share | | (2.74) | | (1.73) | | (2.60) |
| $Log(rainfall_{t-1})$ | | -0.00 | | 0.00 | | 0.00 |
| * Population density | | (0.00) | | (0.00) | | (0.00) |
| Observations | 354 | 354 | 378 | 378 | 366 | 366 |
| Districts | 59 | 59 | 63 | 63 | 61 | 61 |
| Estimation | Poisson | | | | | |

Notes: District-year level observations, covering 2005-2010 (2004-2010) in column 1. Column 1 includes the union of the districts included in column (2)-(7). Districts are merged as described in the text. With the exception of the mineral dummy, all interaction variables are demeaned. All regressions include district fixed effects, state-year fixed effects and mineral dummy-year fixed effects. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1.

#### 6.3.7 IV Results

**Table 9: Robustness check: IV results**

| | Log(Attacks on SF) | | Log(Attacks on Collaborators) | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $Log(rice_{t-1})$ | 0.07 | 0.94* | -0.13 | -0.68 |
| | (0.06) | (0.53) | (0.10) | (0.50) |
| $Log(rice_{t-1})$ | -0.04 | -0.43** | -0.00 | -0.21 |
| * Log(Mineral value) | (0.03) | (0.18) | (0.4) | (0.19) |
| P value for joint significance | 0.36 | 0.05** | 0.40 | 0.04** |
| Contemporanous rainfall controls | Yes | Yes | Yes | Yes |
| Observations | 354 | 354 | 378 | 378 |
| Districts | 59 | 59 | 63 | 63 |
| Kleibergen-Paap rk Wald F statistic | | 3.2 | | 8.1 |
| Estimation | OLS | LIML | OLS | LIML |

Notes: District-year level observations, covering 2005-2010. Districts were merged as described in the text. Included districts have at least one non-zero observation for the dependent variable. All regressions include district fixed effects, state-year fixed effects and (log) mineral-year effects. Standard errors (s.e.) are clustered at the district level. For (s.e.): *** p<0.01, ** p<0.05, * p<0.1.

The positive relationship between rainfall and rice output in table 3 lent credibility to my interpretation of rainfall shocks as drivers of rural incomes in Naxalite communities. Given that rice production at the district level is an imperfect proxy for the incomes of Naxalite-affected communities within each district, preference is given to the reduced form results. However, the IV results (in which rice production is instrumented by rainfall levels) are broadly consistent with the reduced form estimates. In table 9, I present the LIML results for a model that includes instrumented lagged rice production levels (as instrumented by lagged rainfall levels) and includes contemporaneous rainfall as exogenous controls. The results are qualitatively very similar to the reduced form results.[55]

[55] Compared to a model in which both contemporaneous and lagged production variables are instrumented by rainfall variables, this specification has the advantage of using the entire sample (as rice production data are not available for most states in 2010). It should be noted that there is no evidence of a delayed impact of rainfall shocks in table 3.

## Conclusion

Income shocks could have different impacts on violence depending on the resource environment and on the targets of violence. In the absence of external sources of revenue, the Naxalites may not be able to exploit a negative labour income shock to boost recruitment. However, the centrally funded government forces are not bound by this constraint. Therefore, collaboration between the government and the civilian population becomes more attractive in response to a negative labour income shock, which is expected to spark violence against civilians by the Naxalites in an attempt to deter collaboration. In contrast, the Naxalites can only exploit negative labour income shocks to increase attacks against the government if they have access to external sources of funding. Exploiting exogenous variation in rainfall in a panel of annual casualty numbers, lower rainfall was found to increase Maoist violence against civilians. Importantly, this result appeared to be driven by violence against civilian collaborators. Negative shocks were only associated with increased violence against the security forces in those districts that saw sufficiently strong mining activity. It was positively associated with attacks on security forces in the absence of mining activity.

The results of this paper shed new light on the literature that links labour income shocks to violence. In a context such as India's Naxalite conflict, where the two parties differ strongly in their reliance on local economic conditions, my results show that negative labour income shocks only boost violence against the government in those districts that provide a sufficiently strong independent tax base. Hence, the combination of the relative financial capacity of the parties involved in the conflict and the structures of the underlying tax bases could play an important role in determining the sign of the relationship between labour income shocks and conflict. Future work aims to develop an extension of the current theoretical framework to account for differing degrees of asymmetry between the rebels and the government. Such an extension could form the basis of a careful comparison of the existing empirical studies on the relationship between income shocks and violence. The results from this paper suggest that this approach has the potential of reconciling ambiguous empirical results on the relationship between labour income shocks and violence.

