The London School of Economics and Political Science

Three Essays on Political Economy and Economic Development

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Declaration

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Abstract

This thesis consists of three independent chapters. The first chapter examines the strategic choices of the targets and the intensity of violence by rebel groups. The chapter presents a theoretical framework that links a rebel group's targeting decisions to income shocks. It highlights that this relationship depends on the structure of the rebels' tax base. The hypotheses from the model are tested in the context of India's Naxalite conflict. The second chapter estimates the impact of military recruitment on human capital accumulation in colonial Punjab. In this context, I find that higher military recruitment was associated with increased literacy at the district-religion level. The final chapter presents a model that describes the optimal design of civil-military institutions in a setting where some control of the military over domestic politics is deemed desirable.

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Preface

The chapters in this thesis reflect my broad interest in the political economy of developing countries. While the literature in this area has grown exponentially over the last decade, the list of questions that are still unanswered remains very long. My thesis attempts to contribute to the understanding of some of these outstanding questions.

In the first chapter, I try to shed light on the targeting strategies of rebel groups. Insurgents in civil conflict typically target both government forces and civilians. However, evidence on the causes of targeted violence against civilians is scarce. This chapter examines the strategic choices of the targets and the intensity of violence by rebel groups. In a simple theoretical framework, negative labour income shocks are predicted to: (i) increase violence against civilians to prevent them from being recruited as police informers; (ii) increase the number of rebel attacks against the government, but only if the rebels' tax base is sufficiently independent from local labour productivity. These theoretical predictions are confirmed in the context of India's Naxalite conflict between 2005 and 2010. Exploiting variation in annual rainfall in a panel of district level casualty numbers, I find that negative rainfall shocks: (i) increase Maoist violence against civilians; (ii) increase Maoist violence against security forces, but only in those districts in which the Maoists have access to key mineral resources.

In the second chapter, I study the importance of voluntary military service for human development outcomes. Voluntary military service in professional armies could provide rare educational opportunities to recruits from disadvantaged groups. While the military is one of the most important economic actors in many developing countries, its role has received very little attention from development economists. In particular, there is almost no evidence on the relationship between military recruitment and educational outcomes in in this context. My second chapter explores a historical example of large scale military recruitment: it estimates the impact of military recruitment on human capital accumulation in colonial Punjab. The empirical strategy exploits the exogenous increase in recruitment by the Indian Army during the First World War. Higher military recruitment is found to be associated with increased literacy at the district-religion level. The direct acquisition of literacy skills by illiterate serving soldiers appears to be driving this impact. Limited evidence is found of inter-generational spill-overs. Finally, a political economy mechanism is not supported in this context: military recruitment was not associated with increased investments of district boards in public education.

The final chapter addresses a theoretical problem. Military coups often attract popular support and, historically, several constitutions even contained clauses that allowed the military to intervene in domestic politics. Also, the punishments for leaders of failed coups tend to be surprisingly mild. However, even in settings with coup-friendly institutions, military officers are and were typically not allowed to participate in political debates. Hence, the institutions that govern civil-military relations seem to simultaneously encourage and discourage military influence over politics. This paper offers a theoretical model that rationalises these seemingly paradoxical institutions by highlighting the role of factionalisation within the military. Under the assumption that some control of the military over domestic politics may be desirable, the paper discusses how civil-military institutions should be designed to generate "optimal" political control by the military.

Contents

List of Tables

List of Figures

1 Targets of Violence

Evidence from India's Naxalite Conflict

1.1 Introduction

The cost of civil war is to a large extent borne by the non-combatant population. The civilian population does not just suffer from the indirect or unintentional consequences of war. In most conflicts, insurgents devote considerable effort to targeted attacks on civilians. Understanding the specific logic of different types of violence is crucial for the design of effective conflict resolution policies. A particular concern is that policies that aim to weaken the insurgents' fighting capacity against the government could come at the cost of inciting targeted violence against civilians. This paper tries to uncover the drivers of targeted violence against civilians. To this end, I develop a simple theoretical framework that links the targeting decisions of a rebel group to labour income shocks. I subsequently exploit exogenous variation in rainfall to test the predictions of this framework in the context of India's Naxalite conflict. My findings suggest that rebels strategically choose the intensity of violence against civilians in order to deter civilian collaboration with the government. Moreover, I argue that the structure of the rebels' tax base determines whether a rebel group can exploit negative income shocks to boost its fighting capacity against the government.

Violence against civilians could serve many purposes. This paper highlights the role of civilian collaboration. I develop a theoretical framework that describes a rebel group's strategic choice of how to allocate its fighters. 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. As the rebel group manages a limited number of fighters, it needs to allocate its cadres strategically between either of these two activities: (i) direct assaults on government troops, (ii) or the exercise of control over the civilian population. 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, the conflict 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 informants 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 tests these predictions 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".[1] The conflict claimed at least 4,800 lives over the 2005-2010 period. India's Naxalite conflict provides an ideal testing ground for the theoretical predictions of this paper for a number of reasons. First, the Naxalite conflict has

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

seen high levels of targeted violence against civilians, who account for more than one third of the total number of casualties. Second, due to the reliance of the Naxalite-affected areas on rain-fed agriculture, exogenous variation in rainfall can be exploited to identify the impact of labour productivity shocks on the intensity of violence. Third, the Naxalite conflict affects a large number of districts and its actors have asymmetric financial capacities. Observers indicate that the rebels heavily rely on taxation of the local economy, whereas the government relies on a much broader tax base. 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.

To test the predictions of the theoretical framework, I collect a data set of annual casualty numbers at the district level between 2005 and 2010. These conflict outcomes are combined with Kharif 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: civilians, security forces, and Maoists. In support of the subsequent reduced form approach, I first confirm that negative rainfall shocks lead to lower rice production in the region under study. This finding supports the interpretation of rainfall shocks as determinants of agricultural income in this context.

The key result of this paper is that lower Kharif rainfall boosts Naxalite violence against civilians, 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. For the number of security force casualties and the number of deadly attacks on security forces, I find that violence only increases in response to negative rainfall shocks in those areas that produce key minerals. 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. To shed further light on the mechanism that underlies these results, I use detailed incident information to break down civilian casualties into three groups: civilian collaborators; other civilian targets; and civilians who were not the intended target of the attack. In support of the mechanism highlighted by this paper, I confirm that 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 in mining districts. Furthermore, 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; (b) relying on alternative measures of mineral resource wealth and rainfall shocks; (c) comparing the baseline results from a Poisson model to OLS results.

The results of this paper shed light on the drivers of targeted violence, by highlighting both the role of civilian collaboration and the importance of the rebels' tax base. These insights 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.

This paper brings together recent work on the role of income shocks in conflict and research on the logic of violence against civilians. 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 analyses in detail how civilian collaboration relates to selective violence.[2] 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. The existing empirical evidence on targeted violence against civilians is mainly based on case studies and cross-sectional regressions.[3] This paper is one of the first empirical contributions to explore the

[2]Kalyvas (2006) argues that selective violence against civilians is highest in areas with asymmetric, but incomplete control by the rivalling parties.

[3]Weinstein (2007) also highlights the role of selective violence against civilian collaborators. 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. In an alternative approach, Azam (2006) argues that violence against civilians could be driven by strategic looting that aims at lowering the opportunity cost of participation in conflict. Azam and Hoeffler (2002) highlight that violence against civilians could also be motivated by military objectives. Humphreys and Weinstein (2006) argue that rebels who are driven by material incentives are more likely to abuse civilians in comparison to units which share common goals and have 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. Further empirical work on violence

causes of variation in targeted violence against civilians versus the government in a subnational panel. In contrast to the existing literature, this paper explicitly links targeted violence against civilians to labour income shocks. This approach enables me to overcome key endogeneity concerns.

Several key 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.[4] 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.[5] However, this view has been challenged in recent work by Berman, Callen, Felter and Shapiro (2011). 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. For the opportunity cost channel to dominate in response to a negative labour income shock, the rebels need access to external sources of funding. Therefore, my analysis can account for the conflicting findings on the relationship between income shocks and violence in the existing literature.

Finally, this paper aims to contribute 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.[6] This consideration gains even more relevance because the districts affected by Naxalism are among India's poorest regions.[7] Gi-

against civilians includes Eck and Hultman (2007) and Restrepo and Spagat (2004).

[4]Besley and Persson (2010) confirm these 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).

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

[6]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.

[7]Borooah (2008). Banerjee and Iyer (2005) argue that the so-called "Red Corridor" of severely affected districts suffers from a colonial legacy of underinvestment in agriculture. Gomes

ven 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, appears to increase Naxalite violence.[8] 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.

The paper is organised as follows. First, I present a simple model that generates predictions regarding the impact of labour productivity shocks on different types of violence. Second, I discuss the background of the Naxalite conflict. Third, I describe the data used in this study. Fourth, I discuss the empirical strategy. Fifth, I discuss the main findings and I present key robustness checks. In the final section, I offer concluding remarks.

(2012) provides empirical evidence that suggests that Naxalite violence is spurred by these historical inequalities. In the context of Nepal's Maoist rebellion, the intensity of violence has also been linked to poverty and historical inequality (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.

[8] These authors rely on a different dataset (spanning a different time period and including only a subset of districts affected by the conflict).

1.2 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.[9] The model presented here combines key elements from four recent models in the insurgency literature. It includes (1) a rebel group budget constraint (as in Dal Bó and Dal Bó, 2011), (2) information provision by civilians and the possibility of retaliation by the rebel group (as in Berman et al., 2011b), (3) asymmetric taxation capacity (as in Besley and Persson, 2011), and (4) the strategic allocation of rebels (as in Azam, 2006).

First, the model describes the market for rebels. Rebels tax the economy and their income is given by:

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

This revenue function assumes that a fixed fraction p of economic output is collected as a "tax" (or looted) by the rebels. Total agricultural output is given by $\theta(L-F)$, in which F indicates the number of people fighting for the rebels, and L stands for the total labour endowment in the economy. θ denotes labour productivity in a linear production function, 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: $(1-p)\theta$. 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:

$$\frac{p}{F}[\theta(L - F) + R] = (1 - p)\theta \tag{1.1}$$

The above condition implies that the returns to agricultural work equal the returns

[9]The appendix discusses a re-interpretation and extension of the simple model presented here. This extension further microfounds the use of violence against civilians.

to becoming a rebel.[10] This equilibrium condition can be rewritten as:

$$F = pL + p\frac{R}{\theta} \tag{1.2}$$

The second market considered by the theoretical framework is the market for informants. It is assumed that a certain share of the population, which could include both fighters and civilians, exogenously receives valuable information. Therefore, they can be hired to act as informants for the government. Informants receive payments X that are not responsive to labour productivity.[11] 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.[12] In contrast, informed individuals face a cost if they decide to collaborate with the government. Importantly, the cost is assumed to be increasing in labour productivity. There are two main justifications for this assumption. First, citizens must devote time to inform the government, which may hamper their productive capacity. Second, the rebel group may destroy the economic output of citizens in retaliation for passing on information.[13] These two channels could reinforce each other: the threat of retaliation may force infor-

[10]The condition 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 a fixed point in proposition 3.

[11]Counter-insurgency methods can be brutal (Weinstein, 2007, p.6). To capture this idea, X could also include non-punishment by the government. Similarly, the rebels could offer rewards for collaboration. The crucial assumption of the model is that the appeal of collaboration with the government is decreasing in θ. This assumption is credible if the government has access to a budget that is independent from local economic conditions or if the rebels are less constrained in their capacity to destroy the output of informers.

[12]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 assumed to be independent from θ).

[13]The timing of the game, which will be introduced below, is only fully consistent with the second interpretation. The timing can be altered to incorporate the first interpretation without changing the results.

mants to hide and to give up economic production. Higher retaliation capacity may also increase the share of output destroyed by rebels. These relationships are captured by the cost function $C(\tau F, \theta(1-p))$. The cost function includes the retaliation capacity τF as its first argument. τ stands for the fraction of rebels who are employed to control and monitor the population ($0 \leqslant \tau \leqslant 1$).[14] In this function, it is assumed that $C_1 > 0$, $C_2 > 0$, $C_{1,2} \geqslant 0$. The timing of the game is such that the potential informants move after the rebel group. The decision to provide information is based on observed τF and θ. The returns to providing information to the government can now be described as follows:

$$i[X - C(\tau F, \theta(1-p))] \tag{1.3}$$

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:[15]

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

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.[16] 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

[14] In the appendix (1.8.1), I discuss a model in which the population does not directly observe the investment in retaliation capacity, τF. Instead, it observes the number of non-security force killings by the rebel group, which is a monotonically increasing function of τF: $K(\tau F)$. $K(\tau F)$ reveals the minimum investment in retaliation capacity. This extension microfounds the targeting of civilians.

[15] In principle, the returns to becoming an informant should enter the labour market condition in (Equation 1.1). The appendix provides a justification for this omission.

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

objective function:

$$W(\tau) = (1 - i^*(\tau F))(1 - \tau)F \tag{1.4}$$

The timing of the game is as follows:

1. Production and appropriation take place according to Equation 1.1.
2. The rebel group chooses τF.
3. The informed population decides whether to provide information: $i \in \{0, 1\}$.
4. The pay-offs are realised:
   - For the rebel group: $W = (1 - i)(1 - \tau)F$
   - For the informed population: $U^i = (1 - p)\theta + i(X - C(\tau F, \theta(1 - p)))$
   - For all other individuals: $U = (1 - p)\theta$

The model is solved by backward induction. The rebels maximise their objective function with respect to τ in anticipation of the informers' reaction. It can be seen immediately from the discontinuous objective function that the rebel group optimally chooses τ such that the returns to becoming an informant (expression Equation 1.3) equal zero.

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

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

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

Proposition 3: For $R > 0$, a negative productivity shock increases the size of the rebel group. A negative productivity shock increases the number of rebels engaged in controlling civilians ($\frac{\partial \tau^* F}{\partial \theta} < 0$). A negative productivity shock can lead either to an increase or a decrease in the number of recruits fighting the government. There exists an $\overline{R}$ such that for $R < \overline{R}$, $\frac{\partial (1-\tau^*)F}{\partial \theta} > 0$ and for $R > \overline{R}$, $\frac{\partial (1-\tau^*)F}{\partial \theta} < 0$.

Proof See 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.[17]

1.3 Background

This section briefly sketches the background of India's Naxalite conflict. First, I will offer a brief history of this conflict. Second, 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.

1.3.1 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(M) from brutally repressing the peasant revolt in Naxalbari. The sympathisers of the uprising formed the All India Coordination Committee of Communist Revolutionaries (AICCCR), 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 2003, the two major Naxalite outlets that

[17] The fact that F does not depend on θ in the absence of R is also a reformulation of Fearon's findings (Fearon, 2005).

were committed to violent struggle merged to form the Communist Party of India (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.[18] 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".[19] The number of districts that were "severely affected" by Naxalite activity increased from 51 districts to 62 districts over the period 2005-2007.[20] The continuing popularity and strength of the Naxalite movement is perceived to stem from chronic underdevelopment in the affected communities (Borooah, 2008). The Naxalites are also thought to be banking on the grievances of the tribal population against mining activity, which has led to large-scale displacement in certain Maoist strongholds (Kujur, 2009).

Over the 2005-2010 period, the Naxalite's activities included the sabotage of government infrastructure (e.g. schools that can be used as polling booths, Gram Panchayat buildings, telecommunication towers) in efforts to increase their political control. The Maoists also staged highly visible attacks against the government's security forces. On 15 February 2010, a group of Naxalite rebels killed 24 Bengali policemen. A surprisingly large number of attacks also affect the civilian population, which accounts for more than one third of the total number of casualties (including Maoist and police deaths) in the 2005-2010 period (SATP Timelines).

The Government's response to the Naxalite conflict has been characterised by a lack of coherent strategy between successive governments and different levels of administration (Kujur, 2009). While most states could not stop the recent surge in Maoist activity, Andhra Pradesh is often credited for pursuing a successful combination of targeted development policies and the deployment of a specialised police force ("Greyhounds").[21] Other states rely on a combination of state police forces and Central Reserve Forces (which are raised at the national level) to contain Naxalite activity.[22] Certain states are also thought to support semi-legal militant groups (such as *Salwa Judum*) in response to the Naxalite threat. While the Indian Government has historically treated the Naxalite insurgency as a "Law and Order"

[18] This section is based on Kujur (2008) who provides a detailed overview of the organisational history of India's Maoist organisations.
[19] Economist, 25 Feb 2010, "Ending the Red Terror".
[20] http://www.satp.org/satporgtp/countries/india/database/conflictmap.htm.
[21] Nilakantan and Singhal (2011).
[22] The Economist, 2010 (http://www.economist.com/node/15869400).

issue, it has not completely ignored the economic conditions that are thought to constitute the basis of the conflict. Naxalite affected districts qualify for several sources of central Government funding for development purposes, some of which are specific to Naxalite regions and some of which (including NREGA)[23] were rolled out at a national level. However, the extent to which districts make use of these funds depends on the political capability of the state Governments (Kujur, 2009).

1.3.2 Key characteristics

There are several reasons for why the Naxalite conflict provides an ideal testing ground for the theoretical arguments set out in the theoretical framework.

First, information is important in this conflict. Maoists and the Government clearly compete for civilian collaboration. While certain officials deny the existence of informers[24] (possibly in an attempt to protect civilians from reprisals), the Government openly offers substantial rewards for tip-offs that lead to the death or arrest of Maoists.[25] Certain state governments (possibly with the support of the Centre) are thought to have encouraged civilians to join militant groups that help the police to collect information and assist them in operations. Finally, the state governments have also rolled out several programmes to encourage low ranking Maoists to surrender and provide information.[26] 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:

> "The CPI-Maoist reportedly issued a press release at Chintapalli village in the Visakhapatnam District, blaming the Police for turning the Girijans (local tribals) into informers by spending huge amounts of money

[23] "The Mahatma Gandhi National Rural Employment Guarantee Act aims at enhancing the livelihood security of people in rural areas by guaranteeing hundred days of wage-employment in a financial year to a rural household whose adult members volunteer to do unskilled manual work." (NREGA, 2011, http://nrega.nic.in/netnrega/home.aspx)

[24] Director General of Police, quoted in SATP Timelines, Orissa (2009).

[25] "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)

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

> and warned that the properties acquired by the surrendered Maoists, after taking up the job of Home Guard, would be destroyed.[...]" (SATP Timelines, Andhra Pradesh, 2007)

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 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:[27]

> "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."[28] Thus, the key military units operate at a lower level, in so-called the "Sub-Zonal, Zo-

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

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

nal/District Commands".[29] 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.

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).[30] Newspaper reports provide anecdotal evidence on the modus operandi of the Naxals:

> "Early last year, the Maoists blasted pipelines of a leading steel company cutting through Chitrakonda 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, 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.

1.4 Data

This paper relies on violence data from the South Asia Terrorism Portal (SATP).[31] The SATP combines newspaper reports on Naxalite activity into daily incident summaries. These summaries typically provide the district (and sometimes village) in which the incident took place and the number of casualties on each side

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

[30] Source: SATP 2010 Timeline. See also Srivastava (2009) and The Economist (25 February 2010) for similar claims (http://www.economist.com/node/15580130).

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

of the conflict (civilians, Maoists and security forces). 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.[32] The analysis will be restricted to those states that are confronted with significant Naxalite activity over the period under study.[33]

The dataset used by this paper has several limitations. One limitation is that the dataset does not systematically include casualties who do not immediately succumb to their injuries. An additional limitation is that the number of Maoists casualties is hard to verify and the reports often highlight that these numbers are based on unverifiable police sources.[34] One can imagine that security forces have an incentive to overstate the number of Maoists they killed or to include innocent civilians who are wrongfully targeted in police actions. These concerns are addressed to some extent by the police policy of disclosing the names and the ranks of any killed Maoists to add credibility to its reports.[35] Unfortunately, the dataset does not include state violence directed towards civilians, in spite of widespread claims of atrocities being committed by state forces. Of the three types of violence reported in the dataset, Violence against Maoists is probably the most prone to (systematic) errors. 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. Another concern is that civilian casualties only include deaths thought to be inflicted by Maoists, although it cannot be ruled out that some casualties are wrongfully attributed to the Maoists. The type of casualties which is probably the least prone to misreporting are government casualties, as these are highly visible.

[32] 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. To code the large volume of entries in these timelines, key words (death, killed, injured, etc.) were used to identify relevant entries. The reliance on three different data sources further limits the risk of failing to identify incidents that involve casualties.

[33] Andhra Pradesh, Bihar, Chhattisghar, Jharkhand, Karnataka, Maharashtra, Orissa and West Bengal. These states are located on a map of India in Figure 1.1.

[34] Reports often indicate that Maoists drag bodies of killed fighters away to prevent the police from capturing the body.

[35] Also, Maoist casualties include certain casualties that are inflicted by Maoist groups among themselves or by civilian groups, even though such events appear to account for a small fraction of the entries.

Again, these casualties only include deaths inflicted by Maoist groups. Given that the number of security force 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.

Data on mineral output are obtained from the ministry of Labour and Employment.[36] 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 to lessen 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.[37] Naxalite extortion is often linked to illegal mining activity, which could depress the official output data in affected districts. These concerns 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 alternative measure of mineral production.[38]

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

[37] 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/).

[38] This alternative measure is based on the US geological survey, which restricts itself to major producers and does not provide district-level production data for coal.

Table 1.1: Summary Statistics

Panel A (district-year level)	Mean	Observations
Civilian casualties	1.90 (12.2)	1002
Maoist casualties	1.52 (7.46)	1002
Security force casualties	1.30 (7.12)	1002
Attacks on Security Forces (number of incidents with at least one SF casualty)	0.35 (1.37)	1002
Kharif season rainfall (mm)	1053 (639)	1169
Kharif season rainfall (mm, logarithmic)	6.81 (0.54)	1169
Rice production (tonnes)	287,411 (310,809)	285
Panel B (district level)		
Mineral wealth dummy	0.25 (0.44)	167
Mineral value (10 Million Rs)	184 (551)	167
Log(Mineral value +1) (conditional on positive production value)	5.33 (2.13)	42
Population density (pop/km^2)	419 (381)	167
Scheduled tribe population (fraction of population)	0.14 (0.17)	167
Forest area (fraction of district area)	0.20 (0.19)	164
Scheduled caste population (fraction of population)	0.15 (0.07)	167
Literate population (percentage)	62 (13)	167

Notes: See text for a detailed data description. Table A includes observations for 167 (merged) districts between 2005 and 2010. Rainfall data are from the Indian Meteorological Institute. Violence data are from the South Asia Terrorism Portal. Table B includes mineral data are 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.

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 2003-2007 from the Indian Department of Agriculture.[39] These production data correspond to fiscal years (e.g. 1 April 2003- 1 March 2004) and are assigned to the earliest calendar year. This 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 also collect forest cover and area data from the Ministry of Environment and Forest.[40]

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

[39] http://dacnet.nic.in/eands/AERC.htm, accessed in March 2011. Rice production data were not available for three states (Chhattisgarh, Jharkhand, and West Bengal).