The findings of this paper could also have important implications for the design of conflict resolution policies and counter-insurgency strategies. A first set of policies could aim to mitigate negative income shocks, in an attempt to block rebel recruitment through the opportunity cost channel. Such policies could include targeted employment programmes, investments in agriculture, and subsidised rainfall insurance. This paper suggests that these policies may only be 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. If the policy goal is to prevent targeted attacks on civilians, mitigation policies could be effective regardless of the resource environment. However, a potential drawback of mitigation policies is that they could make it harder for the security forces to recruit informers. In line with the latter idea, a second set of counter-insurgency policies could in fact exploit negative income shocks to attract civilian collaboration with the government. By offering rewards or services that are conditional on collaboration, the government could benefit from negative income shocks to gather more information and to undermine the rebels' fighting capacity (as suggested by Berman *et al.*, 2011a). This paper qualifies the latter policy prescription in two ways. First, a collaboration strategy may be less effective in mineral-rich areas, where negative income shocks could benefit both the government (through increased collaboration) and the insurgents (through increased rebel recruitment). Second, this paper points at an important danger of collaboration strategies. My findings suggest that the rebels may use targeted violence against civilians to match the increased appeal from collaboration due to negative income shocks. In India's Naxalite conflict, various government agencies already encourage civilian collaboration through a variety of policies, including monetary rewards for information, conditional services, and recruitment into vigilante groups. However, the observed retaliatory violence reflects 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 mainly 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

### Proof of Proposition 1 and 2

From expression 3, it can easily be derived that:

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

The relationship between the total number of fighters and labour productivity is given by:

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

If $R = 0$, it follows that:

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

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

If $R > 0$,it can be seen that:

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

This effect does not depend on $R$. While changes in $R$ change both $\tau^*$ and $F$, $(\tau^* F)$ remains constant as the indifference condition does not depend on $R$. However, the impact on the number of fighters employed against the government depends on $R$:

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

Hence, 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 $\alpha_1$ of the population is non-strategic and always provides information to the government. Fraction $\alpha_2$ 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" $\alpha_2$. The collaboration of the $\alpha_2$ population is assumed to be critical. The rebel group will lose its fighting capacity if and only if the $\alpha_2$ population passes on information to the government.

In contrast to the earlier model, the population does not directly observe $\tau F$. Instead, it observes the number of non-security force killings by the rebel group among the $\alpha_1$ informers, which is a monotonically increasing function of $\tau F$, $K(\phi\tau F)$, 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 $\alpha_1$ 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.[56]

The timing of the altered game is as follows:

[56] 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 $\varphi$.

1. Nature draws:

    - The informant types in the population, with probabilities $\alpha_1$ for unconditional informers, $\alpha_2$ for opportunistic informers, and $1 - \alpha_1 - \alpha_2$ for the remaining population.

2. Production, rebel recruitment, and appropriation take place according to 1.[57]

3. $\alpha_1$ informers provide information to the government.

4. The rebel group chooses $\tau F$ and $\phi$.

5. The $\alpha_2$ population:

    - Observes the number of killings of $\alpha_1$ informers: $k= K(\phi\tau F)$
    - Decides to provide information $i \in (0, 1)$.

6. The pay-offs are realised:

    - The rebel group's pay-off: $W(\tau) = (1 - i^*)(1 - \tau)F$
    - The pay-off of the $\alpha_2$ 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 3 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

[57] In principle, the collaboration decision should enter the labour market condition derived in (1) 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 $\tau F$ 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.

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 the results in 2.