[40] Ministry of Environment and Forest, Govt. of India., "District-Wise Forest Cover", accessed through www.indiastat.com. While Gawande et al. (2012) cast some doubt over the reliability of this measure, it should be noted that I only use this variable for additional control interactions (all the results are robust to its omission) and, in contrast to these authors, I do not use the variation in forest cover over time (which may be measured less accurately and could be endogenous to the conflict).

between district capitals).[41] 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.[42] To avoid merging districts across state borders, these observations are treated independently. The resulting data set contains a balanced panel of 167 (merged) districts.[43]

Table 1.1 provides summary statistics for key variables. In appendix 1.8.2, maps are provided for the districts that see at least 1 casualty related to the Naxalite conflict (Figure 1.2). The empirical strategy will focus on these districts. Maps are also presented for the number of civilian casualties over the 2005-2010 period (Figure 1.3), the number of security forces casualties over the same period (Figure 1.4), and the logarithm of the mining output value (Figure 1.5).

1.5 Empirical strategy

This paper investigates how agricultural productivity shocks affect different violence outcomes. The paper employs rainfall shocks as exogenous determinants of agricultural output (including from forest resources). While this approach has successfully been employed for the study of violence in the context of Sub-Saharan Africa (Miguel et al., 2004), the relationship between rainfall and economic activity is not straightforward in less arid regions. Nevertheless, a wide range of papers have confirmed the importance of rainfall shocks for agricultural wages and productivity in the Indian context.[44] To further confirm the validity of interpreting

[41] The mergers on the basis of the first two criteria are summarised 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).

[42] This is the case for: Gumla Jharkhand (Jashpur, Chhattisgarh); Kishanganj Bihar (West Dinajpur, West-Bengal); Pakaur Jharkhand (Maldah, West-Bengal).

[43] I confirmed that the main results go through in the unmerged data set (results not reported).

[44] 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 crops. The authors link deviations from optimal rainfall levels to disaster relief and voter preferences. 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

rainfall shocks as productivity/income shocks, I first estimate a rice production function for the states that were selected in this paper:

$$Log(Rice_{ist}) = \beta_1 lograin_{ist} + \mu_{is} + \theta_{st} + \phi_t * M_{is} + \varepsilon_{ist} \tag{1.5}$$

In this equation, β_1 captures the elasticity of rice production with respect to rainfall. μ_{is} is a district fixed effect. θ_{st} and ϕ_{Mt} respectively represent state-year fixed effects and mineral wealth-year fixed effects, which are included to make this model directly comparable to the models used in the main tables. The rice production data set is not available after 2006 and incomplete during the years for which it is available. These data limitations preclude a direct instrumentation approach or a detailed analysis of local production patterns. Moreover, any agricultural income measure at the district level is an imperfect proxy for the agricultural income of the rural communities affected by the conflict. The affected communities are expected to rely much more on rain-fed subsistence agriculture and forest resources than the average community in the district.[45] Nevertheless, if β_1 is estimated to be positive and significant in Equation 1.5, this should add some credibility to the subsequent reduced form approach.

The main specification explains the number of casualties in different categories. To account for the large number of zeroes in the dependent variable, the vertical outliers in the data set, and 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.[46] The estimated model will be based on the following specification:

$$E(C_{ist}) = \mu_{is} exp(\beta_1 lograin_{is,t-1} + \phi_t * M_{is} + \nu_{st}) \tag{1.6}$$

The dependent variable C_{ist} is the number of casualties or attacks of a given type (security forces, civilians, or Maoists) for a given district i in state s and in time

at the district level in their study of climate shocks and violence against women.

[45] Planning Commission (2008). Within-district heterogeneity of the impact of rainfall shocks may explain why Sarsons (2011) finds that poor rainfall spurs riots in dam-irrigated districts where rainfall does not affect the average district-level wages.

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

period t. The coefficient β_1 represents the elasticity of the number of casualties in district i and year t with respect to district rainfall in the previous year (the Kharif harvesting season is at the end of each calendar year). It should be noted that the district-level fixed effects (μ_{is}) are multiplicative to rainfall shocks, which naturally makes districts with higher levels of violence more responsive to a given rainfall shock. As a result, the fixed effects effectively explain all the variation in districts that do not see any casualties and these districts do not contribute towards the estimation of β_1. These districts are dropped from the analysis (as will be reflected in the number of observations).

The state-year effects ν_{st} can account for state-level policy variables that affect the number of casualties. As both economic policy and counterinsurgency strategies are devised at the state level and these policies vary widely between states (as discussed in section 1.3), ν_{st} accounts for a wide 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 1.6 includes the first lag of the logarithm of rainfall.[47] Three factors suggest that a delayed impact of rainfall shocks is appropriate for my study: (1) the timing of the harvesting season, (2) the dynamics of the conflict, (3) and 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 cultivation still relies on sufficient residual soil moisture from the monsoon season (Joshi et al., 2002). As a result, 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.[48] 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

[47] I include rainfall levels to account for the transitory nature of rainfall shocks (Ciccone, 2011).

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

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, I add additional interaction terms to Equation 1.6. This yields the following baseline specification:

$$E(C_{ist}) = \mu_{is} exp(\beta_1 lograin_{is,t-1} + \beta_2 lograin_{is,t-1} * M_{is} + \\ + \beta_3 lograin_{is,t-1} * Z_{is} + \phi_t * M_{is} + \nu_{st}) \quad (1.7)$$

In this model, 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 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 (1.7) is the fact that the availability of mineral resources is not exogenous to the process that drives violence. The district-fixed effects and mineral-year fixed effects should address some of these concerns. Nevertheless, it remains possible that β_2 captures the differential effect of rainfall by any other variable that is correlated with the presence of mining activity. To account for this possibility, I also include interactions of rainfall with other key socio-economic variables at the district level (summarized in Z_{is}): the proportion of the tribal population, the proportion of the scheduled caste population, the proportion of literates, the percentage of the district area covered by forests and population density.

1.6 Results

1.6.1 Main findings

The first column in Table 1.3 confirms that rainfall shocks at the district level are 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.[49] 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 agricultural incomes in the region considered by this study.

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 dummy for mineral production to test whether the impact of rainfall depends on the availability of mineral resources. For civilian casualties, a negative rainfall shocks lead to more violence. The additional impact in mineral-rich regions is negative but insignificant. In contrast, mining districts see a different pattern of violence against security forces. These mining districts account for 40% of the 58 districts with at least one security force death. Strikingly, the impact of rainfall shocks on the number of fatal attacks against security forces is positive in non-mining districts, but becomes negative in mining districts. The coefficient on the interaction term is significant at the 1% level. These signs are consistent with the predictions from the model. The results are robust to the addition of interactions with key (demeaned) covariates, as shown in the even columns. For Maoist deaths, none of the coefficients gain significance. However, out of the three violence measures, this is likely to be the measure that is most prone to errors. Nevertheless, the insignificant effect is 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.

[49] Survey evidence confirms the prevalence of rain-fed agriculture in Naxalite-affected districts (Banerjee and Saha, 2010). In this region, British colonial policy awarded land titles to landlords, resulting in lower agricultural investment (Banerjee and Iyer, 2005).

Table 1.2: Baseline results

	Log (Rice$_{t-1}$)	Civilian Casualties		Attacks on Security Forces		Maoist Casualties	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Log(rainfall_{t-1})$	0.40***	-0.71**	-1.26***	0.77**	1.08**	0.48	0.04
	(0.14)	(0.32)	(0.32)	(0.39)	(0.48)	(0.52)	(0.54)
$Log(rainfall_{t-1})$	0.17	-0.33	-0.49	-2.13***	-1.77**	-0.67	-0.46
* Mineral dummy	(0.34)	(0.59)	(0.61)	(0.71)	(0.86)	(0.88)	(0.77)
$Log(rainfall_{t-1})$			0.55		-0.26		2.67
* ST share			(1.90)		(2.94)		(3.81)
$Log(rainfall_{t-1})$			-3.55		0.83		2.63
* SC share			(4.09)		(5.20)		(9.70)
$Log(rainfall_{t-1})$			-0.05***		0.02		-0.04*
* Literacy share			(0.02)		(0.02)		(0.03)
$Log(rainfall_{t-1})$			2.85*		-3.01		-0.77
* Forest area share			(1.68)		(2.87)		(3.23)
$Log(rainfall_{t-1})$			0.002*		-0.0013		0.003*
* Population density			(0.001)		(0.0016)		(0.001)
Observations	268	444	438	348	342	360	360
Districts	123	74	73	58	57	60	60
Estimation	OLS				Poisson		

Notes: District-year level observations, covering 2005-2010 (2004-2006 in column 1). 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.

Table 1.3: Rainfall shocks and violence

	Civilian Casualties (1)	Security Force Casualties (2)	Attacks on Security Forces (3)	Maoist Casualties (4)
$Log(rainfall_t)$	-0.15	-0.70	-0.39	0.58
	(0.55)	(0.66)	(0.48)	(0.62)
$Log(rainfall_t)$	-0.10	0.73	0.90	-1.35
* Mineral dummy	(0.66)	(1.07)	(0.65)	(0.89)
$Log(rainfall_t)$	-0.75**	0.45	0.76*	0.56
	(0.35)	(0.60)	(0.40)	(0.60)
$Log(rainfall_t)$	-0.28	-2.83***	-2.05***	-1.02
* Mineral dummy	(0.61)	(0.92)	(0.70)	(0.97)
Observations	444	348	348	360
Districts	74	58	58	60
Estimation	Poisson	Poisson	Poisson	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. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 1.3 includes contemporaneous rainfall variables. The coefficients on these contemporaneous rainfall variables are insignificant for all three types of violence. Based on the methodological arguments put forward earlier and on the observed delayed impact of rainfall in Table 1.3, I focus on lagged rainfall for the remainder of the analysis. Table 1.3 also shows results on the number of security force casualties. The coefficients are less precisely estimated in this specification, which could be due to the fact that the "success" of Naxalite attacks in terms of the number casualties varies substantially. Nevertheless, the interaction term of rainfall and mineral resource wealth remains negative and significant for security force casualties (and this finding carries holds for all subsequent robustness checks).

Table 1.4 repeats the analysis of Table 1.3 for a continuous measure of mineral wealth, using $Log(1+mineralvalue)$. This specification is closer to the theoretical model and the key results are indeed strengthened. These results on a continuous measure also suggests that the results on the interaction term are not driven by districts with relatively small mining output. The coefficient of (-0.67) on civilian

Table 1.4: Baseline results for a continuous mining measure

	Log (Rice_{t-1})	Civilian Casualties		Attacks on Security Forces		Maoist Casualties	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Log(rainfall_{t-1})$	0.41***	-0.67**	-1.18***	1.12***	1.39***	0.68	0.28
	(0.14)	(0.29)	(0.31)	(0.36)	(0.40)	(0.50)	(0.53)
$Log(rainfall_{t-1})$ * Log(Mineral value)	0.02	-0.06	-0.10	-0.47***	-0.42***	-0.18	-0.17
	(0.06)	(0.07)	(0.08)	(0.11)	(0.12)	(0.13)	(0.13)
$Log(rainfall_{t-1})$ * ST share			0.41		0.59		2.21
			(1.86)		(2.69)		(3.80)
$Log(rainfall_{t-1})$ * SC share			-4.40		2.30		1.37
			(3.87)		(5.22)		(9.71)
$Log(rainfall_{t-1})$ * Literacy share			-0.04**		0.03		-0.05
			(0.02)		(0.02)		(0.03)
$Log(rainfall_{t-1})$ * Forest share			3.87**		-2.27		0.56
			(1.78)		(2.87)		(3.32)
$Log(rainfall_{t-1})$ * Population density			0.002**		-0.0010		0.003*
			(0.001)		(0.0016)		(0.001)
Observations		74	73	60	58	57	62
Districts	268	444	438	348	342	360	360
Estimation	123	74	73	58	57	60	60

Notes: District-year level observations, covering 2005-2010 (2004-2006 in column 1). 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.

casualties in Table 1.4 indicates that for a 20% decrease in log(rainfall),[50] the number of civilian casualties increases by 13%.[51] The first column suggests that the corresponding decrease in rice production is 9%. The coefficients on attacks imply that a 20% negative rainfall shock in the average *mining* district *increases* the number of deadly attacks on police forces by 28%.[52] In *non-mining* districts, a negative shock of the same magnitude *decreases* the number of deadly Naxalite attacks significantly by 22%.

As a robustness check on the main specification, I investigate the sensitivity of the main results to the choice of the econometric model. Table 1.9 (in appendix) presents OLS results for the sub sample of districts that see at least one casualty of the relevant type. While the OLS results are less precisely estimated, most of the signs and magnitudes are consistent with the Poisson results. It appears that the results are strongest in second and the third quartile, which should lessen concerns that the Poisson results picked up small absolute changes in the outcome variables. Moreover, a split-up of results by tertiles of the dependent variable confirms that the impacts are proportional to the level of the dependent variable. These results strongly suggest that a logarithmic model is appropriate. Table 1.10 (in appendix) confirms that the key results go through in an OLS estimation in which the dependent variable is subject to a $log(1 + x)$ transformation.[53]

1.6.2 Interpretation

The main results indicate that lower rainfall results in more violence directed against civilians, regardless of the presence of mineral resources. This finding is consistent with the theoretical model developed in section 1.2. Negative economic shocks could boost the willingness of civilians to collaborate with the government.

[50] 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.

[51] This corresponds to 0.5 additional civilian casualties at the sample mean of 4.3 civilian casualties (conditional on the district having any civilian casualties).

[52] ($1.4 = (5.33 * 0.47 - 1.12)$). The hypothesis that this elasticity is 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.

[53] Relying on the OLS specification, I confirm that the main results are robust to spatial clustering of the standard errors (reported in square brackets). The main results also carry through if the 2nd lag of rainfall is added to the model (results not reported).

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 show that they have invested in sufficient retaliation capacity to locate and punish informers.

Table 1.5: Motives for violence against civilians

	Civilian Casualties by Motive		
Motive	Number	Percent	Percent (excluding unspecified)
Collaboration			
Suspected police informers	389	20.58	28.23
Surrendered Maoists	23	1.20	1.65
Members of political parties/ political activity	424	22.20	30.46
Members of vigilante groups	101	5.29	7.26
(Collaboration total)	937	49.27	67.6
Other			
Untargeted	366	19.16	26.29
Failure to pay levy	31	1.62	2.22
Punishment for crimes	25	1.31	1.80
Other motives	29	1.52	2.08
Unspecified	518	27.12	-
Total	1,924	100	100

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

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.

Table 1.6: Baseline results per type of civilian casualty

	Civilian Casualties	Civilian Casualties (Collaboration)	Civilian Casualties (Untargeted)	Attacks on Security Forces
	(1)	(2)	(3)	(4)
$Log(rainfall_{t-1})$	-0.67**	-1.11**	1.41	1.12***
	(0.29)	(0.46)	(1.22)	(0.36)
$Log(rainfall_{t-1})$ * Log(Mineral value)	-0.06	0.09	-1.32***	-0.47***
	(0.07)	(0.10)	(0.42)	(0.11)
Observations	372	366	192	192
Districts	62	61	32	32
Estimation	Poisson			

Notes: District-year level observations, covering 2005-2010. Districts were merged as described in the text. See text and Table 1.5 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 1.5 and Table 1.6, I provide further evidence on the importance of civilian collaboration. Table 1.5 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.[54] Focusing on casualties for whom a motive is recorded, a large majority is referred to as (suspected) collaborators. Police informers (28%), members of mainstream political parties that oppose the Naxalites (30%), surrendered Naxalites (2%), and members of vigilante groups (7%) account for a total of 68% 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 Table 1.6, the main results are shown separately for killings of civilian collaborators and victims

[54] The break-down of casualty numbers is based on my own coding of incidents. Unfortunately, it is unclear which factors determine the provision of more detailed background information and there could be selection bias.

of “untargeted attacks”. In support of the mechanism highlighted in this paper, the main results appear to be driven by attacks on collaborators. In contrast, untargeted civilian killings follow exactly the pattern of attacks on security forces. The latter finding suggests that civilians suffer the indirect consequences of increased violence against the government. The fact that the main results are driven by targeted attacks on civilian collaborators adds further credibility to the main mechanism of this paper. Finally, there is also anecdotal evidence that 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 (Nagpur range) Pankaj 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)

For attacks on security forces, the main results 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 could force them to shift personnel from attacks against the government to the monitoring of civilians. This argument could explain why negative rainfall shocks reduce the number of Maoist attacks against government in non-mining districts. The fact that rebel groups respond to negative shocks with increased violence against the government, but only in mining districts, is consistent with the interpretation that the rebel group’s tax base is less reliant on agricultural output in these districts. As a result, the rebels could increase recruitment and they could boost violence both against the government and against civilian collaborators.

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. The SATP Timelines indicate that most Maoist attacks on the government involve a substantial number of fighters,[55] 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.

1.6.3 Alternative explanations and robustness checks

The main results are consistent with the model developed in section 1.2 and the anecdotal evidence presented in section 1.3. This subsection addresses the extent to which alternative mechanisms can explain the observed patterns.

1.6.3.1 Violent appropriation

Table 1.5 and Table 1.6 strongly suggest that the main results are driven by retaliation against civilian collaborators. 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.[56] From a theoretical perspective, this interpretation would require the civilian population to have assets that do not depend too strongly on local economic conditions. However, these theories cannot explain why violence against the government and violence against civilians would react differently to income shocks in the absence of natural resources. In particular, if the rebels strategically choose the extent to which they loot civilians (as in Azam, 2006), the presence of natural resources should mitigate the impact of negative

[55] "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)

[56] 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. Hence, it is possible that the observed increase in violence stems from the Maoists' goal to protect vulnerable populations against atrocities. 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 a desire to appropriate the possessions of witches.

productivity shocks on violence against civilians. I find no evidence of such a mitigation effect. 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. The SATP timelines provide ample anecdotal evidence on the importance of lethal violence against informers. The Maoists communicate openly about civilian casualties and they typically refer to their victims as police informers (as shown in Table 1.5). Even if the victims of violence did in fact refuse to pay levies to the Maoists, this open communication suggests that the intensity of violence against civilians is driven by the rebels' goal to optimally deter (and punish) collaboration.

1.6.3.2 Incapacitation and precision of attacks

Berman *et al.* (2011a) find that higher unemployment inhibits insurgent attacks against security forces.[57] 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, as described in the model. 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, the increase in civilian casualties that is observed in response to negative shocks could still 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 (Table 1.6). The results on

[57] 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.

untargeted civilian casualties suggest that indirect victims follow the pattern of attacks against the government. This suggests that if there is decreased precision, it is not the result of incapacitation (as in Berman *et al.*, 2011a). While the elasticity on untargeted casualties is larger than the one on government casualties (which implies reduced precision), violence against the government goes up in response to negative productivity shocks in mineral rich areas. Incapacitation would predict that government casualties go down in response to negative income shocks.

1.6.3.3 Police activism

A third alternative explanation for the main results relies on the activities of the police forces. Mining districts might have greater police presence, which offers more opportunity for the rebels to respond to rainfall shocks with increased violence against police forces. Hence, negative rainfall shocks could lead to more violence against civilians in any district and to violence against the security forces in those districts with a large security force presence. 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. In an extreme version of this argument, violence against the police should be zero in non-mining districts. However, mining districts only account for 40% of the districts that see any police casualties.[58] Furthermore, 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. This argument can also help to address concerns that Maoist violence against the police is purely driven by the aspiration to control mineral resources.[59] Again, one would expect this channel to operate through higher levels of violence, which are accounted for by the fixed effects. Nevertheless, it remains possible that mining regions face types of police activity which are not captured by average levels of violence against the police but do shape the incentives for rebels to attack the security forces in response to a productivity shock. Column (7) in Table 1.7 (in appendix) presents one way to account for the possibility that mining regions would be more prone

[58]The correlation between mining activity and violence is positive but not robustly significant in the cross-section (results not reported).

[59]Similarly, it is unclear whether higher extortion would increase police activity in mining regions, especially because the Maoists are suspected of having cosy ties with the industrialists they tax. "You will not find any businessman who has been attacked,' says Ajit Doval, a former head of India's Intelligence Bureau, "only poor tribals and policemen." (The Economist, 25 February 2005, http://www.economist.com/node/15580130).

to police activism. 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.

1.6.3.4 Mining activity

The current analysis cannot provide direct evidence on taxation by rebel groups, which is the key mechanism within my framework that explains the differential impact of rainfall shocks in mining regions. The Maoists publicly 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 small number of communities were directly affected by displacement (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, the adverse impact of mining activity on rural communities could suggest alternative explanations of the observed differential impact of rainfall in mining regions. In particular, rebel groups could be more effective in recruiting from mining regions because of two 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. This channel could even be strengthened through political economy factors. If districts that produce minerals have weaker political institutions, this could exacerbate the impact of a given rainfall shock (as suggested in the ordered conflict model of Besley and Persson, 2010). While the analysis cannot fully rule out this possibility, the estimated rice production function in Table 1.2 and Table 1.4 failed to pick up any differential effect of rain on agricultural output in mining regions. Furthermore, a political resource curse interpretation is undermined by the fact that policies are set at the state level and all selected states (with the exception of Bihar) produce key minerals.[60] A second channel that relies on the environmental

[60] The results are robust to the inclusion of state-specific effects of rainfall and year effects instead of state-year fixed effects. State specific effects of rainfall could capture state-specific political

impact of mining activity is the possibility that grievances against mines create an additional incentive for individuals to join the Maoists. While these channels are different from the pure budget constraint mechanism as presented in the theory, the main difference could be one of interpretation. First, if the impact of rainfall shocks is more severe in mining regions, this could affect the communities who are considered for recruitment (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 be understood within my theoretical framework.

It is possible to test the importance of the tribal population explicitly. If the conflict between mines and rural communities mainly affects tribal groups (as suggested by 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 deadly attacks on security forces), if the effect of rainfall shocks in mining districts is larger for tribal districts. This should be the case if the impact of mining mainly operates through the grievances of the tribal population. However, the coefficient on the triple interaction is insignificant (see Table 1.7 in appendix, columns 2 and 5, for civilian and attacks on security forces respectively).

1.6.3.5 Accounting for floods and alternative rainfall measures

While rainfall was found to be positively related to rice production, the impact of rain on agricultural output is theoretically ambiguous: higher rainfall could boost productivity but it could also spur floods and cause crop damage.[61] One concern is that my analysis captures 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 account for 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

institutions (not reported).

[61] In my dataset, I find no convincing evidence of a negative impact of excess rainfall on agricultural output. However, the logarithmic specification already accounts for the decreasing returns to rainfall levels, which are clearly present.

opportunity cost of conflict (rather than the destruction of conflict capital), I allow for the impact of rainfall to be different in flood-prone areas (Table 1.7 in appendix, columns 1 and 4).[62] The results confirm that these districts are not driving the results. Strikingly, the negative impact on violence against civilians is mitigated in these districts, which is consistent with the idea that positive rainfall shocks in flood prone areas do not necessarily result in an increase in the opportunity cost of engaging in conflict. Therefore, it seems unlikely that the main results are driven by the impact of floods.

As an additional robustness check, I define dry district-years as observations that see Kharif season rainfall below 20% of the district average between 2004 and 2010.[63] Using this dry year dummy as the relevant rainfall shock yields results that are very close in magnitude to those obtained earlier, although the coefficients are less precisely estimated.