## 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 (Hyderabad), Banka (Baghalpur), Arwal (Patna), Begusarai (Khagaria), Gaya (Aurangabad), Gopalganj (Siwan), Jamui (Munger), Kaimur (Rohtas), Jahanabad (Patna), Nalanda (Patna), Nawada (Patna), Saran (Bhojpur), Sheikhpura (Munger), Sheohar (Sitamarhi), Sapaul (Saharsa), Vaishali (Patna), Bokaro (Dhanbad), Chatra (Hazaribagh), Dumka (Deoghar), Garhwa (Palamu), Godda (Deoghar), Jamtara (Deoghar), Khuti (Ranchi), Kodarma (Hazaribagh), Latehar (Palamu), Lohardaga (Ranchi), Pakaur (Maldah West-Bengal), Saraikela (Purbi Singhbhum), Simdega (Gumla), Barddhaman (Nadia), West-Midnapore (Medinipur), Bargarh (Sambalpur), Bhadrak (Jajapur), Baudh (Sonapur), Kendrapara (Jagatsinghapur), Nabarangapur (Koraput), Hingoli (Washim).

### A.3 Maps

**Figure 1: Districts Included in Data Set**

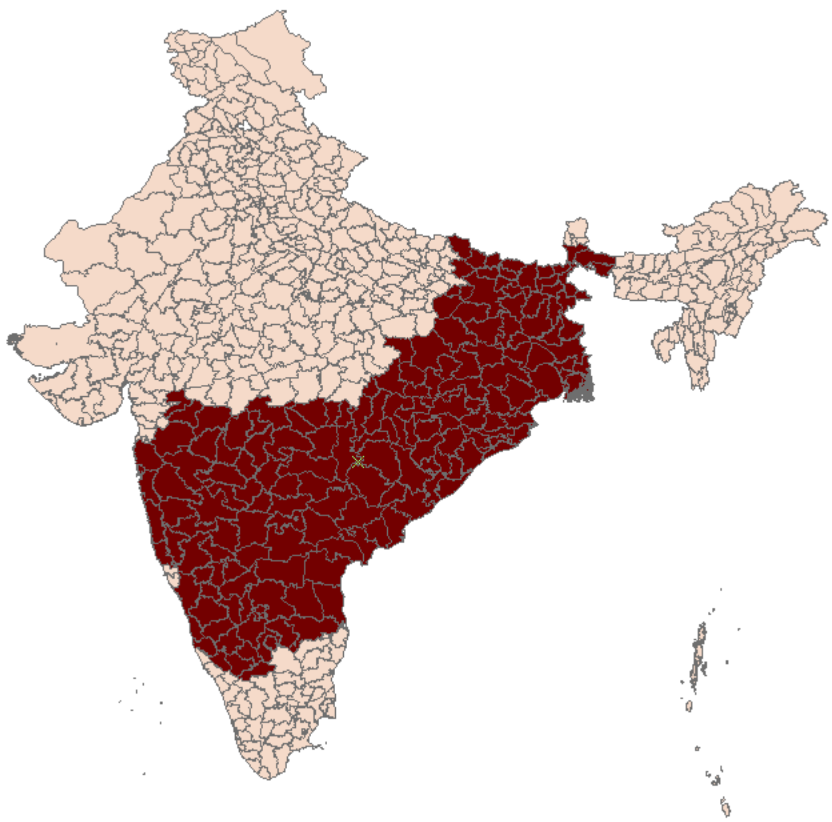
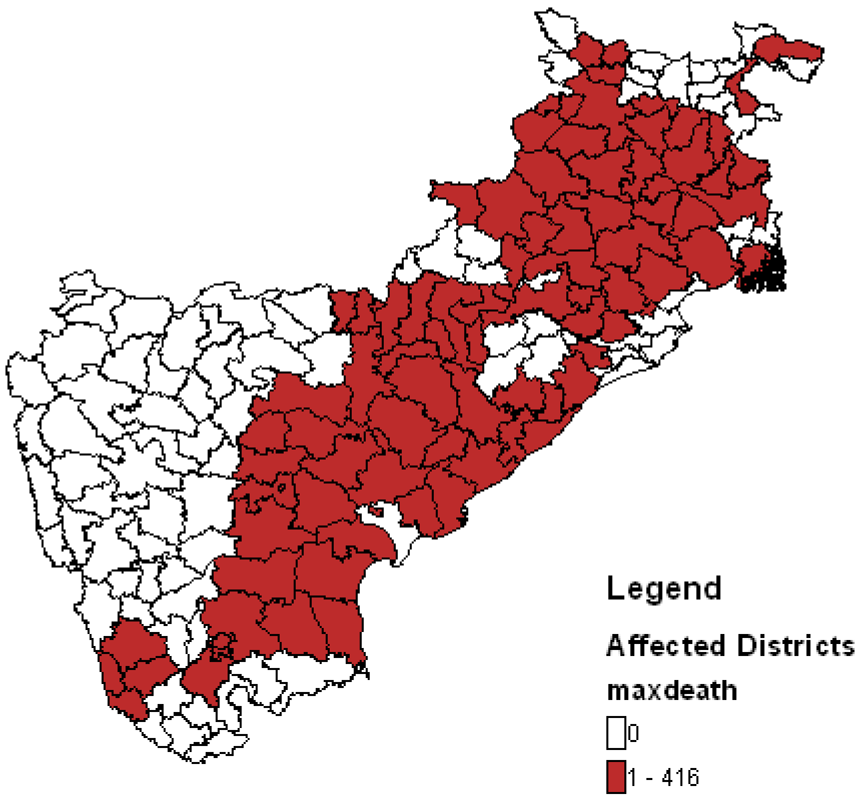
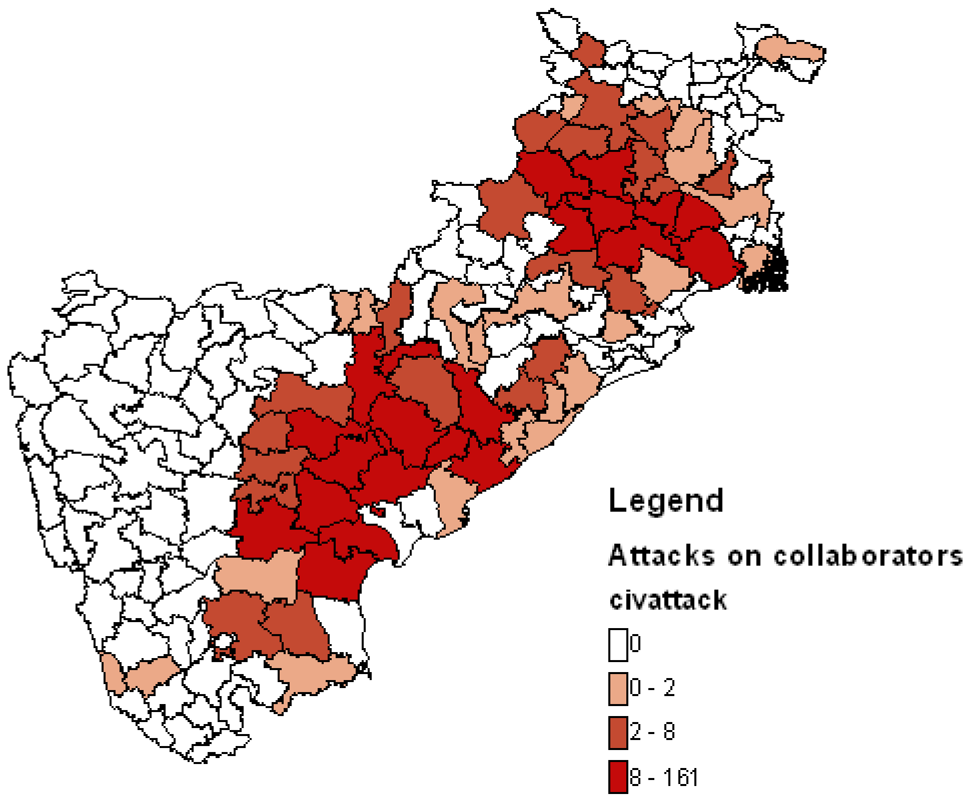