1.6.3.6 Alternative mineral definitions

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 1.7 (in appendix, columns 3 and 6) presents the key results for an alternative measure of district-level production of bauxite and iron mining, which was published by the US Geological Survey.[64] This survey does not provide district-level information on coal mining. Therefore, a dummy for coal mining activity (which is based on 2003 data and does not suffer from severe endogeneity concerns) is added in a separate interaction term. The key results go through in this alternative specification. The coefficient on bauxite and iron on the one hand and coal on the other hand remain negative and significant. The fact that the negative coefficient on the interaction term is not driven by a particular type of minerals provides additional support of the main results.

1.7 Conclusion

In line with the asymmetric nature of the Naxalite conflict, this paper hypothesised that income shocks should have different impacts on violence depending on the

[62] As defined by the Indian Vulnerability Atlas (2006).
[63] 22% of all district-years are categorised as “dry years” according to this definition.
[64] U.S. Geological Survey, 2007, "2005 Minerals Yearbook India", p.13.

resource environment. 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. The Naxalites can only exploit negative labour income shocks to increase attacks against the government if they have access to external sources of funding. My empirical analysis supported these hypotheses. Exploiting exogenous variation in rainfall in a panel of annual casualty numbers, negative rainfall shocks were found to increase Maoist violence against civilians. Importantly, this result was found to be driven by violence against civilian collaborators. Negative shocks were only associated with increased violence against the security forces in those districts that produce key minerals.

The results of this paper shed new light on the conflicting results in the literature that links labour income shocks to violence. In particular, the analysis suggests that 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.

The findings of this paper 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. However, 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 increased reprisals. It could also be that the rewards from collaboration in the Naxalite conflict are too limited to outweigh the risk of retaliation by the Naxalites. 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.

1.8 Appendix to Chapter 1

1.8.1 Theoretical Framework

Proof of Proposition 1 and 2

From expression 1.3, 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 τ^* 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 α_1 of the population is non-strategic and always provides information to the government. Fraction α_2 receives valuable information and chooses to pass on this information, depending on the costs and benefits associated with this action.

A fraction $1 - \alpha_1 - \alpha_2$ does not receive any information. These informer types are hidden. It is assumed the government pays X for valuable information that is provided by the "opportunistic informants" α_2. The collaboration of the α_2 population is assumed to be critical. The rebel group will lose its fighting capacity if and only if the α_2 population passes on information to the government.

In contrast to the earlier model, the population does not directly observe τF. Instead, it observes the number of non-security force killings by the rebel group among the α_1 informers, which is a monotonically increasing function of τF, $K(\phi\tau F)$, with $0 \leqslant \phi \leqslant 1$. For $\phi = 1$, $K(\phi\tau F)$ perfectly reveals the minimum investment in retaliation capacity. This extension microfounds the targeting of civilians. In particular, the rebel group now kills non-strategic informers to show that they have fighters devoted to retaliation activities. The ability to target α_1 informers also reflects monitoring capacity. Without investments in monitoring capacity, the rebel group may be able to kill civilians, but it will fail to target only informers. It is assumed that the types are revealed after the killing, so that the population can derive both the strength of the rebels devoted to controlling civilians and their monitoring capacity.[65]

The timing of the altered game is as follows:

1. Nature draws:

   - The informant types in the population, with probabilities α_1 for unconditional informers, α_2 for opportunistic informers, and $1 - \alpha_1 - \alpha_2$ for the remaining population.

2. Production, rebel recruitment, and appropriation take place according to Equation 1.1.[66]

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

[66] In principle, the collaboration decision should enter the labour market condition derived in (Equation 1.1) 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 τF that makes the returns to collaboration equal to zero). Therefore, the functions describing the rebel market can depend on the returns to

3. α_1 informers provide information to the government.

4. The rebel group chooses τF and ϕ.

5. The α_2 population:

   - Observes the number of killings of α_1 informers: $k = K(\phi\tau F)$

   - Decides to provide information $i \in (0, 1)$.

6. The pay-offs are realised:

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

   - The pay-off of the α_2 population is given by: $(1-p)\theta + i(X - C(\tau F, \theta(1-p)))$

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

Proposition A.1: In the Subgame Perfect Equilibrium, the rebel group sets $\tau^* F$ so that 1.3 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 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 section 1.2.

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.

1.8.2 Maps

Figure 1.1: Districts Included in Data Set

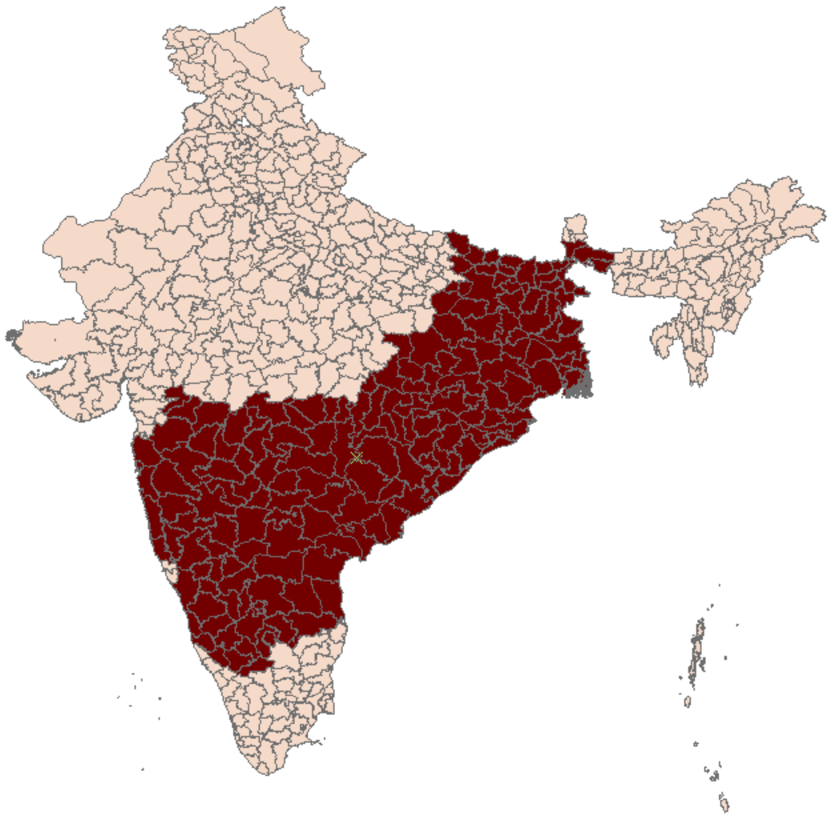
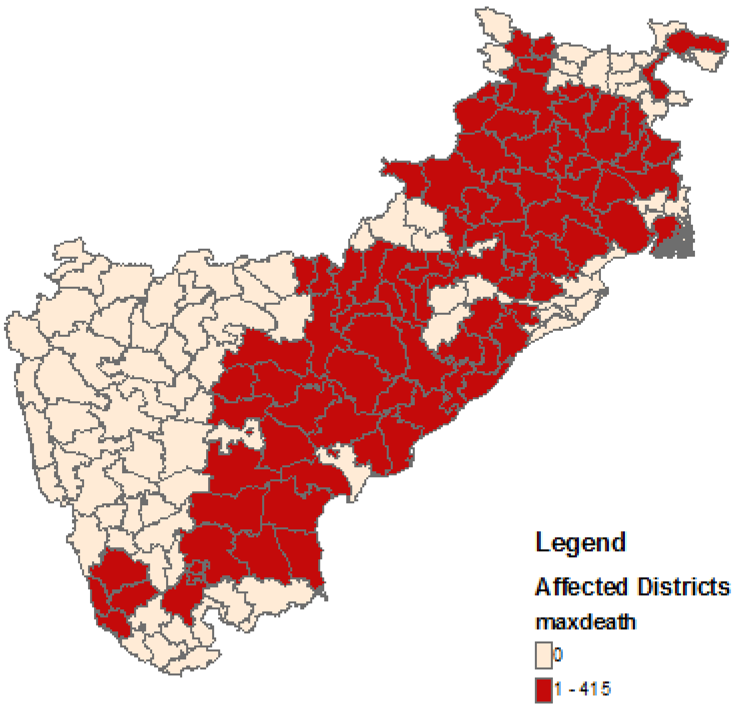
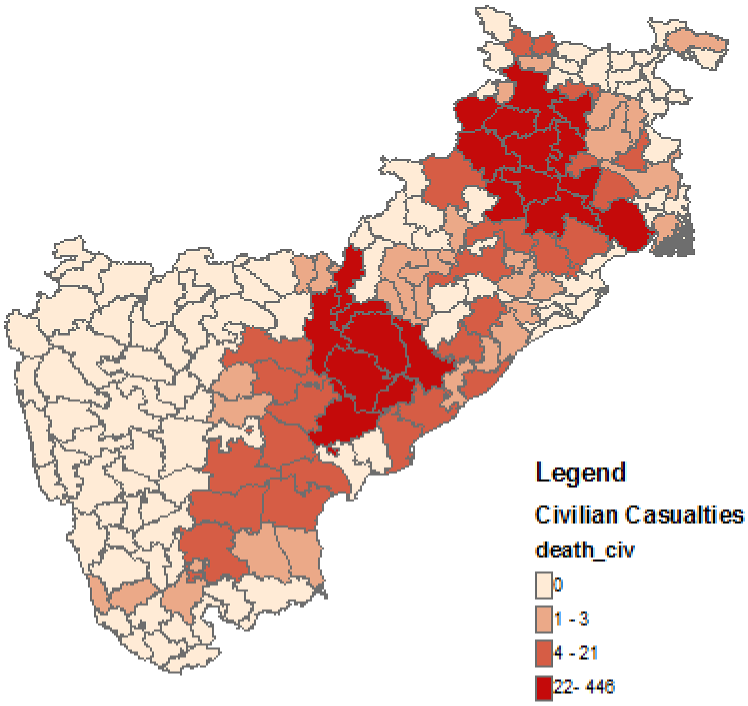


Figure 1.2: Affected Districts



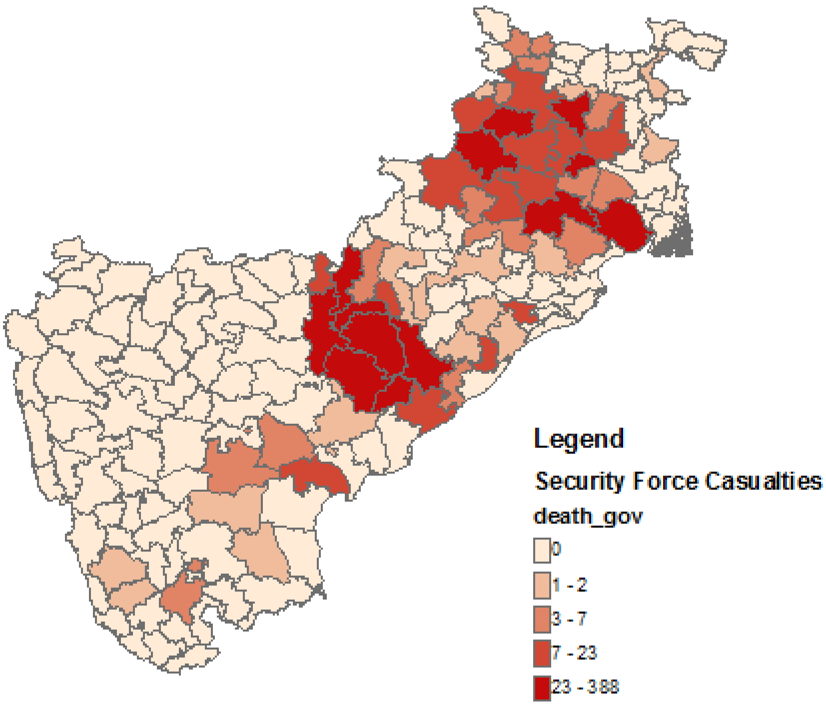
Notes: Affected (merged) districts see at least one casualty of any type between 2005 and 2010.

Figure 1.3: Civilian casualties



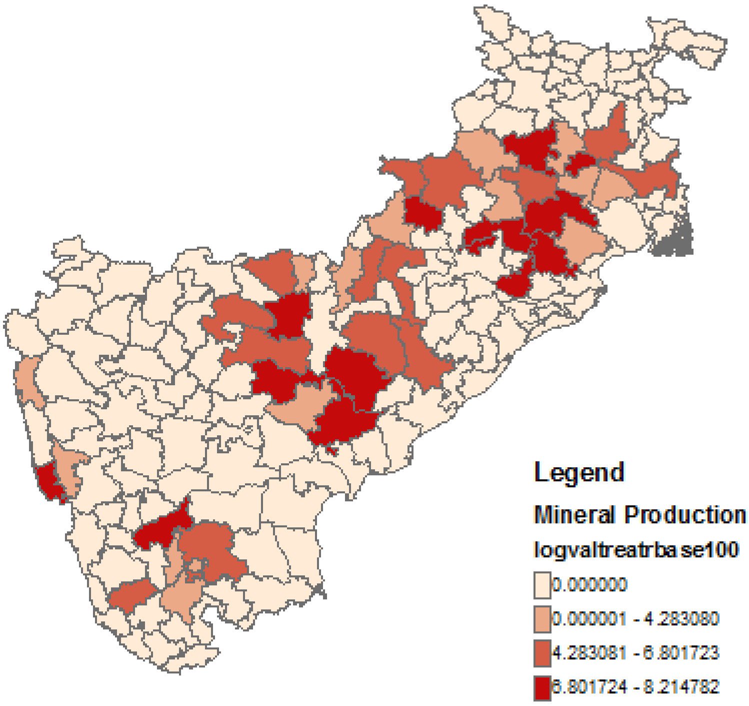
Notes: Total number of civilian casualties (per merged district) between 2005 and 2010.

Figure 1.4: Security force casualties



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

Figure 1.5: Mineral production



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

1.8.3 Tables for robustness checks

Table 1.8: Robustness checks (an alternative shock measure)

	Civilian Casualties	Security Forces Casualties
$Dry\,year_{t-1}$	0.31	-0.49**
	(0.20)	(0.22)
$Dry\,year_{t-1}$	0.02	0.15**
* Log(Mineral value)	(0.07)	(0.06)
Observations	444	348
Districts	74	58
Estimation	Poisson	
P-value on $\beta_1 = \beta_2 = 0$	0.08*	0.03**

Notes: District-year level observations observations, covering 2005-2010. Districts were merged as described in the text. Dry years are district-years that see less than 20% of the average district-level rainfall (2004-2010). The 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.

Table 1.7: Robustness checks (interactions with rainfall)

	Civilian Casualties			Attacks on Security Forces			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Log(rainfall_{t-1})$	-0.84***	-0.80**	-0.98***	0.98**	1.17***	0.51	1.69***
	(0.33)	(0.32)	(0.31)	(0.43)	(0.35)	(0.38)	(0.36)
$Log(rainfall_{t-1})$ *Log(Mineral value)	-0.04	-0.13*		-0.45***	-0.40***		-0.46***
	(0.07)	(0.8)		(0.11)	(0.14)		(0.10)
$Log(rainfall_{t-1})$ *Log(Mineral value)*ST share		0.19			-0.36		
		(0.20)			(0.29)		
$Log(rainfall_{t-1})$ *ST Share		1.10			1.37		
		(1.28)			(1.85)		
$Log(rainfall_{t-1})$ *Flood prone	0.31				0.32		
	(0.44)				(0.66)		
$Log(rainfall_{t-1})$ *Mineral USGS			0.53			-2.22***	
			(0.72)			(0.73)	
$Log(rainfall_{t-1})$ *Coal dummy			0.11			-1.40**	
			(0.47)			(0.69)	
$Log(rainfall_{t-1})$ *(2005 incidents with Maoist fatalities)							-0.40***
							(0.12)
Observations	444	444	444	348	348	348	348
Districts	74	74	74	58	58	58	58
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. *** p<0.01, ** p<0.05, * p<0.1.

Table 1.9: OLS reference (results per tertile)

Panel A

	Civilian Casualties (per 100,000 of the population)					
Mean	0.26	0.01	0.05	0.74	0.32	0.18
$Log(rainfall_{t-1})$	-0.31**	-0.01	-0.09	-1.94	-0.52*	-0.20**
	(0.15)	(0.03)	(0.05)	(1.27)	(0.28)	(0.10)
$Log(rainfall_{t-1})$ * Log(Mineral value)	-0.03	0.01	0.02	0.33	0.01	-0.00
	(0.04)	(0.01)	(0.01)	(0.27)	(0.05)	(0.02)
Outliers omitted	No	No	No	No	Yes	Yes
Tertiles	All	1^{st}	2^{nd}	3^{rd}	3^{rd}	2^{nd} & 3^{rd}
Observations	444	150	150	150	126	276
Districts	74	25	25	25	21	46
Estimation	OLS					

Panel B

	Attacks on Security Forces (per 100,000 of the population)					
Mean	0.078	0.007	0.021	0.198	0.104	0.060
$Log(rainfall_{t-1})$	0.005	0.004	0.017	-0.021	0.14	0.048
	(0.04)	(0.007)	(0.020)	(0.208)	(0.13)	(0.029)
$Log(rainfall_{t-1})$ * Log(Mineral value)	-0.016	0.004	-0.007	-0.036	-0.047*	-0.026*
	(0.013)	(0.004)	(0.016)	(0.047)	(0.0243)	(0.13)
Outliers omitted	No	No	No	No	Yes	Yes
Tertiles	All	1^{st}	2^{nd}	3^{rd}	3^{rd}	2^{nd}& 3^{rd}
Observations	342	120	114	114	102	216
Districts	57	20	19	19	18	36
Estimation	OLS					

Notes: District-year level observations, 2005-2010. Districts were merged as described in the text. Included districts have at least one non-zero observation for the dependent variable. Tertiles are based on the distribution of the total number of casualties over the sample period divided by the district population and conditional on the district total exceeding zero. Outliers are above the 95th percentile of the distribution of the district casualty total. Reported means are for the dependent variable of relevant sub-sample. All regressions include district fixed effects, state-year fixed effects 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.

Table 1.10: OLS reference (baseline results)

	Log(Civilian Casualties+1)		Log(Attacks on Security Forces+1)		Log(Maoist Casualties+1)	
	(1)	(2)	(3)	(4)	(5)	(6)
$Log(rainfall_{t-1})$	-0.34*	-0.39*	0.30**	0.41***	-0.02	-0.35
	(0.20)	(0.21)	(0.14)	(0.15)	(0.33)	(0.32)
	[0.20]	[0.19]	[0.13]	[0.14]	[0.35]	[0.31]
$Log(rainfall_{t-1})$ * Log(Mineral value)	-0.03	-0.03	-0.14**	-0.14***	-0.10	-0.08
	(0.05)	(0.05)	(0)	(0.05)	(0.07)	(0.06)
	[0.04]	[0.05]	[0.04]	[0.05]	[0.06]	[0.05]
$Log(rainfall_{t-1})$ * ST share		0.23		-0.53		-0.20
		(1.25)		(0.98)		(2.01)
$Log(rainfall_{t-1})$ * SC share		-3.05		-1.24		-0.41
		(2.80)		(1.83)		(4.00)
$Log(rainfall_{t-1})$ * Literacy share		-0.01		0.01		-0.04*
		(0.01)		(0.01)		(0.02)
$Log(rainfall_{t-1})$ * Forest share		0.99		-0.70		1.13
		(1.02)		(0.96)		(1.77)
$Log(rainfall_{t-1})$ * Pop. density		0.00		-0.00		0.00
		(0.00)		(0.00)		(0.00)
Observations	440	438	348	342	360	360
Districts	74	73	58	57	60	60
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. 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.

2 Military Service and Human Capital Accumulation

Evidence from Colonial Punjab

2.1 Introduction

Voluntary military service in professional armed forces is often thought to offer rare educational opportunities to disadvantaged groups (Khalidi, 2001; Moskos and Butler, 1996). The risk premium on military wages could force the military to hire low-skilled recruits and to provide training on the job, rather than to pay the market wage for skilled labour. The claim that disadvantaged groups benefit disproportionally from military service gains additional policy relevance because the military is one of the largest employers in most countries (WDI, 2006). In the context of the US armed forces, evidence suggests that disadvantaged groups benefit mildly from voluntary service (Angrist, 1998). However, very little evidence is available on how this finding translates to a developing country context. Nevertheless, the returns to military service in professional armies could be higher in developing countries, as the average human capital in their populations tends to be lower.[1] In spite of the central importance of military support and training to

[1] Benoit (1978) argues that defense expenditures could spur growth in developing countries. Stroup and Heckelman (2001) find a positive relationship between military spending and growth in countries with low levels human capital. Dunne, Smith and Willenbockel (2006) survey the extensive related literature on military expenditures and growth.

the relations between developing countries and the developed world, not much is known about the role that military service could play in economic development.[2]

Research into this topic faces two key challenges.[3] First, the confidentiality of military data restricts subnational work on this topic. Second, selection into voluntary military service is typically non-random, which could bias the estimated returns to military service. This paper addresses these challenges by focusing on the recruitment surge in colonial Punjab during the First World War (WWI). This setting is unique in that recruitment patterns can be reconstructed and exogenous factors determined the extent to which communities were exposed to a demand shock for military labour. The size of this demand shock enables an analysis at the aggregate level: out of a total population of approximately 20 million, more than 362,000 Punjabi men (1.8% of the population) served in the Indian Army during the First World War. Two key questions will be explored. First, did military recruitment during the First World War boost the literacy rate of recruited communities? Second, through which of three possible channels did military service affect literacy: (i) direct skill acquisition by serving soldiers, (ii) increased demand for the education due to higher earnings, or (iii) preferential public spending on primary education?

For information on the recruitment patterns of the Indian Army, this paper relies on the "Debt of Honour Register", which is administered by the Commonwealth War Graves Commission (CWGC). Using individual records of Indian casualties in the Register, information on the place of origin of soldiers who died in WWI can be aggregated at the district level. A name-based algorithm enables a further split-up of war casualty estimates into two religious communities: Hindu-Sikhs and Muslims. These data on military war deaths at the district-religion level are used as a proxy for military recruitment. I present historical evidence that supports the use of casualty numbers as proxies for recruitment. My main results are derived from a panel of literacy outcomes at the district-religion level in colonial Punjab for the period 1901-31.

[2]Observers indicate that 80 per cent of recruits in the Afghan army are illiterate (BBC News, "Afghanistan and Pakistan face decisive year", http://news.bbc.co.uk/1/hi/8424289.stm, last accessed 4 January 2011). Hence, the scope of large-scale military recruitment to contribute to human capital development seems substantial. The recent 25 January revolution in Egypt also illustrates the importance of military training in shaping the views of soldiers (BBC News, "Egypt unrest: Military at heart of Egyptian state", http://www.bbc.co.uk/news/world-middle-east-12368711, last accessed 11 February 2011).

[3]See also Annan and Blattman (2010).

The identification strategy used in this paper corresponds to a continuous difference-in-difference approach: I compare male literacy rates in years before and after WWI, between communities with different ratios of military war casualties. This approach relies on the fact that recruitment into the British army was restricted to certain groups from specific geographical areas. Historical sources suggest that the recruitment patterns of the Indian Army during the First World War were mainly based on the recruitment grounds that had been identified by British recruitment officers at the end of the 19th century. This initial selection favoured the recruitment of so-called 'martial races'. It can be assumed that the martial qualities of communities were not linked to their potential for literacy improvements during WWI. An analysis of the baseline characteristics of recruited communities and their literacy trends before the war is consistent with this hypothesis. Therefore, the intensity of the WWI recruitment surge, as proxied by the ratio of military war deaths, is considered as an exogenous treatment in the main analysis. However, this analysis cannot fully address certain endogeneity concerns, including the possibility that the proxying approach leads to systematic errors. To address these remaining concerns, I also present IV results for a restricted sample. In this robustness check, I instrument the observed recruitment patterns with an indicator of "recruitment suitability" that is based on the assessments of the fighting potential of Hindu-Sikh communities by British recruitment officers at the end of the 19th century.

The results indicate that an increase in war casualties is associated with a significant increase in the number of male literates. On average, ten additional recruits per thousand of the 1901 male population are associated with an increase in the ratio of male literates by three per thousand in 1931. A further split-up of the baseline results per age group indicates that the positive impact on literacy is strongest for the group of men aged over 20. This finding is consistent with the hypothesis that direct skill acquisition during military service was a key channel through which military recruitment influenced literacy outcomes. Historical evidence confirms that recruits were typically illiterate but often acquired literacy skills on service. These sources also suggest that the observed effect is likely to result from informal learning and skill transfers rather than from formal literacy training. Further analysis confirms that the positive impact of military recruitment is not driven by a supply shock of education or by a political economy channel: heavily recruited districts did not attract more investments in education by the Punjabi District Boards. The latter finding points at constraints on the long-run distributional impact of military recruitment in this context.

This paper adds to previous work on the economic impact of military recruitment.[4] It is one of the first contributions to exploit largely exogenous variation in military recruitment to provide evidence on the relationship between military recruitment and human capital formation in a developing economy. One exception is a recent contribution by Annan and Blattman (2010), who examine the labour market impact of forced child soldiering in Uganda. They conclude that military service is a poor substitute for schooling in this context.[5] However, it is not clear whether these results would carry through to the volunteer forces of professional armies. One contribution that shares my focus on human capital accumulation in the Indian Army, is the recent work of Jha and Wilkinson (2010). Their analysis indicates that the combat experience of Indian World War II veterans helped these ex-soldiers to organise violence against minorities. They find that the average duration of combat assignment at the district level can explain the observed patterns of ethnic cleansing across the subcontinent during the Partition in 1947. This paper complements their study and suggests that the human capital impact of military service could also have more benign aspects: improving the literacy skills of recruits and their families.

The second strand of literature to which this paper contributes is the fast growing body of research on the effects of colonial institutions on economic growth. In their seminal contribution, Acemoglu *et al.* (2001) assert that settler mortality had a persistent impact on economic growth through institutions. In contrast, Glaeser *et al.* (2004) emphasise that colonisers exported human capital alongside institutions. These authors point out that there is very little evidence on which specific colonial policies promoted institutional development and/or human capital accumulation. Bridging this gap in our understanding of colonial economic history, a large literature has recently emerged on the economic impact of specific colonial institutions in specific regions.[6] Chaudhary (2009; 2010) shares

[4] Key contributions on the individual returns to military service include Angrist (1990 and 1998), Angrist and Krueger (1994), Bedard and Deschenes (2006), Imbens and van der Klaauw (2005), Grenet, Hart and Roberts (2011).

[5] These findings are consistent with earlier survey evidence from the Sierra Leonean civil war (Humphrey and Weinstein, 2007). Costa and Khan (2010) find that US civil war veterans faced higher mortality due to war time stress. See Blattman and Miguel (2010) for a review of the literature on the role of veterans in post-war reconstruction.

[6] Key contributions include Acemoglu, Johnson and Robinson (2001), Banerjee and Iyer (2003), Cassan (2009), Cogneau (2008), Dell (2010), Donaldson (2009), Huillery (2009), Moradi (2008) and Nunn (2008 and 2009).

my focus on human capital accumulation in colonial India. She finds that public spending on primary education is positively associated with male literacy and that private investment in education was more limited in districts with high religious diversity. This paper complements these findings by exploring if military service could promote human capital development in this context of severe private and public underinvestment in education. More broadly, it is striking that, in the large literature on colonial institutions, the role of colonial armies has received little attention.[7] Nevertheless, one could argue that no other colonial institution required as much close collaboration and interdependency between local non-elite groups and their colonisers. This paper provides one of the first attempts at assessing the developmental effects of recruitment into the colonial armies.

Finally, this paper relates to the large literature on literacy and education. While public education reaches an ever growing number of students in the developing world, educational attainment remains low.[8] Recent work highlights how non-traditional and informal learning environments could play an important role in improving educational outcomes, in particular for adult learners.[9] In the context of the Indian Army, the historical evidence discussed in this paper suggests that the military service dramatically boosted the personal returns to literacy skills. As a mail service was provided to soldiers, being literate facilitated the soldier's correspondence with his family. Moreover, the Indian Army provided literature (including religious books and pedagogical material) to entertain soldiers. Hence, the direct acquisition of literacy skills by Punjabi soldiers could reflect the effectiveness of non-traditional learning environments that offer increased personal returns to literacy in combination with decreased learning costs.

This paper is organised as follows. First, I outline the historical background of military recruitment in colonial Punjab. Second, I discuss the mechanisms through which military recruitment could affect literacy. Third, I introduce the data set I use in this study. Fourth, I present the empirical strategy. Fifth, I interpret the

[7] Moradi (2008, 2009) uses information on recruits in the African colonial armies to assess the impact of colonisation on nutritional status, but he does not assess the developmental impact of military recruitment in itself. Fafchamps and Moradi (2010) find that soldiers entering the British Colonial Army in Ghana based on referrals performed worse than their non-referred colleagues. Echenberg (1975) argues that conscription in French West Africa during the First World War contributed to the subsequent economic stagnation of this region.

[8] UNESCO (2008). See also Glewwe and Kremer (2006), and Duflo, Dupas and Kremer (2009).

[9] For example, Aker, Ksoll and Lybbert (2011) evaluate a programme that teaches adults literacy skills by using mobile phones. Given the low cost of text messages sent by mobile phones, the personal returns of acquiring literacy skills are very large in this programme.

empirical results. Sixth, I discuss the robustness of my findings. Finally, I offer concluding remarks.

2.2 Historical background

In this brief historical overview, I sketch the context in which military recruitment took place in colonial India. In the seventeenth century, the Indian Army was conceived by the East India Company as just a small irregular force that would draw recruits from the local population. However, the importance of this so-called "native army" grew steadily and, by 1856, the British Raj relied on the Indian Army for most of its security needs.[10] Throughout the 19th century, the Indian army remained of central importance to the Raj to counter the advances of Russian forces in Afghanistan.

When WWI broke out in 1914, the Government of India had more troops at its disposal than it strictly needed for its internal security. For this reason, the Indian Army entered the war in 1914.[11] As the war developed, the Indian Army kept on providing ever more troops. Raw figures illustrate the enormous scale of the war-time recruitment effort in colonial India: out of a population of approximately 20 million, the number of Punjabi troops increased from 69,458 to 362,027 over the period 1910-19. The underlying recruitment efforts had to rise even more to keep up the size of the army in the face of casualties. During the war, India sent 138,000 men to France, 675,000 men to Mesopotamia and 144,000 men to Egypt. Of these 957,000 recruits, at least 74,260 men died, of whom approximately 19,000 had been recruited in Punjab.[12] The Indian army kept on playing an important role in the Middle East and on the Indian-Afghan border until 1921 (i.e., after Armistice). Therefore, the full demobilisation of WWI recruits was not reached until the mid-twenties.

Historians argue that the First World War was crucial for the industrialisation of India and that large-scale recruitment and the foreign experience of soldiers

[10] The potential dangers of this strong dependence on native troops became apparent when the so-called Sepoy mutiny broke out in 1857. The mutiny was initiated by native soldiers and shook the British interests to their core. The Sepoy mutiny marked a clear shift in the regional composition of the military, which will be discussed in more detail later.

[11] See Mason (1974, p. 410) on the motives of the Indian Government to assist mainland Britain in the war.

[12] Figures drawn from Mazumder (2003, p.18) and the CWGC Debt of Honour Register.

contributed to the emerging independence movement (Lawrence, 1997).[13] An assessment of the economic impacts of the first World War is well beyond the scope of this paper. Similarly, this paper is not able to identify the general equilibrium impact of military recruitment. For instance, the fact that the Indian Army was financed by taxes raised by the Raj would have to be taken into account to make any assessment about the net impact of military recruitment. However, this paper illustrates a specific result of the outbreak of the Great War: the distributional impact of First World War recruitment on human capital development.

2.3 Mechanisms and conceptual framework

The key focus of this paper is on the impact of military recruitment on literacy rates. There are multiple channels through which military recruitment could affect literacy outcomes at the district-religion level, three of which are discussed here: (i) direct skill acquisition by serving soldiers, (ii) increased demand for the education due to higher earnings, or (iii) preferential public spending on primary education.

First, soldiers could acquire literacy skills on service. While most military cantonments provided some schooling in peace time, extensive schooling cannot have been an important part of the standard training of the large numbers of new recruits who were set to serve abroad in WWI. However, historical accounts highlight the strength of the personal relationships between British officers, Indian sub-officers and the soldiers under their command. They point at the extent to which skills were shared during the many hours that soldiers had "to kill" in their small companies.[14] Such a direct learning channel appears to be referred to by the census report of 1931, as one of the reasons why heavily recruited districts saw an increase in literacy rates (Khan, 1932, p216):

> "[...] Ludhiana and Shahpur, and most of the district with the next highest percentage of increase, namely Rawalpindi, Jhelum, Gujrat and Mianwali, also owe the increase in literacy to the return home of demobilised soldiers, who very often pick up reading and writing in

[13] The relationship between large-scale war-time military service and the demand for political and economic reforms is explored by Prezworski (2007), Scheve and Stasavage (2010), and Ticchi and Vindigni (2008).

[14] Mazumder (2003). In WWI, all Indian soldiers and low-ranking officers were under direct command of British officers, as native soldiers were not deemed capable of fulfilling officer roles.

> Roman or any other of the vernaculars in the course of their military career."

Similar statements can be found in the reports of the Censor of letters from soldiers serving abroad (Censor of Indian Mail, 1915):

> "Under stress of necessity many Indian soldiers during their stay in Europe have learned to read and write their own languages, and primers and spelling books come in large quantities from India to the army."

The latter quote suggests that the main channel through which soldiers acquired literacy was not formal training, but the boost in the personal returns to becoming literate. Unfortunately, the report does not explicitly identify the factors that contribute to the “stress of necessity” it refers to. In other sections the Censor Reports mention several contributing factors. First, the Indian Army maintained a postal service. Hence, literacy skills could facilitate the communication between soldiers and their families enormously. Interestingly, this channel could operate both within the army and in their home region. Given that this study identifies the impact on aggregate literacy, the results could capture both the impact on serving soldiers and on their families who remained in India. Second, acquiring literacy skills could have been particularly important for soldiers who were heavily wounded in the fighting, as this could allow them to take on relatively well paid jobs that did not require hard physical labour. Third, literacy could have facilitated communication at the battlefield. Finally, and perhaps most importantly, military life outside of the battlefield was often uneventful and the demand for leisure activities of any sort was strong. In response to this demand, the Indian Army published magazines that brought soldiers news from India and from the front line. Similarly, the army provided soldiers with a steady supply of religious literature (Censor of Indian Mail, 1915). In brief, the military could have offered a unique environment, in which the costs of acquiring literacy skills were reduced and the returns were boosted.

A second broad channel through which military recruitment could affect literacy is through an income effect. The inflow of military income could have fuelled a demand shock for education, both in formal schools and informally through learning from relatives or friends. The recruited communities were most likely to be affected by the remittances of soldiers who were on duty and by pensions for ex-soldiers. Mazumder (2003) provides descriptive evidence of the impact of military incomes on a large number of outcome variables, including clothing, housing, dietary choices and education. Mazumder notes that "[t]he education of children was another investment soldiers willingly made" (2003, p.42). While primary education was free, books, stationary, and uniforms made education expensive in rural areas (Darling, 1934, p.173). The income effect could potentially be further boosted by changes in preferences that were induced by military service. The following Jat soldier writing from France is quoted in Mazumder (2003): "What we have to do is educate our children, and if we do not we are fools and our children will be fools also". While demand for education (as a normal good) should increase in response to an inflow of income, the loss of male labour forces in the home communities due to the mobilisation of men for military service can counteract this effect. In the presence of credit and labour market imperfections, the opportunity cost of sending children to school may increase substantially if households have less labour available to work on the land held by the household. Hence, the opportunity cost effect could outweigh the income effect and the impact of large-scale military recruitment on the demand for education remains theoretically ambiguous.

A third channel through which military recruitment may influence literacy is the supply side of education. It is possible that heavily recruited communities attracted more public spending on education. While public spending on education could be exogenously driven by the preferences of the colonial authorities, it is also possible that the public spending reflects increased demand from certain communities. The remarkable success of the military in securing favours for their personnel, often under an implicit threat of rebellion, is indeed a central element in the political economy literature on the military (Collier, 2007). However, the Government of India faced an important trade-off from a recruitment perspective if it was to invest in educating its recruitment grounds: promoting schooling might raise the reservation wage of future recruits. Therefore, the colonial authorities may have preferred not to invest more in education in their recruitment grounds.[15] The responsibility for investments in primary education lay almost exclusively with the so-called District Boards. Chaudhary (2010) reports that the District Boards accounted for 18% of total spending on education, 85% of total primary education spending and 93% of public spending on education in Punjab in 1912-1913. Chaudhary provides historical evidence that suggests that revenues from land taxes were the main determinant of public spending on education. Given that Punjab was subject to the same land revenue system (in which land taxes were collected directly by

[15]Pasha (1998) links military recruitment in Pakistan to underdevelopment on these grounds.

the British authorities and laid down in so-called "settlements"), the revenues and total spending on education in Punjabi districts should be driven mainly by the agricultural potential of the district and not by the intensity of recruitment. Also, given the strong relationship between public spending and tax revenues, increasing public spending on education would probably come at the cost of higher taxation. Furthermore, Chaudhary's evidence suggests that upper-caste elites had considerable influence over the allocation of funds (Chaudhary, 2009). Nevertheless, it remains possible that soldiers or the British authorities could influence district boards to invest more in education in the recruitment grounds, both as an indirect remuneration of its soldiers in response to their political pressure and in an attempt to boost the skills of its future recruits.[16]

In sum, there are three main channels through which military recruitment could affect literacy outcomes in their home communities: direct learning and demobilisation, a demand shock for education due to higher earnings and preferential spending on education by the district authorities. In an attempt to tease out the mechanism underlying the main result, I rely on two approaches. First, I repeat the main analysis for different age groups. If demobilised soldiers are driving the results, the effects should be strongest for men of military age and they should be visible immediately after the war. If, by contrast, the effect is driven by younger age groups and is delayed, then the demand and supply channels for education are more plausible. A second approach, which allows me to disentangle demand and supply shocks to some extent, is an analysis of investment data on education. Assuming that these reflect the independent decisions of the local authorities of how much to fund education in a given district, higher investment in recruited districts could reflect a supply shock. If investment does not change noticeably, then a demand-driven change seems more likely.

[16] A specific provider of primary education which could be relevant to this study were the army cantonment schools. These would be open to children of soldiers if they chose to have their family stay at the cantonment. Unfortunately, there is little evidence on the number of military families that lived in the cantonments and made use of these facilities. At one particular WWI recruitment rally, free education up to the secondary school level was promised for the children of deceased and disabled soldiers (Mazumder, 2003). Again, there is no direct evidence on how many children made use of this system and whether it was actually implemented at all.

2.4 Data

In my main analysis, I use military war casualties as proxies for military recruitment. I collect data on the district of origin from a list of soldiers who died during WWI, the “Debt of Honour Register”. This register is administered by the Common Wealth War Graves Commission (CWGC) and has the names of 74,260 Indian military personnel who died in WWI. For virtually all soldiers, the name, the rank, the regiment and the date of death are provided. For 68% of entries, the name of the father and the district of birth have been recorded.[17] This proxy approach necessarily induces some measurement error and this issue will be addressed in detail in section 2.5.

Based on the information in the register, the names of soldiers are used to assign them to two religious groups: Hindu-Sikh or Muslim.[18] The main results will be presented using this distinction and including all soldiers and low-ranking officers in the register (all higher ranking officers were British).[19] Literacy and population details for each of the three religious groups are collected at the district level in Punjab for the four census years (1901, 1911, 1921 and 1931). Twenty-eight districts provide literacy data for all four census years. Nominal expenditures on education by the District Boards are also collected for each of the four census years

[17] This information was in principle recorded on all of the individual service records of each soldier, but according to the CWGC there is no reason to expect missing entries to be systematically different. Several hypotheses can be put forward as to why some entries are incomplete. According to CWGC, the missing information is most likely the result of different attitudes of the clerks who recorded the information of new recruits. These differences in the punctuality of individual recruitment clerks are unlikely to produce a systematic bias. The loss of service records and the ease with which they could be accessed by the Indian administrators who prepared the information for the CWGC is another potential cause of missing records. These hypotheses were put forward by Peter Holton, Records Supervisor at the CWGC.

[18] The algorithm relies on the recognition of Muslim names (such as “Khan” and “Abdullah”) or Hindu-Sikh Names (such as “Singh” and “Ram”) in either the name of the father or the name of the casualty. While there is no theoretical ground not to further distinguish between Hindus and Sikhs, some names (in particular the name “Singh”) are common to both religions. Results not presented in the paper indicate that the main results are robust to a further split-up between Hindus and Sikhs. However, in any such analysis ad hoc assumptions need to be made about how to assign casualties called “Singh” to either the Hindu or the Sikh community.

[19] The Indian army did not just employ soldiers, but hired personnel in a multitude of roles. Approximately 10% of the Punjab casualties were employed as labourers or as part of the transport corps. These are not included in my estimates, as their roles are not strictly military and their recruitment may not have been driven by the same principles as the recruitment of soldiers.

at the district level.[20] These data will be important to distinguish the channels through which recruitment could affect literacy outcomes.

Figure 2.1: War deaths in colonial Punjab

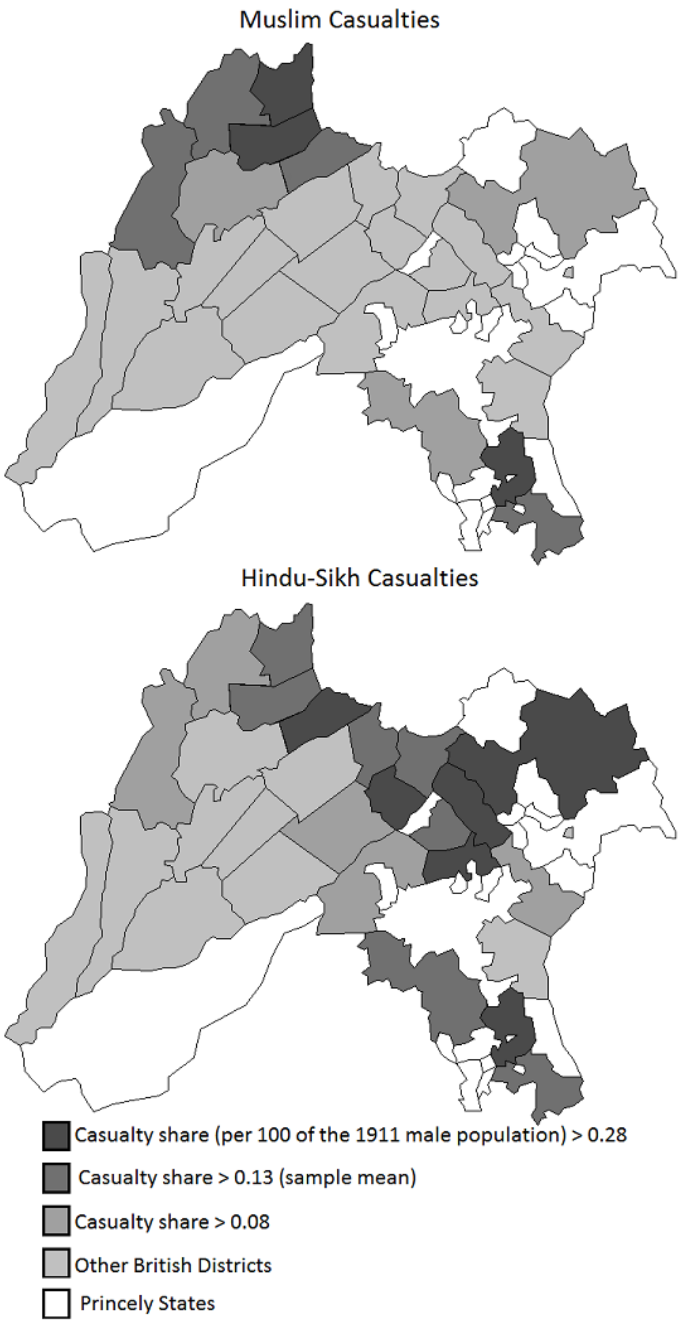


Figure 2.1 maps the number of war deaths recorded in the CWGC register as a

[20] "Reports on the Progress of Education in the Punjab", annual from 1892-1931.

Table 2.1: Summary statistics (district-religion level)

	Sample	Lightly recruited	Heavily recruited	P-value
Male literacy rate 1911	0.11	0.12	0.10	0.57
	(0.12)	(0.13)	(0.11)	
Male population 1911	187,428	176,058	207,893	0.30
	(111,440)	(114,369)	(105,678)	
Muslim dummy	0.50	0.58	0.35	0.10*
	(0.50)	(0.50)	(0.49)	
Difference in literacy rate (1921-1911)	-0.003	-0.008	0.005	0.07*
	(0.004)	(0.039)	(0.015)	
Difference in literacy rate (1931-1911)	0.019	0.012	0.031	0.05*
	(0.036)	(0.038)	(0.031)	
Casualty share (per 100 of the 1911 male population)	0.13	0.04	0.30	0.00***
	(0.15)	(0.04)	(0.13)	
Observations	56	36	20	

Notes: District-religion level observations for two religious groups (Muslim or Hindu-Sikh) in 28 districts. Heavily recruited communities have recruitment above the relevant sample average (0.13 deaths per 100). The table records sample averages and standard deviations (in parentheses). P-values are based on a t-test on the equality of means for Lightly and heavily recruited communities. *** p<0.01, ** p<0.05, * p<0.1.

proportion of the 1911 population in colonial Punjab. The death rates per district are shown separately for both religious communities (Muslim and Hindu-Sikh). The non-coloured areas correspond to the so-called 'princely states' which were not directly governed by the British. As recruitment policies in these areas differed and are less well documented and the availability of data (e.g. on public education spending) is more limited for these areas, the princely states are not included in the main analysis.[21]

Table 2.1 presents summary statistics for all the key variables at the district-religion level. The large standard deviations are indicative of the substantial diffe-

[21]Relying on the princely states would also give rise to serious comparability concerns, for example because most of them are much smaller in size than British districts and were different in several relevant dimensions. See Iyer (2006) for an in depth discussion. In the appendix, I show that the main results are robust to the inclusion of the princely states.

rences between the levels of these variables across communities.[22] As my analysis relies on the comparison of communities that were recruited with varying intensity, I provide separate summary statistics for 'heavily' and 'lightly recruited' districts (based on whether ratio of war casualties is above the sample mean). The share of casualties in the 1911 population is approximately one per thousand at the sample mean. While recruited communities tend to be less literate on average, this difference is not significant. However, the increase in the male literacy rate (1911-31) is significantly higher for the heavily recruited communities.[23] This is the first piece of evidence in favour of the hypothesis that military service promoted literacy.