**Figure 2: Affected Districts**



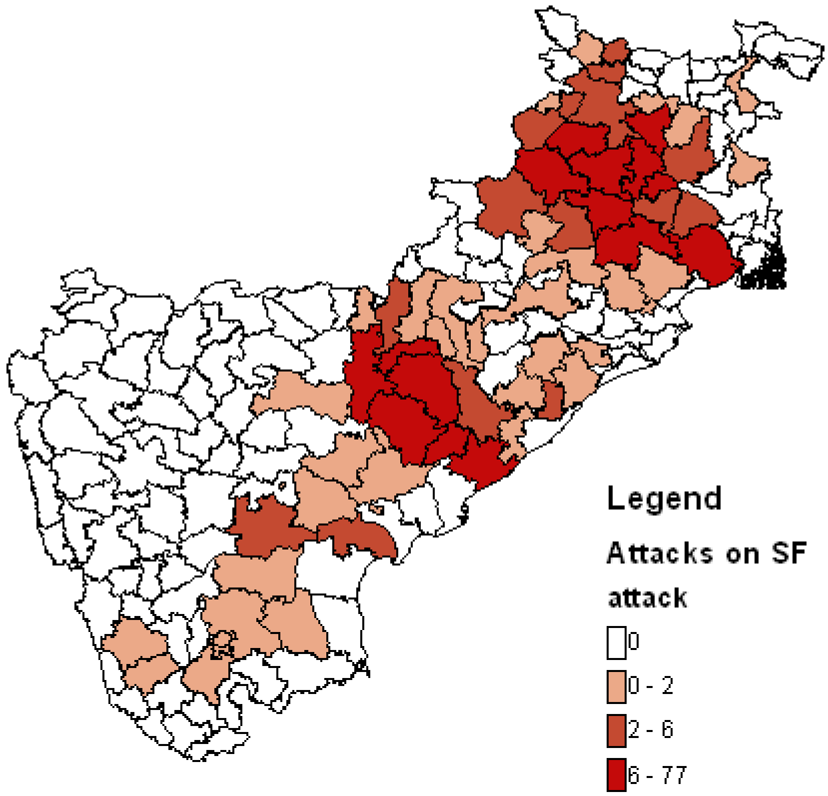

Notes: Affected (merged) districts see at least one casualty of any type between 2005 and 2010.

**Figure 3: Civilian collaborator attacks**



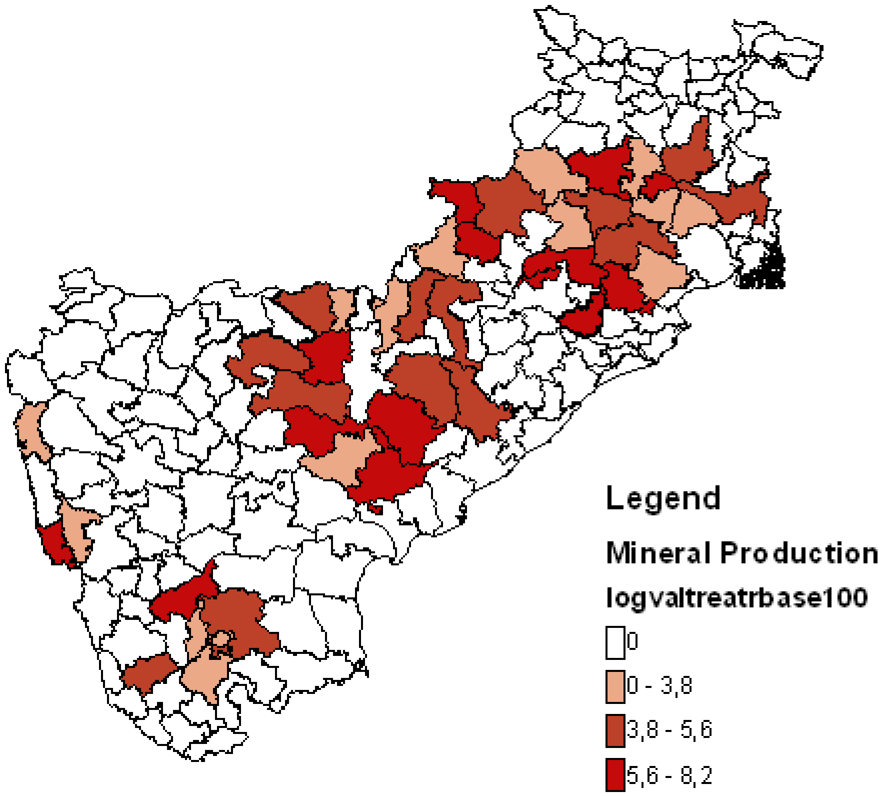

Notes: Total number of civilian casualties (per merged district) between 2005 and 2010.

**Figure 4: Attacks on SF**




Notes: Total number of security force casualties (per merged district) between 2005 and 2010.