In Table 2.2, summary statistics are provided at the district level. As several variables of interest are only available for districts, part of the analysis will be conducted at the district level. Most of the differences in baseline variables fail to gain significance. One exception is the colony status of districts.[24] These districts were recipients of extensive irrigation projects and tended to be lightly recruited, which also helps to explain why heavily recruited districts tend to have a larger share of the population that is born in the census district of enumeration in 1911. The potentially confounding effect of colony status and migration will be dealt with explicitly in the robustness checks. Heavily recruited districts also have a higher ratio of students in the male population. While the difference is small in economic terms, it is precisely estimated and significant at the 10% level. Again, my analysis will present findings where this baseline difference is explicitly controlled for.

[22] The econometric specification will take the large variation in average literacy between religious communities into account by including fixed effects and religion-year-effects on the one hand and by measuring outcomes in logarithms on the other hand.

[23] I focus on the male population because this group is most directly affected by military recruitment and educational policies. Female literacy in Colonial Punjab was much lower than male literacy and focusing on combined literacy measures would not change the results. Repeating the analysis of this paper for female literacy suggests a *negative* but non-robust impact of military recruitment on female literacy (appendix A.5.). The size of the male population will also be used in all per capita measures in this paper.

[24] These are located in the band of lightly recruited districts existed in the South-West in Figure 2.1.

Table 2.2: Summary statistics (district level)

	Sample (1)	Lightly recruited (2)	Heavily recruited (3)	P-value (3)-(2)
Male literacy rate 1911	0.07 (0.04)	0.07 (0.04)	0.07 (0.02)	0.76
Male population	379,601 (125,758)	392,421 (142,958)	356,524 (89,001)	0.42
Casualty share (per 100)	0.15 (0.14)	0.06 (0.05)	0.30 (0.11)	0.00***
Primary education spending 1911 (Rs per male)	0.07 (0.04)	0.07 (0.04)	0.07 (0.02)	0.90
Primary school students in 1914 (per male population)	0.021 (0.007)	0.019 (0.007)	0.024 (0.006)	0.07*
Colony dummy	0.21 (0.42)	0.33 (0.49)	0.00 (0.00)	0.01***
Fraction of males born in district of enumeration	0.87 (0.15)	0.83 (0.18)	0.93 (0.04)	0.05**
Population density (1911 male population/ha)	149 (83.6)	142 (87.2)	161 (79.5)	0.56
Fraction of Muslims (in 1911 male population)	0.56 (0.27)	0.59 (0.24)	0.51 (0.33)	0.50
Fraction of Hindus (in 1911 male population)	0.32 (0.27)	0.30 (0.20)	0.37 (0.34)	0.52
Fraction of Sikhs (in 1911 male population)	0.10 (0.10)	0.09 (0.08)	0.11 (0.14)	0.79
Observations	28	18	10	

Notes: District level observations in 28 districts. Heavily recruited districts have recruitment above the sample average. The table records sample averages and standard deviations (in parentheses). P-values are based on a t-test on the equality of means for lightly and heavily recruited districts. *** p<0.01, ** p<0.05, * p<0.1.

While the census data used in this study are very rich in comparison to other contemporary data sets, they still give rise to measurement concerns. First, the definition of literacy has changed over the years. In the 1901 census, literates were expected to be able to "both read and write” in any language (Kaul, 1912, p316). In practice, it was often sufficient for respondents to be able to spell out words from a book or to be able to sign with one’s name to be recorded as "literate" (Kaul, 1912). It is suggested in the census report that this would mostly affect people who were able to read religious texts. From 1911 onwards, the definition became more strict: "[a] person should not be entered as literate unless he can write a letter to a friend and read the answer to it". While this change in definition makes the literacy numbers not directly comparable, the inclusion of year-effects in my econometric specification can account for the effect of this administrative change that was common to all units of observation. While differences in enumerator practices are unlikely to produce systematic measurement error, I choose not to include 1901 in the sample for the main results. However, I use the 1901 data to estimate pre-treatment effects.[25] A second measurement concern relates to border changes. Certain districts were subject to boundary changes over the census years. Merging or dropping the affected districts limits the number of observations severely. The main analysis will focus on the literacy rates of the nominal districts, but the appendix presents results for merged districts with constant borders that are quantitatively very similar (see Table 2.10).

2.5 Empirical strategy

2.5.1 Main specification

To account explicitly for the possibility that the recruited communities enjoyed different levels of literacy, the main identification strategy is based on the comparison of literacy rates in years before and after the war, for heavily and lightly recruited communities. This approach could be interpreted as a continuous difference-in-

[25]Chaudhary (2010) does not include 1901 in her sample on the grounds that the 1901 data on literacy would suffer from substantial variation across provinces in the methods adopted. Given that I am focusing on just one province (i.e. Punjab), I expect the 1901 data to be comparable in the cross-section and I expect the definition change to have proportional effects that do not bias my results.

difference analysis. The corresponding econometric specification is:

$$Log(literacy_{r,d,t}) = \sum_{\tau=1921,31} \beta_\tau * (casualties_{r,d,1911}) * I(t=\tau) + \varphi_{r,t} + \theta_{r,d} + \varepsilon_{r,d,t} \quad (2.1)$$

$Log(literacy_{r,d,t})$ is the logarithm of the male literacy rate of religion r in district d in year t (1911, 1921, 1931).[26] β_{1921} and β_{1931} are the key parameters of interest. They measure the impact of the intensity of military recruitment, as proxied by the casualty share, on subsequent literacy rates. $\varphi_{(r,d)}$ and $\theta_{(r,t)}$are respectively district-religion and religion-year fixed effects. This specification accounts for omitted variables at the district-religion level that do not change over time and time-varying determinants of literacy that are specific to each one of the religious groups.

In $Log(literacy_{r,d,t})$, the use of the literacy rate raises the concern that effects could be driven by both the denominator (the total male population) instead of the numerator (the total number of literates). To account for this possibility, the main specification is repeated with the logarithm of the size of the male population as a dependent variable. Furthermore, the logarithmic specification is used to make estimates less dependent on observations with high literacy rates. This specification seems appropriate given the large differences in the level of the dependent variable in various districts (which is reflected in the large standard deviations on the literacy rate in Table 2.1). This specification also ensures the proportionality of all estimated effects; on theoretical grounds, one can expect the process that is driving the creation of more literates to be multiplicative to the existing stock of literates.[27]

The impact of military recruitment is captured by the coefficients β_τ on the number of war deaths as a proportion of the 1911 male population for a religious group $casualties_{r,d,1911}$. The estimation of two separate coefficients allows me to interpret the timing of the effect. Given that full demobilisation was only reached in the mid-twenties, one could expect β_{1931} to be higher than β_{1921}.

[26] As recruitment practices were set out at the district-religion level, this is also the most natural unit of observation in this context. In the main tables, I use standard errors adjusted for clusters at the district-religion level, but using district level clusters instead does not affect the significance of most results.

[27] The findings are robust to alternative functional specifications of the dependent variable, including the use of literacy rates as level, a log-odds specification (which ensures full support of the dependent variable) and the logarithm of the number of male literates.

The religion-time fixed effects $\theta_{(r,t)}$ account for factors determining literacy of all communities of the same religion in the whole of Punjab. The inclusion of religion-year effects (rather than just year-effects) can be justified because Muslim communities were characterised by larger proportional increases in literacy rates than Hindu-Sikh communities during the period under study. The distinctive literacy characteristics of different religious groups are well documented.[28]

The fixed effects $\varphi_{(r,d)}$ account for unobservable determinants of literacy that remain constant over time at the district-religion level. The inclusion of district-religion fixed effects may alleviate concerns that recruitment grounds were selected or that recruits could choose to join the army on the basis of unobserved determinants of literacy.

In the results section, variations on the main specification will be presented to address specific endogeneity concerns or to tease out the relevant channel.

2.5.2 Endogeneity

For the above main specification to yield causal estimates of the treatment effects, I rely on three assumptions:

1. The recruitment patterns of the Indian army did not change substantially over the course of the First World War and reflected the demand side constraints imposed by the British recruiters.
2. The selection of recruitment grounds was unrelated to the potential for literacy improvements between 1921 and 1931.
3. The measurement error induced by using war casualties as a proxy for recruitment is non-systematic and small.

Regarding the first assumption, the historical context provides evidence of the persistence of recruitment patterns. The recruitment policies in place during the First World War had been established in the second half of the 19th century, when recruitment shifted towards the so-called 'martial races'. The 1857 Sepoy mutiny had justified a shift in the recruitment patterns away from high-caste Hindus from present-day UP, who had constituted the core of the pre-mutiny army. The supposedly superior fighting skills of the martial races, who were predominantly living

[28]The 1921 and 1931 census reports discuss the causes of these different patterns in detail (Marten, 1921 and Khan, 1932).

in North-West India, were deemed to be crucial for the Indian Army to withstand a Russian invasion of India.[29] Recruitment handbooks, commissioned by the Quartermaster-General, provided religion-specific assessments of the 'martialness' of the population at the district or even village level.[30] The recruitment policy also shaped the organisational structure of the Indian army, in which most battalions were composed of men of the same caste, religion and region. Recruitment policies from the late 19th century onwards helped to entrench the composition of the army, because the army mainly relied on serving soldiers to identify "good recruits" in their home villages. The result of this policy was that recruitment patterns did not change substantially during the First World War. Hence, the main effect of increased military recruitment during WWI was a demand shock for military labour in those groups that had already been identified as good military recruitment grounds.[31]

In support of this hypothesis of entrenched recruitment patterns, Figure 2.2 plots war deaths before and after 1916 for each district-religion. I expect casualty numbers in the beginning of the war to reflect the pre-existing recruitment patterns. In contrast, the casualty numbers in a later stage of the war could reveal shifts in the recruitment pattern during the war. The linear pattern in Figure 2.2 supports the hypothesis that recruitment patterns at the district-religion level remained stable over the course of the war.[32]

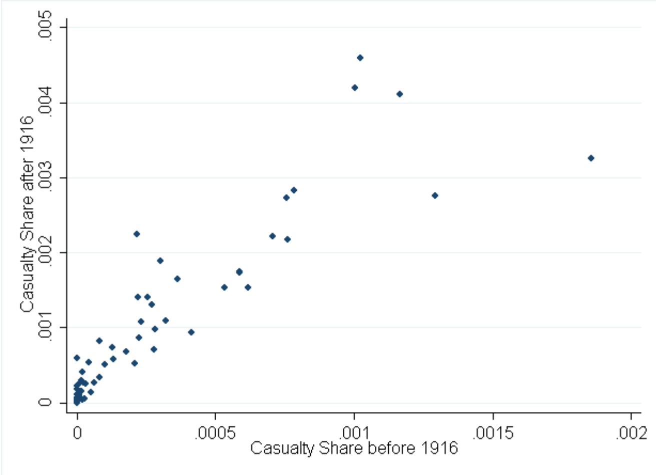
[29] According to Mazumder (2005, p 16-17), the rationale behind the martial races theory included: (1) a further justification to stop recruiting from disloyal groups implicated in the 1857 mutiny; (2) the increased need for troops that could engage in guerrilla war fare, for which men living the North West were supposed to be the best pick; (3) Quartermaster-General Frederick Robert's personal prejudice, as he had himself only served in the North of India; and (4) the fashionable trend in European anthropology to explore and exploit the intrinsic qualities of different races.

[30] Falcon (1892) and Bingley (1897a, 1897b, 1899).

[31] 'The bulk of the army was drawn from those classes which had traditionally been recruited' (Cohen, 1971, p.69) Even though the recruitment grounds could not be met entirely by these so-called traditional classes, the Indian Army kept on restricting recruitment rigidly: 'Of the seventy-five new classes which the army recruited, many were either closely related to classes already on the army list [...] and many were formerly recruited classes[...]' (Ibid., p.73).

[32] War deaths before 1916 account for approximately 22% of all recorded military casualties who originated from Punjab. The correlation between the casualty shares is 0.89.

Figure 2.2: Time pattern of casualty shares at the district-religion level



Notes: Observations are at the district-religion level, for 56 districts and 2 religious groups (Hindu-Sikh and Muslim). Casualty shares are relative to the 1911 population.

The second assumption paraphrases the common trend assumption. There is no historical evidence that the British targeted communities that had a higher potential for literacy improvements over the period 1911-31. Praising the fighting skills of Jat Sikhs, Falcon writes (1892, p.107):

> “Hardy, brave and of intelligence too slow to understand when he is beaten, obedient to discipline, devotedly attached to his officers [...], he is unsurpassed as a soldier in the East [...]”

It is interesting to note that the criteria were not just limited to caste or religion, but also took into account the regional characteristics of potential recruits:

> “The value of Sikh recruits and the characteristics they are likely to show themselves possessed of, depends more upon the districts they come from than upon the tribe they belong to” (Bingley, 1897, p61)

> "The cultivation of sugar cane to any great extent seems to me to give a softer character to the cultivator" (Falcon, 1892, p.83)

These recruitment handbooks suggest that recruitment officers relied on a multitude of selection criteria that have no obvious connection with the potential for literacy improvement. Besides, the selection of recruitment grounds took place well before the First World War. Therefore, the historical evidence seems to justify the interpretation of the observed recruitment surge as an exogenous shock.

For this reason, I rely on a standard (continuous) difference-in-difference specification to derive my results. However, it remains possible that a few selection criteria (such as sugar cane production) are correlated with determinants of human capital formation in the period of this study. My analysis deals with these concerns in two ways. First, Table 2.1 and Table 2.2 fail to find significant differences between heavily and lightly recruited communities/districts for most relevant variables. As a robustness check of the main results, time-effects of these baseline controls are included to account for the possibility that military recruitment is merely picking up the effect of another variable. Second, direct evidence of the validity of the common trend assumption is provided by the estimation of a 'pre-treatment' effect that relies on observations between 1901 and 1911.

The third identifying assumption is that the error resulting from my proxy approach is orthogonal to the regressors. As a first check of the validity of the proxy, the casualty data can be compared to independent sources of information. Of the six districts of which the 1931 Census Report suggests that demobilised soldiers may be boosting literacy rates, five have a proportion of military war deaths in the 1911 population that is above the median and the mean at the district level. The assumption that casualties are proportional to recruitment can also be examined explicitly at the Province level. Out of 50,935 casualties for which the records provide information on the father and place of birth, 19,073 casualties could be matched to Punjabi districts. Under the assumption that all remaining casualties originated from other Provinces, the implied percentage of Punjabi soldiers in the Indian Army was 37%. This percentage should slightly underestimate the actual percentage of Punjabi recruits, as I assigned imprecise Punjabi records that did not allow for matching to the other Provinces. Independent sources put the actual percentage of Punjabi soldiers in the Indian Army between 39% and 44% during the First World War.[33] Therefore, the casualties at the state level appear to be largely proportional to the underlying number of recruits.[34] The proportionality of war casualties could have been a direct result of strategic considerations. Historical

[33]Figures drawn from Mazumder (2003, p.18) and the CWGC Debt of Honour Register.

[34]Jha and Wilkinson (2010) can compare recruitment estimates from the CWGC casualty records to actual recruitment numbers for certain provinces, including Punjab, during the Second World War. They find that casualty data are "broadly reflective" of recruitment patterns. Areas with an intermediate recruitment intensity were underrepresented in these casualty numbers. Unfortunately, I cannot assess to which extent this conclusion carries through to WWI. Nevertheless, the results presented in this paper are robust to a variety of alternative specifications (including an analysis based on recruitment quantiles rather than a continuous measure).

evidence indicates that the Indian Army deliberately sent representative units on its foreign missions.[35] Based on its experience from the Sepoy mutiny, the Indian army made regiments sufficiently heterogeneous to limit the risk of mutiny. Hence, regiments would typically recruit from different districts (and sometimes even religions). In support of the idea that the Indian Government sent "representative" units on its foreign missions, I find that the regiments for which I observe Punjabi casualties recruited on average from at least 10 different Punjabi districts. A final concern regarding the proxy approach is that literate soldiers faced different probabilities of death. However, Indian soldiers could not typically rise to the rank of officer during WWI (Mazumder, 2003). Therefore, literate soldiers should not have faced dramatically different hazards in battle than illiterate soldiers.[36] For all these reasons, I rely on a proxy approach in the main results. However, in recognition of the remaining concerns related to measurement error, I also present IV results that should not suffer from bias due to measurement error. The IV approach takes the early assessments of British officers seriously and uses these as an instrument for the observed WWI casualty share. If the first two identifying assumptions hold, the IV estimates will be unbiased. The IV estimates should also remain unaffected by temporary economic conditions that could affect recruitment during the World War.[37]

2.6 Results

2.6.1 Main specification

The results from the baseline specification can be found in Table 2.3. Column (1) shows that an increase in the casualty share by 0.1 per 100 of the male population is associated with an increase in the literacy rate by 4.6 per cent (proportional). Based on a back of the envelope calculation, this implies that for 1 additional recruit per 100 of the male population, the literacy rate increases by 2.4 per cent

[35] This argument is put forward by Jha and Wilkinson (2011).

[36] See appendix for robustness checks based on rank.

[37] One final caveat to this identification strategy is that the selection of recruits within districts (or religious communities in a given district) is not random. At the level of individuals, recruitment was targeted at young and healthy men of particular castes. Similarly, within the groups who qualified for recruitment, the poorest individuals were most likely to enlist. While this within-group selection is relevant for the interpretation of the treatment effect, it does not invalidate the identification strategy, which relies on the comparison between groups.

in 1931.[38] Evaluated at the sample mean, this corresponds to an increase of three additional literate males per thousand of the male population.

Table 2.3 also provides the first piece of evidence on the mechanism. In columns (2) and (3), the baseline regression is run for two age groups separately: over-20-year-old males and under-20-year-old males.[39] While military war deaths are not associated with significant literacy improvements for the under-20-year-olds (column 3), the over-20-year-olds in recruited communities improved their literacy significantly relative to other communities (column 2). The fact that over-20-year-olds are driving the main results supports the hypothesis that direct skill acquisition is a key mechanism through which military recruitment improved literacy. If the improvements in literacy are driven by the return of demobilised soldiers to their home communities, then we should only expect literacy to improve for men above military age and for the impact to be visible immediately after the war (in 1921). If over-20-year olds would see their literacy improve in response to higher earnings, one would expect to see a similar (if not a stronger) effect on under-20-year olds, as they have the lowest opportunity cost of acquiring literacy skills through education. The further increase in the literacy rate from 1921 to 1931 is consistent with the fact that complete demobilisation was only reached after 1921. The estimated returns to military service are large in economic terms. Chaudhary (2009, 2010) highlights the limited effectiveness and efficiency of the public education system in terms of improving adult literacy. In this context, it is particularly striking that military service was able to improve adult literacy.

The right-hand-side columns confirm that military recruitment did not have an impact on the size of the population, which addresses the concern that the observed effects on literacy rate are driven by changes in the denominator. One reason for why war casualties had a limited direct impact on the aggregate population size is that the casualty rate remained relatively low (on average, 1 out of 18 recruited soldiers were recorded as a war casualty in the Debt of Honour Register).

[38] I assume an equal probability of dying and divide the number of Punjabi men recruited for overseas service (app. 360,000) by the number of Punjabi war deaths (app. 19,000) to obtain an estimate of the number of recruited soldiers corresponding to one war death (18.94).

[39] One caveat on the analysis of these numbers for different age groups is that a large proportion of respondents would typically not know their age. The resulting measurement error is likely to be classical (Chaudhary, 2010).

Table 2.3: Baseline specification

	Log(male literacy rate)			Log(male population)		
	All ages	Over 20	Under 20	All ages	Over 20	Under 20
	(1)	(2)	(3)	(4)	(5)	(6)
Casualty share	0.33**	0.40**	0.06	0.13	0.13	0.14
*1921	(0.16)	(0.15)	(0.21)	(0.17)	(0.17)	(0.17)
Casualty share	0.47*	0.50**	0.30	0.10	0.10	0.09
*1931	(0.24)	(0.20)	(0.33)	(0.19)	(0.19)	(0.20)
Observations	168	168	168	168	168	168

Notes: District-religion level observations for two religious groups (Muslim or Hindu-Sikh) in 28 districts, for three census years (1911-31). Casualty shares are expressed per 100 of the 1911 male population. All regressions include district-religion fixed effects and religion-year effects. Standard errors are clustered at the district-religion level. *** p<0.01, ** p<0.05, * p<0.1.

Table 2.4: Pre-treatment effect

	Log(male literacy rate)			Log(male population)		
	All ages	Over 20	Under 20	All ages	Over 20	Under 20
	(1)	(2)	(3)	(4)	(5)	(6)
Casualty share	0.02	0.10	-0.13	-0.37***	-0.34**	-0.41***
*1911	(0.11)	(0.11)	(0.22)	(0.13)	(0.13)	(0.13)
Casualty share	0.32*	0.47***	-0.09	-0.21	-0.18	-0.24
*1921	(0.17)	(0.15)	(0.28)	(0.26)	(0.26)	(0.27)
Casualty share	0.41	0.52**	0.07	-0.23	-0.21	-0.28
*1931	(0.26)	(0.22)	(0.40)	(0.30)	(0.28)	(0.31)
Observations	204	204	204	204	204	204

Notes: District-religion level observations for two religious groups (Muslim or Hindu-Sikh) in 26 districts, for four census years (1901-31). All regressions include district-religion fixed effects and religion-year effects. Rawalpindi and Attock are omitted from this analysis because of substantial border changes. Standard errors are clustered at the district-religion level. *** p<0.01, ** p<0.05, * p<0.1.

In Table 2.4, the sample is restricted to allow for the estimation of a ‘pre-treatment effect’ by including the first census years.[40] While the use of the 1901 census data gives rise to additional measurement concerns (as discussed in section 2.4), the results are in line of earlier findings. Most importantly, the pre-treatment effect on the male literacy rate is estimated to be insignificant and close to zero, which addresses the concern that the casualty share could be picking up an existing trend. The estimates in columns (4)-(6) show that higher war deaths are associated with a significant decline in the male population relative to other districts. This effect is due to the fact that none of the districts with canal colonies were heavily recruited (as shown in Table 2.2), while these canal colonies attracted large numbers of immigrants over the period 1901-11. This effect disappears as soon as year-effects for the canal status of a district are included in the regression, while the results on the literacy rate remain very similar.[41] The absence of a pre-treatment effect on literacy rates adds credibility to the common trend assumption that underlies my identification strategy.

2.6.2 Public spending and education

To rule out the possibility that investments in education by the District Boards are driving my results, this section analyses the extent to which education expenditures can explain the observed literacy patterns. Three outcome variables are considered: total primary school expenditures, the net expenditures on primary education, and the number of native-language students enrolled in public and private schools. If recruited districts were successful in attracting more educational investment by the local authorities after the war, one would expect a positive effect on these expenditures. If military service created a demand shock for education, this should be reflected in the number of students.

As school expenditure and student data are only available at the district level, the variables of interest were aggregated at the district level instead of at the district-religion level.

[40] The complete version (including the year effects) of Table 2.3 is reported in appendix subsection 2.9.2. The table clearly show that Muslims and Hindus enjoyed different literacy patterns: while Hindu communities were on a decreasing literacy trend between 1911 and 1921 (which followed an existing decreasing trend between 1901 and 1911, results not reported), Muslim literacy improved steadily over the sample period. The census reports offer detailed explanations of these general trends (Kaul, 1912; Marten, 1921; and Khan, 1932).

[41] Results with inclusion of these controls are reported at the district level in Table 2.9.

Table 2.5: Expenditures on education

	Primary education		
	Log(Primary expenditure rate)	Log(Net primary expenditure rate)	Log(share of primary students)
	(1)	(2)	(3)
Casualty share*1921	-0.50*	-0.44	-0.24
	(0.27)	(0.29)	(0.28)
Casualty share*1931	(0.41)	-0.41	
	(0.51)	(0.54)	
Observations	84	83	40

Notes: Observations are at the district level for three census years (1911-31) for column 1 and 2. Column (3) includes 20 districts that provide data on students for 2 years (1914-21). Casualty shares are expressed per 100 of the 1911 male population. All regressions include district fixed effects. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1.

Table 2.5 relies on the main specification (now estimated at the district level) to examine the association between military war deaths and primary education expenditures.[42] Column (1) of Table 2.5 uses total spending on primary education at the district level as the dependent variable. This column shows that the evolution of spending on primary education bears little relationship to the proportion of military war deaths to the 1911 population. If anything, heavily recruited districts spent less on primary schooling after the war. This finding goes against the hypothesis that the colonial authorities targeted education spending to heavily recruited districts. To the contrary, the Government of India may have feared that too much educational investment in the recruitment zones could undermine the recruitment potential of these regions by improving the outside options of prospective soldiers. The results on net expenditures on primary education (column 2) remain close to those obtained in column (1), which reflects the fact that fees only accounted for a small fraction of total spending on primary education. Column (3)

[42]Chaudhary (2009 and 2010) argues that literacy in colonial India mainly depended on the availability of primary schools, which suggest that this category of expenditures is most relevant. The results are robust to the use of total (net) education spending by the District Boards instead of primary education spending.

presents a difference-in-difference analysis of student enrolment between 1914 and 1921 and shows a negative but non-significant impact of military recruitment on the number of students in vernacular primary schools (both in public and private education).[43]

Table 2.6: Controlling for education at the district level

	Log(male literacy rate)					
	All ages		Over 20		Under 20	
	(1)	(2)	(3)	(4)	(5)	(6)
Casualty share *1921	0.47***	0.54***	0.51***	0.64***	0.33*	0.26
	(0.17)	(0.17)	(0.17)	(0.15)	(0.17)	(0.25)
Casualty share *1931	0.49*	0.51**	0.47*	0.54*	0.50*	0.45
	(0.24)	(0.28)	(0.23)	(0.27)	(0.29)	(0.36)
Log(Primary expenditure rate)	0.02		-0.04		0.19*	
	(0.07)		(0.06)		(0.097)	
1911 Primary expenditures - year effects		Yes		Yes		Yes
1914 student share - year effects		Yes		Yes		Yes
Observations	84	84	84	84	84	84

Notes: Observations are at the district level for three census years (1911-31). Casualty shares are expressed per 100 of the 1911 male population. All regressions include district fixed effects and year effects. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1.

The hypothesis that public investment in education is not driving earlier findings is further confirmed in Table 2.6. The findings from this specification are in line with earlier results, even though the analysis is now conducted at the district level.[44]

[43]Unfortunately, I have not been able to locate student enrolment data for years after 1922. Even for 1921, the information is incomplete. However, the main result on the relationship between the casualty share and literacy holds for the districts included in column (3), i.e. the subsample of 20 districts that provide enrolment data for 1921 (results not reported).

[44]As the control variables considered in this section only vary at the district level, I use the

In the odd columns, contemporaneous spending on primary education is included as a control in the main regression. This specification checks if the observed effects of war deaths can be explained by expenditures on public primary education. The even columns allow for initial investment in education (in 1911) and student enrolment rates (in 1914) to have a year-specific effect on literacy outcomes. This specification addresses the concern that recruited districts had already attracted preferential investments in education before the war. The interaction between initial spending on education and year dummies allows for a delayed impact of initial investments on literacy rates. The main results are robust to the inclusion of year effects for 1914 student enrolment. The positive relationship between education spending and literacy in column (5) is consistent with Chaudhary's evidence (2010). In conclusion, the results on public expenditures on education indicate that education expenditures are unlikely to drive the observed improvements in the human capital stock of recruited communities relative to lightly recruited communities.

In conclusion, the results presented in this section seem most consistent with direct skill acquisition by serving soldiers. While the aggregate impact could include spill-overs to wider community, the size of the effect is not larger than the total number of recruits. Therefore, the results are consistent with the impact being limited to soldiers. Further analysis suggested that recruited districts were not directly targeted by investments in education. Nor is there evidence of stronger demand for education in the recruited districts. The fact that military recruitment did not lead to strong inter-generational spill-overs or to higher public spending on education may have limited the long-run distributional impact of military recruitment in Punjab.

2.7 Robustness

In this section I discuss the robustness of the results presented earlier in more detail. First, I return to the identification of the main result and present an alternative IV approach. Second, I go over confounding policies and alternative explanations for the results presented earlier.

district-level average literacy rate as the dependent variable. However, the coefficients on war casualties are similar (and more precisely estimated) when these regressions are run at the District-Religion level.

2.7.1 An IV approach

The historical evidence presented in section 2.5 and the insignificance of pre-treatment effects justified an identification strategy based on raw proxies for military recruitment. As a further robustness check, I present an instrumental variable (IV) approach based on the classification of districts in terms of their recruitment potential by British recruitment officers. My key source of information for this exercise is a set of publications by Captain A. H. Bingley, who wrote detailed handbooks for the recruitment of Sikhs and Dogras (Bingley, 1897, 1899).[45] Based on the qualification of districts in these publications, I construct an indicator variable to measure "recruitment suitability". For recruitment suitability to be a valid instrument, it needs to be correlated with the proxy for military recruitment and it cannot influence the observed literacy pattern through any other channel than through military recruitment (as proxied by war deaths). Given that the recruitment officers were led in the first place by a wish to identify the best fighting races, regardless of their average willingness to enlist, one could expect the classifications made by these officers to have no relationship with the determinants of literacy in these Hindu-Sikh communities. Moreover, the assessments of recruitment suitability were made well before the start of the First World War.

The information provided by Bingley differs for each publication. For Sikhs, Bingley reports a ranking of tahsils (sub-districts) based on their suitability for military recruitment (ranging from "very good" to "very bad"). I create a score for each tahsil within a district, ranging from 0-1 (where 1 corresponds to "very good") and I use the average score. For Dogra recruits, information is only available on which tahsils make the "best" recruitment grounds (without further distinction). I assign a district "1" to each district containing a tahsil that was considered as a top recruitment ground. Since Bingley's detailed assessments are only available for Hindu-Sikhs, I have to limit the IV analysis to this religious group.[46]

The set of instruments will include the levels of the recruitment suitability variables for Hindus ($h_{r,d}$) and Sikhs ($s_{r,d}$). The relationship between "recruitment suitability" and the observed casualty rate should depend on the relative size of each religious group. As the casualty rate is measured relative to the entire Hindu-Sikh population, the relevance of the classification of a given group for the district-level

[45] Both Dogras and Brahmins are Hindu castes.

[46] The average score for Sikhs is 0.34, the average score for Dogras is 0.11, the average Sikh fraction in the Hindu-Sikh population is 0.27.

casualty rate will depend on the relative size of the group. Therefore, I include interactions of the suitability indicators with the fraction of Sikhs in the 1911 Hindu-Sikh population ($f_{d,11}$). The set of instruments will consist of the suitability variables and their interactions with the relative size of the Sikh population. The resulting first stage regression is given by:

$$Cas_{d,11} = \lambda_0 + \lambda_1 f_{d,11} + \lambda_2 h_d + \lambda_3 h_d * f_{d,11} + \lambda_4 s_{r,d} + \lambda_5 s_{r,d} * f_{d,11} + \varepsilon_{d,11} \quad (2.2)$$

In this equation, the r subscript is dropped as I can only include Hindu-Sikhs. The construction of the instrumental variables implies that the first stage equation has to control for year effects of the 1911 Sikh fraction. Including this variable also addresses concerns that the suitability variables are merely picking up the relative size of one subgroup that was over-recruited. A 2SLS regression of the change in literacy rates relative to 1911 is run separately for 1921 and 1931.

$$\triangle y = \varphi + \{\beta_\tau \widehat{cas}_{d,11} + \gamma_\tau f_{d,11}\} + v_d \quad (2.3)$$

Table 2.7 presents the results of the IV approach. The first stage in column (3) confirms the relevance of the instrument. In the IV results, the coefficient on the casualty share retains its significance and its magnitude is higher than in the OLS results.[47] These findings suggest that if the OLS estimate is biased, the bias is downwards rather than upwards. Of course, the instrumentation approach is only valid if the initial selection of recruitment grounds is exogenous. I cannot fully rule out the possibility that recruitment officers selected communities on criteria that led to subsequent literacy development. Hence, this robustness check mainly addresses the endogeneity concerns that relate to the proxy approach and endogeneous selection into the army due to time-varying factors during the First World War. However, the IV results are consistent with attenuation bias being the main endogeneity concern.

[47] Based on an overidentification test, I cannot reject the hypothesis that the instruments are exogenous (the p-value on the Hansen J statistic is 0.26 for 1921 and 0.76 for 1931). The substantially higher IV estimates could also capture a local average treatment effect or they could be due to the instruments being insufficiently strong.

Table 2.7: IV approach

	$\triangle Log(MaleLiteracy)$		Casualty share (per 100)
	OLS	IV (2SLS)	First Stage
	(1)	(2)	(3)
Casualty share*1921	0.60**	1.10***	
	(0.26)	(0.34)	
Casualty share*1931	0.78**	1.31*	
	(0.37)	(0.72)	
Hindu Suitability			0.19***
			(0.05)
Hindu Suitability * Sikh Fraction			-0.28
			(0.30)
Sikh Suitability			-0.11
			(0.18)
Sikh Suitability * Sikh Fraction			0.73*
			(0.42)
F-statistic			8.04
Observations	28	28	28

Notes: Observations include Hindu-Sikh communities in 28 districts. Coefficients are reported for the change in log-literacy rates relative to 1911. The 1911 Sikh fraction is controlled for columns (1) and (2), and (3). See text and Equation 2.2 for a description of the instruments. Standard errors are heteroskedasticity-robust. The IV results use 2SLS with a small sample adjustment. *** p<0.01, ** p<0.05, * p<0.1.

2.7.2 Further robustness checks

In this subsection, I go over certain alternative explanations of the observed effects that are suggested by the historical literature. In response to these challenges, this section also presents two alternative specifications of the main regressions which help to counter these arguments.

2.7.2.1 District level controls

Table 2.8: Baseline results with district-year effects

	Log(male literacy rate)			Log(male population)		
	All ages	Over 20	Under 20	All ages	Over 20	Under 20
	(1)	(2)	(3)	(4)	(5)	(6)
Casualty share	0.26*	0.26*	0.21	-0.04	-0.02	-0.06
*1921	(0.15)	(0.14)	(0.21)	(0.07)	(0.09)	(0.05)
Casualty share	0.73***	0.60***	0.94***	-0.12	0.01	-0.26**
*1931	(0.24)	(0.22)	(0.32)	(0.12)	(0.11)	(0.13)
District-year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	168	168	168	168	168	168

Notes: Observations are at the district-religion level for three census years (1911-31). All regressions include district-religion fixed effects. Standard errors are clustered at the district-religion level. *** p<0.01, ** p<0.05, * p<0.1.

One way to check if any policy that affected districts rather than religious communities can explain the observed pattern in literacy rates is to include district-year effects in the main regression. These effects fully absorb the impact of all district-level variables that affected both communities to the same extent. The availability of transport and trade infrastructure could be one example of an omitted variable that mainly operates at the district level.[48] Of course, a key concern of this approach is that religious communities are affected differentially by these investments, even though I estimate proportional effects by relying on a semi-log-specification.

[48]Given its strategic importance, Punjab received significant investments in its transport infrastructure. Due to its geographical closeness to the North West Frontier, it was an area that in itself was of great military importance. This was the primary motivation for the British to invest strongly in roads, railways and cantonments. Lines of communication and supply were essential in case of an emergency at the frontier. In 1931, the North Western Railway System accounted for 23% of the total open mileage in India totalling 7,092 miles (Mazumder, 2003, p.56). In contrast, Punjab and the North West Frontier province accounted for less than 12% of India's total area and population. More than one third of these lines were built out of military needs. Similarly, Punjab benefited from major investments in its road network at the end of the 19th century. These investments in infrastructure are not restricted to recruited communities nor do they target these communities in particular: by 1911, all but two districts were connected to the railroad network (Marten, 1911, Census Report). Therefore, it seems unlikely that differential investment in transport infrastructure is driving my earlier findings.

Another concern in my relatively small panel is that relevant variation is lost because those districts with similar recruitment intensities for both religions are no longer used to identify the main effect. Subject to these caveats, the results presented in Table 2.8 are broadly consistent with earlier findings. One difference with earlier findings is that the coefficient on the casualty ratio in 1931 gains significance for under-20-year-olds. This result suggests that inter-generational spill-overs could previously have been obscured by variables affecting literacy at the district level. However, the immediate impact remains only significant for over-20-year-olds. It should also be noted that the size of the population under-20-years-old decreases significantly in column (6), which implies that the observed increase in the literacy rate for under-20-year-olds could partly reflect a decrease in the denominator.

Table 2.9: District level controls

	Log(male literacy rate)					
	All ages		Over 20		Under 20	
	(1)	(2)	(3)	(4)	(5)	(6)
Casualty share*1921	0.45**	0.41*	0.51**	0.46**	0.24	0.27
	(0.20)	(0.22)	(0.18)	(0.20)	(0.36)	(0.37)
Casualty share*1931	0.60***	0.65***	0.57*	0.60***	0.67***	0.75***
	(0.17)	(0.17)	(0.21)	(0.21)	(0.20)	(0.17)
Baseline Controls-year effects	Yes	Yes	Yes	Yes	Yes	Yes
Migration, area, and population controls		Yes		Yes		Yes
Observations	84	84	84	84	84	84

Notes: observations are at the district level for three census years (1911-31). "Baseline controls- year effects" include year effects of the 1911 value of proportion of the Hindus in the male population, the proportion of Sikhs, the proportion of Muslims (with other religions omitted), population density, colony status, primary education expenditures per capita, primary fees per capita, primary school students per capita, and the fraction of the male population born in the district of enumeration. Even columns includes contemporary values of the logarithm of the district area, the logarithm of the size of the relevant age population, and the fraction of the population born in the district. District fixed effects and year effects are also included. See Table 2.2 for summary statistics. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1.

In Table 2.9, the main regression is presented at the district level with both year effects for baseline controls (odd columns) and additional contemporary controls (even columns). These results are remarkably similar to those obtained in Table 2.8. This results address concerns that the significant baseline differences in district-level variables (as reported in Table 2.2) can account for the positive coefficients on the casualty share.

2.7.2.2 Alternative explanations

Throughout the analysis, the potential impact of military recruitment on the total size of the population was carefully examined. This analysis could not uncover strong impacts, which makes it unlikely that the main effect of military recruitment on literacy was through a demographic channel. Nevertheless, a very specific type of demographic shocks could still affect the results.[49] A first key source of concern is the possibility that heavily recruited communities faced different survival rates for literates versus illiterates. Unfortunately, the census category of over-20-year-olds is too broad to distinguish between a higher survival rate of individuals who are already literate or the growth in the number of *new* individuals who can both read and write. However, all findings are robust to using the logarithm of the number of literates instead of the literacy rates.[50] This implies that military recruitment should have a positive impact on the survival of literates to confound the main results. Hence, the most likely drivers of differential demographic trends can be ruled out, including higher mortality in recruited communities as a direct result of military service or delayed demobilisation. Furthermore, any confounding factor that has a positive impact on the size of the literate population should mainly affect the recruited communities (even within the same district) and mainly affect the population of male over-20-year-olds to be consistent with the results. Only if an alternative shock satisfies this restrictive set of conditions, it can bias the main results. A second differential demographic shock could be due to migration. If more literates moved into recruited districts (perhaps in the hope of being recruited), they could boost the number of literates in their new home districts. Again, this would require only literates to immigrate. The regressions in Table 2.9 controlled explicitly for migration movements.

A second set of alternative explanations for my findings relate to my interpretation of the results in terms of the main mechanisms. It is possible that, on top of the main channels on which my analysis has focused, other (more indirect) channels were important. In his detailed historical account, Mazumder provides historical evidence on a wide range of policies that were to some extent related to Punjab's status as a military recruitment ground. A first policy directly targeted recruited

[49] Epidemics (including the Spanish flu of 1918) hit Punjab at a regular basis throughout the sample period.

[50] In the absence of significant effects on the aggregate population, this is not a key concern for the main results and this robustness check is not reported. However, some results in the appendix (A.1.) point at negative impacts on the size of the population. For these results, the alternative specification using the number of literates is reported in the tables.

soldiers. Soldiers were among the main beneficiaries of land grants in the so-called canal colonies. These colonies contained newly created tracts of cultivable land irrigated by canals. The primary aim of these projects was to generate more revenue by developing potentially fertile areas and moving some of the population away from densely populated regions to the newly established colonies (Mazumder, 2003, p.66).[51] Even though most canalisation projects were completed before the war, Mazumder notes that soldiers were given preference in the allocation of new tracts of land after WWI. This policy is unlikely to lead to an upward bias of our estimates, as ex-soldiers who moved to the colonies would dampen the extent to which recruited communities would have benefited from improvements in literacy. A second policy that directly benefited recruited districts was taxation after the war. The main source of income of the Raj came in the form of taxes on agriculture. These taxes were laid down in so-called revenue assessments. Descriptive evidence suggests that, mainly after WWI, heavily recruited districts enjoyed more favourable assessments. I do not think this policy is driving the results, given that it was only implemented after the war and there is evidence of a positive impact from 1921 onwards. However, this channel may have caused spill-overs of military service on household incomes in the home communities. A third policy that may have affected recruited communities is the Punjab Land Alienation Act (1901), which protected agricultural castes (among whom mainly martial races) from indebtedness by outlawing land sales from agricultural to non-agricultural castes.[52] While the families of recruited soldiers could have benefited from the Land Alienation Act, the Act applied to a wider set of agricultural castes in the whole of Punjab and not just to those that delivered recruits. Also, the Act was implemented well before First World War. Therefore, it seems unlikely that the results presented earlier are merely capturing a different human capital development path for the communities that benefited most from the Land Alienation Act.

2.8 Conclusion

This paper exploited the exogenous increase in military recruitment during the First World War to estimate the impact of recruitment on human capital accumu-

[51] By 1931, Punjab had 9,929,219 acres of land irrigated by government canals, which corresponds to 46% of land irrigated by canals in the whole of British India.

[52] See Cassan (2011) for a detailed description of the Punjab Land Alienation Act and the incentives it created to manipulate caste identity.

lation. My results suggest that ten additional recruits per thousand of the 1911 male population were on average associated with three more literate males per thousand in 1931. Further analysis suggests that this improvement in the human capital stock was mainly driven by direct skill acquisition. There is weak evidence that military recruitment also raised the literacy rate of children, in particular in 1931, but this result is not robust across specifications. However, no evidence could be found of preferential spending on primary education in heavily recruited districts. These results on inter-generational spill-overs and on public investments put bounds on the long-run distributional impact of military recruitment in this context. While the proxy approach of this paper gave rise to certain econometric concerns, it does have the interpretational benefit of highlighting a substantial cost to the observed improvements in literacy. The estimates suggest that for every six additional literates per thousand, one Punjabi soldier gave his life. The fact that volunteer soldiers made this implicit trade-off is suggestive of the harsh economic conditions that the Indian population faced during this period.

Earlier work on public education in colonial India has highlighted the failure of the public education system to teach lasting literacy skills to its students. In this context, it is striking that military service improved literacy outcomes for adults. One interpretation of this result is that the military provided a unique environment in which the personal returns to education (including the ability to communicate with one's family) were boosted and the costs of acquiring literacy skills were strongly reduced. Obviously, this paper does not promote war-time military service as an alternative to public education. However, the results of this paper could inspire more peaceful adult literacy programmes. Such programmes could offer non-traditional learning environments that strongly change both the returns to literacy and the costs of acquiring these skills. In the light of the poor quality of public education in many developing countries, non-traditional learning environments could prove to be powerful complements to the public education system, in particular for adult learners.

Finally, this paper is one of the first studies to confirm the long-standing hypothesis that disadvantaged groups could benefit substantially from military service. Such evidence on the returns to military service could be important for policy makers who design military recruitment policies. It is interesting to note that post-independence India has moved away from the old recruitment patterns, but it only did so in the course of the 1970s. A simple archive search reveals that military recruitment policies are now regularly discussed in the Indian Lok Sabha. This paper indicates that military recruitment policies could have important distributional impacts. Therefore, the political salience of military recruitment policies could be well justified.

2.9 Appendix to Chapter 2

2.9.1 Further robustness checks

Robustness to border changes

Table 2.10: Baseline specification for merged districts

	Log(male literacy rate)		Log(male literates)		Log(male population)	
	Over 20	Under 20	Over 20	Under 20	Over 20	Under 20
	(1)	(2)	(3)	(4)	(5)	(6)
Casualty share *1921	0.60***	0.38	0.45**	0.22	-0.15	-0.16*
	(0.22)	(0.35)	(0.19)	(0.35)	(0.13)	(0.09)
Casualty share *1931	0.91***	1.07***	0.87***	0.90***	-0.04	-0.18
	(0.31)	(0.37)	(0.36)	(0.39)	(0.26)	(0.25)
Observations	96	96	96	96	96	96

Notes: District-religion level observations for two religious groups (Muslim or Hindu-Sikh) in 16 merged districts, for three census years (1911-31). Standard errors are clustered at the district-religion level. *** p<0.01, ** p<0.05, * p<0.1.

The districts analysed in this paper were subject to several border changes of the period under consideration. While most of these border changes were small and are not expected to affect the literacy rate systematically, this section explores the robustness of the main findings to accounting more explicitly for border changes. In Table 2.10, I conduct the analysis at the level of merged districts with stable borders. The main results carry through, but there is some evidence in these adjusted samples of negative impacts of military recruitment on the size of the population. To address the concern that the impacts on literacy are reflecting changes in the composition of the population, the main results are also shown for the logarithm of the number of male literates rather than the corresponding literacy rates in columns (3) and (4).

Inclusion of Princely States

As reported in section 2.4, the Princely States were omitted from the main analysis for reasons of comparability and data availability. In this section, I show that the main results are robust to the inclusion of the princely states in the analysis. Table 2.11 repeats the main analysis with the inclusion of all religion-districts in Princely states (excluding the Simla Minor Hill States, of which the composition changes over time). These results are quantitatively smaller and no longer significant. However, it turns out that these results are sensitive to the inclusion of outlying small communities (for which we expect the data to be particularly unreliable). Omitting those Princely State communities with a male population of less than 4,000 individuals in 1911 (all British districts have substantially larger communities), the results become very similar to earlier findings (Table 2.12).