**Figure 5: Mineral production**




Notes: Logarithm of mineral production value (plus 1), measured at baseline as described in the text.

## A.4 Alternative specifications

**Table 10: Robustness check: OLS baseline results**

| | Log(Attacks on Security Forces) | Log(Attacks on Collaborators) | Log(Attacks on Maoists) |
|---|---|---|---|
| | (1) | (2) | (3) |
| $Log(rainfall_t)$ | -0.03 | -0.13 | 0.03 |
| | (0.16) | (0.17) | (0.22) |
| | [0.17] | [0.18] | [0.23] |
| $Log(rainfall_t)$ * Log(Mineral value) | 0.03 | -0.02 | -0.03 |
| | (0.04) | (0.04) | (0.07) |
| | [0.04] | [0.04] | [0.07] |
| $Log(rainfall_{t-1})$ | 0.29** | -0.28* | -0.09 |
| | (0.14) | (0.16) | (0.21) |
| | [0.14] | [0.17] | [0.21] |
| $Log(rainfall_{t-1})$ * Log(Mineral value) | -0.17*** | -0.08 | -0.08 |
| | (0.05) | (0.05) | (0.07) |
| | [0.06] | [0.04] | [0.05] |
| | 354 | 378 | 366 |
| Districts | 59 | 63 | 61 |
| Estimation | | OLS | |

Notes: District-year level observations, covering 2005-2010. Districts were merged as described in the text. Included districts have at least one non-zero observation for the dependent variable; dependent variables are calculated as $\log(1+x)$. With the exception of the mineral dummy, the interaction variables are demeaned. All regressions include district fixed effects, state-year fixed effects and (log) mineral-year effects. Standard errors (s.e.) are clustered at the district level, standard errors [s.e.] are spatially clustered with linearly decreasing weights within a 250km radius. For (s.e.): *** p<0.01, ** p<0.05, * p<0.1.

**Table 11: Robustness check: Lagged dependent variable and flexible timing**

| | Log(Attacks on Security Forces) | | Log(Attacks on Collaborators) | | Log(Attacks on Maoists) | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Lagged Dep Var | | 0.10 | | -0.01 | | 0.11 |
| | | (0.11) | | (0.13) | | (0.11) |
| $Log(rainfall_t)$ | -0.06 | -0.04 | -0.20 | -0.19 | 0.27 | -0.19 |
| | (0.17) | (0.16) | (0.22) | (0.15) | (0.28) | (0.25) |
| $Log(rainfall_t)$ * Log(Mineral value) | 0.07 | 0.03 | -0.01 | -0.01 | -0.08 | -0.04 |
| | (0.05) | (0.05) | (0.05) | (0.04) | (0.09) | (0.08) |
| $Log(rainfall_{t-1})$ | 0.25 | 0.47** | -0.56** | -0.31** | -0.06 | -0.03 |
| | (0.21) | (0.19) | (0.22) | (0.15) | (0.28) | (0.24) |
| $Log(rainfall_{t-1})$ * Log(Mineral value) | -0.19*** | -0.19*** | 0.02 | 0.00 | -0.08 | -0.09 |
| | (0.07) | (0.07) | (0.06) | (0.06) | (0.08) | (0.08) |
| $Log(rainfall_{t-2})$ | 0.16 | 0.11 | -0.04 | 0.09 | 0.38 | 0.29 |
| | (0.19) | (0.18) | (0.23) | (0.18) | (0.32) | (0.33) |
| $Log(rainfall_{t-2})$ * Log(Mineral value) | -0.12 | -0.08 | -0.06 | -0.01 | -0.12 | -0.09 |
| | (0.08) | (0.07) | (0.06) | (0.04) | (0.08) | (0.07) |
| Observations | 236 | 236 | 252 | 252 | 244 | 244 |
| Districts | 59 | 59 | 63 | 63 | 61 | 61 |
| Estimation | OLS | GMM | OLS | GMM | OLS | GMM |

Notes: District-year level observations, covering 2007-2010. Districts were merged as described in the text. Included districts have at least one non-zero observation for the dependent variable; dependent variables are calculated as $\log(1+x)$. All regressions include district fixed effects, state-year fixed effects and (log) mineral-year effects. Standard errors (s.e.) are clustered at the district level. For (s.e.): *** p<0.01, ** p<0.05, * p<0.1.