Table 2.11: Baseline specification with Princely States

	Log(male literacy rate)			Log(male population)		
	All ages	Over 20	Under 20	All ages	Over 20	Under 20
	(1)	(2)	(3)	(4)	(5)	(6)
Casualty share *1921	0.19 (0.18)	0.26 (0.18)	-0.17 (0.22)	0.12 (0.13)	0.12 (0.14)	0.14 (0.13)
Casualty share *1921	0.22 (0.23)	0.26 (0.19)	-0.10 (0.32)	0.05 (0.16)	0.04 (0.16)	0.05 (0.15)
Observations	270	270	270	270	270	270

Notes: District-religion level observations for two religious groups (Muslim or Hindu-Sikh) in 45 districts/Princely states, for three census years (1911-31). The regression includes district-religion fixed effects and religion-year effects. Standard errors are clustered at the district-religion level. *** p<0.01, ** p<0.05, * p<0.1.

Table 2.12: Baseline specification with Princely States (2)

	Log(male literacy rate)			Log(male population)		
	All ages	Over 20	Under 20	All ages	Over 20	Under 20
	(1)	(2)	(3)	(4)	(5)	(6)
Casualty share *1921	0.29	0.35*	-0.03	0.14	0.14	0.14
	(0.18)	(0.18)	(0.21)	(0.14)	(0.14)	(0.13)
Casualty share *1931	0.41*	0.42**	0.19	0.08	0.08	0.07
	(0.22)	(0.18)	(0.29)	(0.15)	(0.15)	(0.16)
Observations	249	249	249	249	249	249

Notes: District-religion level observations for religious groups (Muslim or Hindu-Sikh) of which the male population exceeds 4,000 individuals, in 42 districts/Princely states, for three census years (1911-31). The regression includes district-religion fixed effects and religion-year effects. Standard errors are clustered at the district-religion level. *** p<0.01, ** p<0.05, * p<0.1.

Rank Analysis

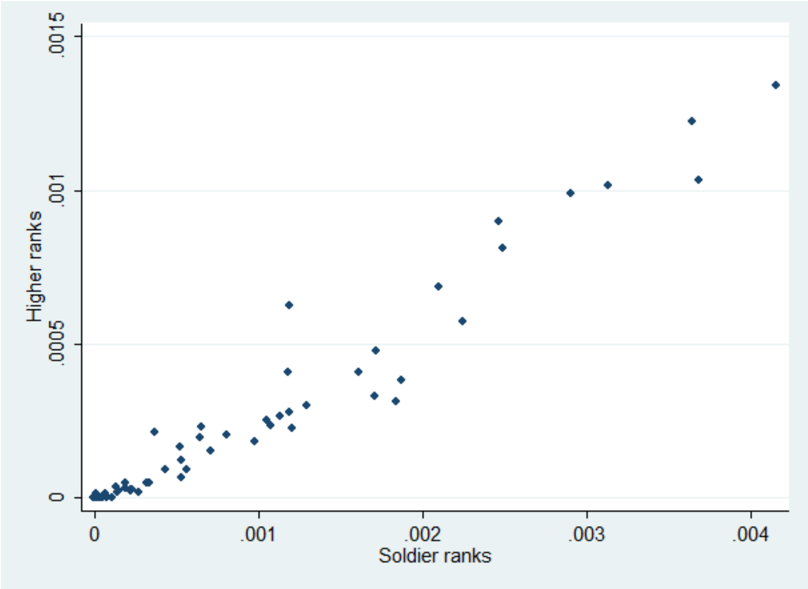
Table 2.13: Baseline specification for soldier rank casualties

	Log(male literacy rate)			Log(male population)		
	All ages	Over 20	Under 20	All ages	Over 20	Under 20
	(1)	(2)	(3)	(4)	(5)	(6)
Casualty share *1921	0.50**	0.60**	0.12	0.17	0.18	0.19
	(0.24)	(0.23)	(0.32)	(0.24)	(0.25)	(0.24)
Casualty share *19231	0.68*	0.71**	0.48	0.12	0.13	0.10
	(0.35)	(0.30)	(0.48)	(0.28)	(0.27)	(0.28)
Observations	168	168	168	168	168	168

Notes: District-religion level observations for two religious groups (Muslim or Hindu-Sikh) in 28 districts, for three census years (1911-31). All regressions include district-religion fixed effects and religion-year effects. Standard errors are clustered at the district-religion level. *** p<0.01, ** p<0.05, * p<0.1.

In the empirical strategy (section 2.5), it was argued that the proxying approach is unlikely to assign higher “recruitment intensities” to communities with increasing literacy rates. In particular, it was argued that literate soldiers should not have faced a different casualty pattern than illiterate soldiers. In further support of this hypothesis, I can distinguish between casualties from three categories of army ranks: soldiers, above-soldier ranks and military personnel in supportive roles. Figure 2.3 shows the relationship between pure soldier casualties and casualties among higher ranks at the district-religion level. This figure confirms that the geographical pattern of casualties is similar across ranks. An alternative explanation of the key results could have been that higher ranks were driving this impact. This could be the case if higher ranks were recruited from regions with a higher potential for literacy improvement and if they had different casualty patterns (at the district-religion level) than the lower ranks. Under the latter scenario, the proxy approach would lead to an upward bias of the impact of military recruitment. However, the similarity of the recruitment patterns suggest that this is an unlikely scenario. Table 2.13 further confirms that the key results are robust to relying on casualty rates for strict soldier roles (excluding higher ranks and other groups).

Figure 2.3: Higher ranks versus soldier ranks



Cohort Analysis

Table 2.14: Baseline specification for cohort changes

	Log(male literacy rate over 20/male literacy rate$_{t-1}$10 to 20)	
	(1)	(2)
Casualty share *1921	0.49***	0.50**
	(0.17)	(0.21)
Casualty share *1931		0.37**
		(0.17)
District FE	Y	
District-religion FE		Y
Religion-year effects		Y
Religion dummy	Y	
Observations	56	166

Notes: District-religion level observations for two religious groups (Muslim or Hindu-Sikh) in 28 districts, in 1921 (1) or for three census years 1911-31 (2). Standard errors are clustered at the district-religion level in (3). *** p<0.01, ** p<0.05, * p<0.1.

It was argued in section 2.6 that the results are most consistent with the direct acquisition of literacy skills by serving soldiers. Under this hypothesis, we should observe that the cohort that served in the war gained additional literacy skills during the war. It should be noticed that the earlier analysis did not correspond to a cohort analysis, as I compared the same age groups at different points in time (which allows the composition of these groups to change). The split up of literacy rates provided in the census does not allow for a detailed cohort analysis in different age categories. However, I can construct a variable that approximates the literacy changes for the cohorts of 10-to-20-year-olds in 1901, 1911 and 1921:

$$y_{r,d,t} = log(literacy^{over20}_{r,d,t}) - log(literacy^{10to20}_{r,d,t-1})$$

This variable does not correspond to the actual cohort-specific change in literacy rates, as I need to use the broader category of over-20- year-olds.

Table 2.14 examines whether the main results are confirmed in a cohort analysis.

In column (1), district dummies are included to account for any determinants of the cohort literacy gains that are district-specific. In column (2), I report difference-in-difference estimates, which can account for time invariant determinants at the district-religion level of the cohort-specific literacy gains. The results of the cohort analysis are consistent with the hypothesis that military recruitment positively affected the literacy of the cohort that served in the first world war.

Female literacy

Table 2.15: Female literacy summary statistics

	Sample	Lightly recruited	Heavily recruited	P-value
Female literacy rate 1911	0.011	0.010	0.012	0.78
	(0.018)	(0.014)	(0.024)	
Observations	56	36	20	

Notes: see Table 2.1.

The analysis presented here can also be applied to female literacy. In Table 2.15, I present summary statistics for female literacy. The average level of female literacy is very low, with certain communities virtually lacking any literate women. These low literacy rates give rise to additional measurement concerns. Subject to this caveat, Table 2.16 presents the baseline results for female literacy. The results indicate that the impact of military recruitment on female literacy could have been negative. This result could be consistent with the hypothesis that the loss of male labour increases the opportunity cost of women in education, although the significance of this negative coefficient is not robust to re-specifications. Furthermore, the estimated impact of recruitment on female literacy evaluated at the sample mean is neglegible from an economic perspective. Nevertheless, these negative coefficients are consistent with a scenario in which direct skill acquisition is the key channel that explains improvements in male literacy in recruited communities.[53]

[53] While the results on female literacy could be interpreted as a "placebo" test of the direct skill acquisition channel (which should only affect males), this interpretation should be subject to an important caveat. Chaudhary (2010) finds that female literacy is less responsive to educational investments than male literacy. Hence, the differential impact on male and female literacy is not necessarily evidence against the income channel or supply-side channel. Besides, the provision of a postal service to serving soldiers could in theory have spill-overs for women.

Table 2.16: Female literacy baseline results

	Log(female literacy rate)			Log(female population)		
	All ages	Over 20	Under 20	All ages	Over 20	Under 20
	(1)	(2)	(3)	(4)	(5)	(6)
Casualty share *1921	-0.60**	-0.53**	-0.74**	0.19	0.18	0.21
	(0.27)	(0.26)	(0.31)	(0.14)	(0.12)	(0.15)
Casualty share *1931	0.01	-0.08	0.11	0.09	0.06	0.13
	(0.36)	(0.32)	(0.41)	(0.17)	(0.16)	(0.19)
Observations	168	168	168	168	168	168

Notes: District-religion level observations for two religious groups (Muslim or Hindu-Sikh) in 28 districts, for three census years (1911-31). All regressions include district-religion fixed effects. Standard errors are clustered at the district-religion level. *** p<0.01, ** p<0.05, * p<0.1.

Heterogeneity

Table 2.17: Heterogeneity

	Log(male literacy)		Log(male population)	
	Over 20	Under 20	Over 20	Under 20
	(1)	(2)	(3)	(4)
Casualty share *1921	0.61**	0.37	0.15	0.14
	(0.25)	(0.32)	(0.21)	(0.22)
Casualty share *1931	0.84**	0.75	0.09	0.07
	(0.32)	(0.49)	(0.32)	(0.34)
Casualty share *Muslim*1921	-0.34	-0.53	-0.04	-0.00
	(0.31)	(0.42)	(0.33)	(0.32)
Casualty share *Muslim*1931	-0.59	-0.76	0.03	0.05
	(0.40)	(0.66)	(0.39)	(0.42)
Observations	168	168	168	168

Notes: District-religion level observations for two religious groups (Muslim or Hindu-Sikh) in 28 districts, for three census years (1911-31). All regressions include district-religion fixed effects. Standard errors are clustered at the district-religion level. *** p<0.01, ** p<0.05, * p<0.1.

Given the data availability constraints, the district-religion level is the finest level at which the analysis can be conducted. This approach also enables a comparison between the treatment effects of Muslims and Hindu-Sikhs respectively.[54] The results presented in Table 2.17 suggest that the impact is largest for Hindu-Sikhs, but the difference between the treatment effects is not statistically significant and, for over-20-year-olds, the effect remains positive and large for Muslims.

[54] Chaudhary and Rubin (2010) highlight the importance of the proportion of Muslims in the district to explain Muslim literacy levels in 1911 and 1921. The Punjabi districts under consideration all have a Muslim population that is larger than 28% of the population and the level effect of the share of Muslims reported by Chaudhary and Rubin should be captured by the district(-religion) fixed effects in my approach.

2.9.2 Complete baseline results

Table 2.18: Complete baseline results

	Log(male literacy rate)			Log(male population)		
	All ages	Over 20	Under 20	All ages	Over 20	Under 20
	(1)	(2)	(3)	(4)	(5)	(6)
Casualty share	0.33**	0.40**	0.06	0.13	0.13	0.14
*1921	(0.16)	(0.15)	(0.21)	(0.17)	(0.17)	(0.16)
Casualty share	0.47*	0.50**	0.30	0.10	0.10	0.09
*1931	(0.24)	(0.20)	(0.33)	(0.19)	(0.19)	(0.20)
Muslim	0.26***	0.29***	0.15**	0.01	-0.00	0.02
*1921	(0.05)	(0.04)	(0.06)	(0.05)	(0.05)	(0.05)
Muslim	0.37***	0.32***	0.47***	0.07	0.06	0.07
*1931	(0.06)	(0.06)	(0.09)	(0.05)	(0.05)	(0.06)
1921	-0.08	-0.13***	0.13**	0.02	0.02	0.02
	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)	(0.05)
1931	0.10	0.04	0.37***	0.09	0.06	0.13**
	(0.06)	(0.06)	(0.08)	(0.06)	(0.06)	(0.06)
Observations	168	168	168	168	168	168

Notes: District-religion level observations for two religious groups (Muslim or Hindu-Sikh) in 28 districts, for three census years (1911-31). Casualty shares are expressed per 100 of the 1911 male population. All regressions include district-religion fixed effects and religion-year effects. Standard errors are clustered at the district-religion level. *** p<0.01, ** p<0.05, * p<0.1.

3 Coup-friendly Institutions and Apolitical Militaries

A Theory of Optimal Military Influence

3.1 Introduction

Surprisingly, the civil-military institutions that historically governed the civil-military relations of many countries simultaneously encouraged and discouraged coups. In 1970, fourteen Latin American countries had constitutional clauses that allowed the military to intervene in politics (Stepan, 1971). Also, the punishments for the leaders of failed coups were (and are) often surprisingly low: the leader of the failed 2000 coup in Ecuador, Lucio Gutiérrez, was allowed to run in the presidential elections only three years later.[1] Low punishments and institutionalised legitimacy of coups seem to encourage political interventions of the military. These coup-friendly institutions could reflect the view that the armed forces have a role to play in controlling the executive power. At the same time, even in contexts in which political institutions are "coup friendly", officers are typically not allowed to openly engage in political debates. The latter institution clearly constrains the political role of the military. This paper will explore the optimal design of civil-military institutions, under the assumption that political elites or social planners deem some control of the military over the executive power desirable.

This paper presents a model that rationalises observed civil-military institutions such as the neutrality of the army and limited expected punishments for failed coup leaders. The process of staging a coup will be modelled as a leader-follower game between two different groups within the military. Both of these groups care about

[1] Shifter (2004).

the quality of government in a general interest dimension, but they may differ on a second, factional dimension (e.g. ethnic or ideological). Each group receives an imperfect signal of the other group's factional identity. The leader decides to stage a coup attempt, but will only be successful if he is supported by the group of followers. Hence, the gains from staging a coup will include the possibility to oust a poorly performing government and the chance to promote a factional agenda. These gains will be weighted against the expected costs of staging a failed coup. By manipulating the expected costs associated with failed coup attempts, civil-military institutions will be able to shape the military's coup behaviour. The welfare measure employed in this paper will assume that coups against poorly performing governments should be encouraged, whereas coups targeting a well performing government should be discouraged. According to this welfare criterion, my model suggests that is never optimal to allow open political affiliations in the military. Open affiliations will tend to promote coups driven by factional interests. As a corollary, the military is expected to perform poorly if officers cannot hide their political affiliations (e.g. in case of ethnic cleavages). However, the optimal punishments for failed coup leaders vary. If the military is severely factionalised in different political groups, then it may optimal to limit punishments for failed coups to encourage the military to play its role as arbitrator in domestic politics. In contrast, if political or ideological cleavages in the military are limited, then high punishments for failed coup plotters are optimal. Further extensions of the baseline model will account for endogenous communication, and the possibility of military take-overs by an "extremist faction" (which is *not* preferred to a poorly performing incumbent). This last extension highlights how a combination of factionalisation and uncertainty about political views within the military can be an important driver of the gradual demilitarisation of politics.

The paper contributes to a growing literature that models the influence of the military over policy making. In a closely related contribution, Besley and Kudamatsu (2007) focus on institutional design aimed at holding a government accountable for its general interest policy in a divided "society". Whereas these authors compare stylised autocracies with democracies, I focus specifically on the role of military interventions and on normative implications for civil-military institutions. Sharing my focus on military interventions, Besley and Robinson (2011) model the strategic interaction between a civilian government and the military. In their set-up, the size of the army and the decision to stage a coup are the key decision variables. A central idea that my paper shares with these authors is the fact that the military is *politicised*, i.e. that the military does not just promote its own corporate interests but is a mapping from society at large. A different model of military interventions is developed by Acemoglu, Ticchi and Vindigni (2009). These authors explore the moral hazard problem that arises when the elite empower the military to repress democratisation attempts: a stronger military may want to overthrow the elite. These authors assume that the military is always united and driven by corporate interests (e.g. military spending), which is very different from my assumption of a politicised and factionalised military. Leon (2009) focuses on career options for a representative officer (in the army or in a military government) and links coup behaviour to the frequency of wars.[2] All these recent contributions point at the rich interactions between coups and specific policy decisions, but they mostly abstract from the mechanics of the coup process. This paper will analyse the internal coup process within the military in more detail. A contribution that shares my focus on the internal coup process is Sutter (2003). This author models the coup process as a collective action problem, but he does not explore the interaction between factionalisation, asymmetric information, and institutions. The internal coup process is also the main focus of Geddes (2003), who models coups as a simultaneous coordination problem between different factions in the military. This author shares my focus on a factionalised military, but she does not explore the impact of civil-military institutions and asymmetric information. In contrast, Crescenzi (1999) highlights the importance of asymmetric information in political transitions, although this author does not focus on military interventions.[3] While the existing literature has offered a rich insights on the factors that could drive coup behaviour, including both internal characteristics of the army and structural economic factors, it is striking that few models incorporate the idea that the military is factionalised over political views. Nevertheless, a substantial body of literature criticises the idea that the military can be considered as a unitary actor.[4] The information asymmetries that arise from hidden affiliations in a factionalised military can easily account for (the risk of) failed coups, whereas

[2] Several authors have conducted empirical research on coups, but focusing on different questions than mine. Such econometric analyses of coups can be found in Belkin and Schofer (2003), Collier and Hoeffler (2007), and Londregan and Poole (1990).

[3] This author models the decision to revolt by a domestic opposition who faces authoritarian leaders of unknown types (hard-liner or soft-liner). Feaver (2003) models the agency problem that arises between a government and the military, but he does not focus on military interventions.

[4] See for example Stepan (1971, p7), Finer (1962, p34-42), Fitch (1998, p109-110), Geddes (2003), Loveman (1999, p207), and Philip (1974,p75-99 and 1985, p190).

the existing literature tends to attribute failure to random events. This paper places the politicised and factionalised nature of the armed forces at the heart of its analysis. It explores the implications of this approach for the role and design of civil-military institutions.

The paper is organised as follows. First, I will discuss certain stylized facts about coup behaviour that the formal framework will incorporate. Second, I will informally describe the key assumptions, the mechanism and the main results of the theoretical model. In a third section, the formal model will be introduced and its results will be linked to relevant cases. The fourth section will present an extension of the baseline model that offers a microfoundation of earlier assumptions. The fifth section discusses two important extensions of the theoretical framework. The sixth section offers further interpretations. In a final section, I will offer concluding remarks.

3.2 Background

Most militaries do not allow officers to discuss politics: military officers are expected to remain "neutral" (Finer, 1962, p34).[5] In several countries, this neutrality is underlined by constitutional clauses. For instance, the 1982 Turkish constitution does not only prevent military personnel from becoming elected deputies and being members of political parties, it also prohibits military personnel from voting at all.[6] This institutionalised neutrality makes it difficult for coup plotters to recognise supporters. Hence, it discourages coups. While neutrality is the norm, there are exceptions. Sometimes, political affiliations are difficult to hide, for instance if the main political tensions are along ethnic lines (Luttwak, 1968, p59). There is even one case in which political affiliations were deliberately open. In Brazil during the 1950ies and 1960ies, military club elections were fought over political issues and vote results were published in military journals (Stepan, 1971, p44).

Given that the neutrality of the military is common, it is surprising that a norm for the military to abstain from intervening in politics was not wide-spread until recently. In 1970, fourteen Latin American countries had constitutions that implicitly allowed the military to intervene in politics (Stepan, 1971, p79). For

[5]Huntington (1981) also argues that civilian control over the army relies on an autonomous and politically neutral army.

[6]Articles 67, 68 and 76 of the 1982 Turkish constitution.

instance, the Brazilian constitution of 1946 stipulated the military to be "obedient" to the executive, but only "within the limits of the law". This clause was interpreted to give the military the *de jure* power to intervene in politics as soon as the government was considered to transgress "the limits of the law". In this sense, the armed forces took on the role of a "Supreme Court". Surprisingly, the clause was deliberately included in the Brazilian constitution by democratically elected politicians because they considered the military to be a good custodian of the state (Stepan, 1971, p79). These ideas may also explain the surprisingly low punishments for failed coup leaders in several cases. The leaders of the failed Brazilian coup of 1961 were the three generals who served as ministers of defence. They were never prosecuted for their role in the coup and this mild punishment was institutionalised, because their coup attempt could be considered as a lawful "ministerial decision".[7] Even if political institutions do not explicitly allow for military control, military interventions often have a high degree of legitimacy. The de facto role of the military as a "supreme court" could stem from a situation in which political institutions are too weak to produce legitimate civilian arbitrators in political conflicts. In line with this idea, a number of very recent military interventions attracted strong popular support in Africa.[8] However, the role of the military in Latin America has clearly declined over the past decades. All Latin American countries have now adopted new constitutions that curtail the role of the military in politics (Einaudi, 1996).[9] Similarly, Turkey has recently adopted a package of constitutional amendments that increase executive control over the army.[10]

The main aim of this paper is to investigate how these institutional settings affect coup behaviour and which settings can be "optimal" from a social planner's perspective. While the starting point of the paper will be that military control may be desirable under certain conditions, the exercise will also highlight the tensions that are inherent to the design of civil-military institutions. These tensions will

[7] Another example: Ramon Barquin, the Cuban colonel who staged a failed coup attempt against president Battista in 1956, was sentenced to a mere six years in jail. (Bonachea et al., 1974)

[8] In Madagascar the military installed president Rajoelina in 2009 in response to growing public discontent (Ploch, 2009). In Egypt's 2011 revolution, the army played a pivotal in ousting Hosni Mubarak.

[9] In Peru, the 1993 constitution states explicitly that coups can never be legitimate: "Power emanates from the people. [...] No person, organization, Armed Force [...] may arrogate to themselves the exercise of such power. To do so constitutes rebellion or sedition." (Art.45)

[10] The Economist, "Erdogan wins again", 16 April 2010 (http://www.economist.com/node/17046653).

be able to explain shifts away from legitimising military control over politics.

3.3 Theoretical framework

In this section, I will informally introduce the key assumptions, mechanism and results of the theoretical model. The model's set up will rely on three main assumptions.

First, I propose a model in which coups can be "desirable". I assume that an incumbent government has a default ideology (say, left wing). Moreover, government can be "low quality" or "high quality" in a general interest dimension.[11] The quality of government in the general interest dimension will be taken as the welfare measure, which is not sensitive to ideology in the baseline model. If a military government replaces the incumbent, I assume that it has a higher expected quality than a bad incumbent, but a lower expected quality than a good incumbent. Under these assumptions, a coup against a bad incumbent is "desirable" in the general interest dimension. It is not difficult to find examples of cases in which military coups attracted strong popular support because the military ousted unpopular leaders. For instance, the 1964 coup in Brazil was enthusiastically welcomed in the editorials of all major newspapers (Stepan, 1971, p110-12). In contrast, a coup against a well-performing incumbent is always "undesirable" according to this welfare measure.[12]

The explanation for why "undesirable" coups ever occur builds on the second assumption: the military consists of officers who care unanimously about the government's quality, but who are factionalised along ideological lines. Hence, officers either share the ideology of the incumbent (say, left-wing) or hold rivalling views (say, right-wing). The idea that the military does not just narrowly promote its corporate interests, but is factionalised along lines similar to those in society at large is supported by a substantial body of literature.[13] If coups are driven by

[11] The idea underlying coup friendly constitutions is exactly that, sometimes, coups can be "desirable" in a general interest dimension. Following Besley and Kadumatsu (2007), "good" governments might be thought of as being characterised by low child mortality, high economic growth, high educational attainment and low corruption.

[12] In Nigeria, gen. Murtala Mohammed, who was widely acclaimed for his efforts to cut corruption, was killed in a coup in 1975. In this case, the interest of one particular faction within the military seemed to have driven the coup (Alli, 2000).

[13] Stepan (1971, p7) writes for instance: "Descriptions of ideal military institutions which may emphasise such features as military unity or national orientation often conceal more than they

factional interests, rather than the general interest, they are undesirable.[14] Once these rivalling political affiliations are introduced in the military, staging a successful coup becomes a *leader-follower* problem, possibly with *two-sided asymmetric information*. Successful coup leaders need the support of a critical mass within the military. However, if political affiliations are kept secret, the leader cannot be certain that a coup will be supported: the officers who are critical for a coup to succeed may be reluctant to lend their support to a coup leader of whom they do not know the true ideology. They fear that, once in office, a coup leader will be in an excellent position to promote factional interest policies. The importance of this coordination problem may vary because of three main sources, which correspond to the key parameters of the model: the strength of factionalisation, the openness of political affiliation, the punishment for miscoordination (i.e. staging a failed coup).

A third assumption of the model is that is impossible to condition punishments for failed coups on the quality of the incumbent government. There are three reasons for this assumption. First, if the incumbent government can decide on the punishments it may not be optimal to make punishments conditional on its quality.[15] Second, the quality of the incumbent government may be incontractible, for instance because it is observable to military officers, but not verifiable by a court.[16] Finally, the organisation that decides over punishments (e.g. the judiciary, a military tribunal or the executive power) may be factionalised itself, which would prevent tailored punishment. More generally, low punishments for failed coup plotters will be considered as a symptom of institutions that grant legitimacy to military interventions.

Based on the three key assumptions, I try to answer the question of which institutional set-up will sufficiently hold poorly performing governments accountable,

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reveal about the interactions between the military and the political system". Authors who emphasise the role of factionalisation within the military include Finer (1962, p34-42), Fitch (1998, p109-110), Philip (1974,p75-99 and 1985, p190) and Loveman (1999, p207). Geddes (2003) argues that the main reason why military regimes are relatively unstable is because the armed forces are typically factionalised between opponents and proponents of military rule. The latter view corresponds to a specific interpretation of the framework developed in this paper.

[14]Finer (1962, p34-60) distinguishes between coups driven by "national interest" versus "sectional interests".

[15]A government might implement high punishments to remain in power, regardless of its quality. If government quality is not observable to the electorate, punishments can be a signal of government quality and, in a simple voting game, a pooling equilibrium with low punishments may arise.

[16]This is a standard assumption in the incomplete contracts literature (Hart , 1993).

while preventing coups that are driven by factional interests only. This model yields three key results.

First, high punishments and low political openness can achieve first best control of the military over politics, which implies that a successful coup is staged if and only if the incumbent is poorly performing. This outcome requires that ideology does not dominate the utility function of officers. In particular, all factions within the military must be willing to support a coup leader of unknown ideology against a bad incumbent. The coup experiences of Peru (1948-1968) and Brazil (1948-1964) are consistent with the positive results of this parameter range, although Brazil's culture of open political debate in the military is not consistent with the "institution design optimum". In contrast, if ideology becomes more important, it may be optimal to implement low punishments for failed coups, while adhering to the neutrality of the army. This is a second best solution, which will see coups by military leaders who share the ideology of the incumbent, at the expense of allowing coups against well-performing governments. This equilibrium requires that factionalisation within the military is sufficiently severe, so that left-wing followers block a coup against a bad government out of fear that the initiators might be right-wing. This parameter range is consistent with the recent coup history of Venezuela (1992).

In an extension of the baseline framework, it can be shown that assumptions on the information structure of the game can be rationalised as outcomes of a communication game in which officers can choose to reveal their types or not. In particular, leaders have an incentive to hide their political affiliation, while followers would like to reveal their political affiliation. This result is important because the incentive for followers to reveal their type implies that institutions need to be put in place in order to keep the military neutral.

Third, there is a case in which institutions do not matter, because ideologies are perfectly observable (for instance because they correspond to ethnicity). This yields a unique equilibrium, characterised by high coup frequency and coup attempts against both good and bad governments. This result is consistent with the case of Nigeria (1966-2000).

Finally, relaxing the assumption that any military government has higher quality than a bad incumbent government, the model can be altered to provide an account of "extremist" factions within the military. This extension highlights that the moderator pattern of civil-military relations, which relies on the willingness of military officers to support their leaders against poorly performing incumbents, necessarily puts countries at risk of take-overs by an extremist faction. In this set-up, it is optimal to prevent any type of coups under very weak assumptions. This extension may explain the gradual move away from the institutional and constitutional promotion of coups.

3.4 The baseline model

3.4.1 Set-up

Consider an incumbent government, indexed g, who is passive and has a left-wing ideology ($I_g = L$) without loss of generality. The government can be high quality ("good") or low quality ("bad"), which is indicated by a quality variable $Q_g \in \{-1, 1\}$. Q_g is known to all players. To carry out welfare analysis, a prior of the government being good is introduced: $\Pr(Q_g = 1) = \gamma$.

There are two players in the model: the leader and the follower, indexed i (for initiator) and f (for follower) respectively.[17] The leader moves first and decides whether or not to stage a coup, the follower then decides whether or not to support the coup. A coup succeeds if an only if the leader takes the initiative and the follower supports the coup. Both officers are characterised by an ideology variable $I_j \in \{L, R\}$, $j = i, f$. Every officer knows his own ideology, but cannot observe the other player's ideology directly. The priors are common knowledge and given by:

$$\Pr(I_i = L) = \alpha$$
$$\Pr(I_f = L) = \beta$$

The follower receives a private signal $t \in \{L, R\}$ about the leader's type, while the leader receives a private signal $s \in \{L, R\}$ about the follower's type. The precision

[17] An example of an initiator would be the general in charge of the army division stationed in the capital. We may think of the follower as the officer in charge of the main army division outside the capital.

of the signal is common knowledge and given by:

$$\Pr(t = x|I_i = x) = \mu = \frac{1}{2},\ x \in \{L, R\}$$
$$\Pr(s = x|I_f = x) = \sigma,\ x \in \{L, R\}$$

The signal about the leader's type, t, is uninformative, i.e. $\mu = \frac{1}{2}$, while the precision of the signal about the follower's type is in the range $\frac{1}{2} \leqslant \sigma \leqslant 1$.[18] At this stage, the openness of political affiliation is captured in a reduced form by the signal precision σ.

If i stages a successful coup, his government is characterised by his quality in office, Q_i. Q_i is ex ante unknown and $E(Q_i) = 0$.[19]

Officers derive utility from the government's quality, Q, and from its ideology, through an indicator function ι which takes on value one if an officer shares the ideology of the government. ϕ measures the importance of ideology. The assumption that ϕ is the same for both left-wing and right-wing officers can be relaxed without changing the key results. A leader staging a failed coup faces a punishment $P > 0$, which is not conditional on the quality of the incumbent. As argued above, P captures the institutional legitimacy of coups: countries that allow for coups to occur under certain circumstances, will find it harder to credibly punish the plotters of failed coups. It is assumed that there is no punishment in case of a successful coup.[20]

The expected utility of a military officer of type j if a government of type k is in office is given by:

$$U_j = \begin{cases} -P + Q_k + \phi\iota(I_j = I_k), & \text{if } j = i \text{ and } i \text{ stages a failed coup} \\ \phi\iota(I_j = I_k) + Q_k, & \text{in all other cases} \end{cases},\ j \in \{i, f\}$$

The action to stage a coup attempt is given by $a \in \{0, 1\}$, where 0 stands for no coup attempt and 1 stands for a coup attempt. The decision to back up a coup

[18] In section 3.5, an explicit microfoundation is provided for these parameter restrictions: in an extended model, leaders want to hide their types, while followers would like reveal their types. Importantly, this implies that institutionally restricting the openness of political affiliation matters, since it will counter the incentive of followers to reveal their types.

[19] This assumption can be relaxed without affecting any of the (qualitative) results, as long as $-1 < E(Q_i) < 1$.

[20] There are several cases of coup leaders being put on trial after they have left government. However, these trials often relate to crimes (such as human rights abuses) committed while in office, rather than to the act of staging a coup in itself.

attempt is given by $b \in \{0, 1\}$, where 0 stands for the decision to resist a coup attempt and 1 for the decision to support a coup.

The timing of the game is:

1. Nature draws the quality of the government, Q_g, the type of the leader, I_i, and the type of the follower, I_f.
2. The leader i receives signal s and chooses a. If $a = 0$, the game ends.
3. If $a = 1$, the follower chooses b. If $b = 1$, i becomes the new government. If $b = 0$, g remains in power and the coup fails.
4. Pay-offs (U_i, U_f) are realised.

3.4.2 The first best solution

In the model described here, "first best" control of the military over politics would imply that successful coups are staged if and only if the incumbent is poorly performing. This outcome maximises the expected government quality ($E(Q)$), which will be our welfare measure and is insensitive to ideology.[21] It can be seen straightaway that inefficiency could stem from two possible sources. First, by not being able to condition punishments on government quality, there is a trade-off between allowing the military to intervene when it is desirable and allowing the military to intervene in case it is undesirable. For punishments to have a bite, there needs to be uncertainty about the success of the coup, which is introduced in this model by the uncertainty about the type of the followers. Second, even if punishments could be made conditional on the quality of the incumbent, then the followers may not support a coup against a poorly performing government (out of fear that the new military government will be of the opposing ideology). The first inefficiency may lead to either too many coups or too few coups, the last inefficiency can lead to too few coups. The next section contains a detailed description of how the welfare optima are affected by these potential inefficiencies.

3.4.3 Low factionalisation equilibria

This section deals with the case in which ideology is sufficiently weak. In this case, both left-wing and right-wing officers may agree to oust a poorly-performing incumbent, even if there is uncertainty about the type of the leader.

[21]This assumption will be relaxed in section 4.

3.4.3.1 Positive results

The combination of signal precision σ, the strength of punishments P and the importance of ideology ϕ will determine the optimal strategies for different types of leaders and followers. A first result is almost trivial: if ideology is less important than the quality of government ($\phi < 1$), then the first best solution will always be reached. Leaders will stage coup attempts if and only if incumbents are bad, followers will support coup attempts if and only if leaders are bad.

Proposition 1 *If $\phi < 1$ perfect accountability is achieved for all parameters.*

Proof 1 *See appendix.*

In the region $1 < \phi < \frac{1}{1-\alpha}$, ideology becomes more important than government quality in the utility functions of military officers. As the followers do not have certainty about the type of the leader, they do not necessarily want to support a coup by a leader of unknown ideology, even if the government is bad. For the R followers this is not important, because they are always glad to see a poorly performing L government replaced, either by an "average" military L government or by an "average" military R government. In contrast, the L followers are worried that they may support a military leader of the R faction. The following condition guarantees that the L followers prefer to support a random military leader (who has a prior α of being L), against a poorly performing government:

$$\phi - 1 < \alpha\phi \Rightarrow \phi < \frac{1}{1-\alpha} \tag{3.1}$$

This condition states that the pay-off from the incumbent (on the left hand side) is smaller than the expected pay-off of the military leader (on the right hand side), which is the sum of the expected quality (0) and the expected ideology pay-off. This latter component consists of the probability of facing an L leader (α) times the strength of ideology (ϕ). Hence, under condition (3.1), both types of followers can be united against a poorly performing government. The condition requires that ideology is sufficiently weak, or the probability that the coup leader shares the L followers is sufficiently strong.

The leaders can now anticipate the reaction of the followers, given that the latter believe that both leaders always stage a coup (which made α the relevant prior).

Now, it can easily be seen that both the L leader and the R leader want to topple the poorly performing incumbent if they would be supported in such attempts. They know that, on average, their rule will be better in the general interest dimension than the rule of the incumbent. Also, they can anticipate the ideology of their own regime. Hence, a Perfect Bayesian pooling equilibrium in which both types of leaders stage a coup attempt can always be supported. This reasoning proves the first part of the following result:

Proposition 2 *If $1 < \phi < \frac{1}{1-\alpha}$ ("low factionalisation") and $Q_g = -1$ ("bad incumbent"), there exists a pooling equilibrium in which both L and R military leaders stage coup attempts against poorly performing incumbents and both L and R followers support such attempts. This pooling equilibrium Pareto dominates all other equilibria.*

Proof 2 *See appendix.*

The equilibrium in proposition 2 does not guarantee the first best solution, as R leaders may want to stage coups against well-performing governments. This is because ideology is more important than government quality. If the incumbent is good, L followers will never support a coup, whereas R followers will always support a coup. L leaders will never want to stage a coup against a good government, but R leaders may bet on the followers being R and attempt a coup against a good incumbent. Given these incentives, any equilibrium with coup attempts against a good government will be separating in the leader's type.

Proposition 3 *If $1 < \phi < \frac{1}{1-\alpha}$ ("low factionalisation") and $Q_g = 1$ ("good incumbent"), the only pure strategy equilibrium sees only R followers supporting coups, while L followers never support any coups. The optimal strategy for the L leader is to never stage coups. The optimal strategy of the R leader is determined by P and σ, for which there exist thresholds $\underline{P}$, $\bar{\sigma}_R(P)$ and $\bar{\sigma}_L(P)$ such that:*

- *$P < \underline{P}$ and $\sigma < \bar{\sigma}_L(P)$: R leader stages coup iff $Q_g = 1$*
- *$P > \underline{P}$ and $\sigma < \bar{\sigma}_R(P)$: R leader never stages coup iff $Q_g = 1$*
- *$\sigma > \max\{\bar{\sigma}_R(P), \bar{\sigma}_L(P)\}$: R leader stages coup iff $Q_g = 1$ and $s = R$*

Proof 3 *See appendix.*

3.4.3.2 Institution design

The positive results of proposition 3 allow us to identify the parameter region in which the first best solution is achieved.

Corollary 1 *If $1 < \phi < \frac{1}{1-\alpha}$ ("low factionalisation"), there exists threshold $\underline{P}$, $\bar{\sigma}_R(P)$ and $\bar{\sigma}_L(P)$ such that for $P > \underline{P}$ and $\sigma < \bar{\sigma}_R(P)$, the first best is achieved.*

Hence, low signal precision and high punishments support the first best solution. This result can only partly rationalise the institutions I presented under the stylized facts. While not allowing information on political affiliation to be revealed is consistent with optimal control of the military over politics in my model, it also prescribes punishments that are higher than those observed in reality.

3.4.3.3 Case studies

Both the cases of Chile (1971-1980) and Peru (1946-1970) fit into the "low factionalisation" parameter range, of which the crucial characteristic is that different factions within the army can be united against a poorly performing incumbent. In Peru, general Odria removed a mildly left-wing president from power in 1948, on accusations of being too soft on violent militants. This latter position was widely supported within the army. In 1962, the army briefly intervened to settle an election with unclear results. It installed Belaunde as a president, a left-wing populist who later sought a coalition with conservative politicians. In 1968, the army ousted Beluande, over a deal with the International Copper Cooperation of which the unfavourable clauses were kept secret. This deal was unacceptable to most Peruvians, and the leading general, Velasco, could easily find sufficient support for his coup. In all cases, the interventions of the military were widely welcomed by the Peruvian public and Peru did not see any coups against governments that were perceived to be well-performing. Also, Peru did not see any failed coup attempts within this period.[22] These two elements are consistent with the $\phi < \frac{1}{1-\alpha}$ parameter range described above. In further support of my approach, Philip (1978) reports that the Peruvian army was factionalised between left-wing radicals and right-wing conservatives. Nevertheless, these political affiliations were effectively kept secret. The key to the success of the coup attempts against poorly

[22] This overview is based on Philip (1978).

performing governments was the fact that both factions were willing to take the risk of supporting a coup leader of ex ante unknown ideology. This was a relevant trade-off, as is illustrated by the fact that General Velasco turned out to promote radical policies which "[...] would have been too extreme for most officers who supported the coup".[23] Thus the relevant parameter range seems to be $1 < \phi < \frac{1}{1-\alpha}$, in which the faction of the army that was ideologically closest to the incumbent government prefers the incumbent to a new government of opposing ideology.

Chile seems to have found itself in a similar equilibrium when Pinochet took power in 1973. His move was supported by a majority within the military (Philip, 1985, p308). Historical sources suggests that the main division within the military was between officers with Christian democratic sympathies and right wing conservatives,[24] but at the time these affiliations were strictly secret (Philip, 1985, p307). The moderate Christian group seemed to have had the strongest support, but once installed in power, Pinochet turned out to belong to the second group. As Philip indicates, it is highly unlikely that Pinochet would have gained the support of the military if his views were known before the coup. As in Peru, the relevant equilibrium range seems to have been $1 < \phi < \frac{1}{1-\alpha}$, where the faction ideologically closest to the incumbent government would not support a coup from the opposing faction in a complete information world, but is willing to take the risk of supporting a "random officer" if a coup is staged against a poorly performing government.

In contrast to the secret affiliation in the Peruvian and Chilean military, the Brazilian military had "[...] in fact institutionalized military debate over public and political issues" (Stepan, 1971, p44). The most important forum was the Military Club in Rio de Janeiro, of which the biennial elections were traditionally fought over political issues. The three coups that succeeded in the 1950-1970 period all targeted a government with low legitimacy (Stepan, 1971, p108). However, Brazil did also see failed coups in this period. The two failed coups both tried to prevent a newly elected politician from assuming power. As these governments had not revealed their quality yet, these coups are unlikely to have been staged in the general interest. This suggests that Brazil was in an equilibrium with $1 < \phi < \frac{1}{1-\alpha}$, but its open political debate put σ in the range where $\sigma > \bar{\sigma}_R$. Therefore, factions not sharing the government's ideology (R) were willing to act upon a favourable

[23] Philip, 1978.

[24] Assuming that the Christian Democrats shared Allende's ideology, as we implicitly do here, is a simplification. However, Philip (1985) suggests they would have preferred Allende to Pinochet, if they had known his agenda.

signal ($s = R$) and stage coups against governments that were not poorly performing and had a high degree of legitimacy. This suggests that Brazil was not at its institutional optimum and could have prevented these unsuccessful coup attempts (and the risk of them being successful) by having less open political affiliation.

3.4.4 High factionalisation equilibria

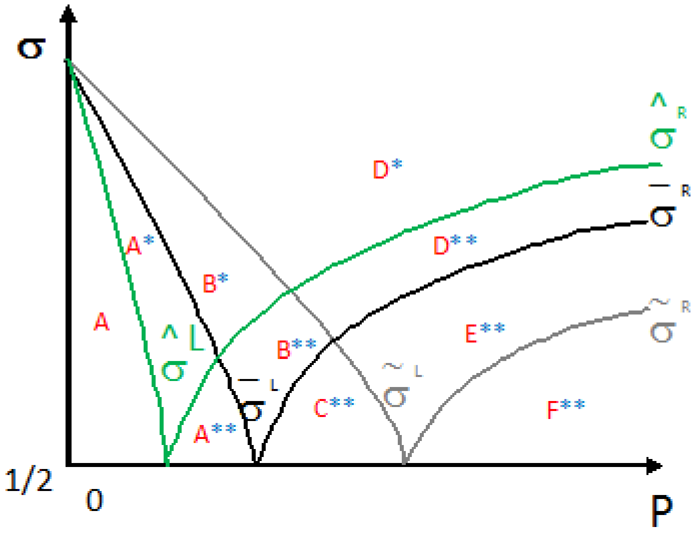
In this section, ideology is so important that the military can no longer be united against a bad government.

3.4.4.1 Positive results

$\phi > \max(\frac{1}{1-\alpha}, 2)$ implies that the L follower is no longer willing to back a coup attempt if both L and R types always try to oust the bad government. As a consequence, there are no pure strategy Bayesian equilibria in which the L follower supports a coup. The R follower, as before, will continue to support any coup. Therefore, the parameters of the model will only affect the optimal strategies of the leader. Deriving these optimal strategies boils down to an exercise of comparing the expected costs and benefits of staging a coup. The set of possible equilibria that can be attained by manipulating punishments and signal precision can be represented in a diagram that delineates the optimal strategies for each type of leader for each possible signal, the relevant quality of the incumbent and any combination of P and σ.

The optimal strategy space of each type of leader in a particular situation is delineated by a V-shaped curve in the (σ, P)-space. For example, the $(\hat{\sigma}_L, \hat{\sigma}_R)$ curves divide the strategy space in different optimal strategies for an L leader who faces a bad government, upon receiving an L or R signal respectively. In the region below the $\hat{\sigma}_L$ curve, signal precision and punishments are sufficiently low, so that left-wing leaders are still willing to stage coups against bad incumbents regardless of the signal (region A). As left-wing followers no longer support coups, the L leaders count on the support of right-wing followers instead. Therefore, if signal precision rises above the $\hat{\sigma}_L$ and $\hat{\sigma}_R$ curves (regions marked with a "*"), the L leader is only willing to stage coups if he receives a favourable signal, i.e. that the followers are right-wing . Finally, if we move underneath the $\hat{\sigma}_R$ curve (the regions

Figure 3.1: Optimal strategies for leaders under high factionalisation



Strategies of *L* leader:

**	No attempt
*	Attempt against bad incumbent for *s=R*
unmarked	Attempt against bad incumbent for any signal

Strategies of *R* leader:

A:	Attempt against any incumbent for any signal
B:	Attempt against bad incumbent for any signal; attempt against good incumbent for *s=R*
C:	Attempt against bad incumbent for any signal; no attempt against good incumbent
D:	Attempt against any incumbent if *s=R*
E:	Attempt against bad incumbent if *s=R*; no attempt against good incumbent
F:	No attempts

marked with "**"), the L leader will never stage a coup as the signal has become unreliable and the punishments for failure are too severe. Similarly the $(\bar{\sigma}_L, \bar{\sigma}_R)$ curves describe the optimal strategies of an R leader facing a good government. Finally, the $(\tilde{\sigma}_L, \tilde{\sigma}_R)$ curves describe the optimal strategies of an R leader facing a bad government. In the graphical representation, the ordering of the $(\hat{\sigma}_L, \hat{\sigma}_R)$, $(\bar{\sigma}_L, \bar{\sigma}_R)$ and $(\tilde{\sigma}_L, \tilde{\sigma}_R)$ curves is intuitive: L officers $(\hat{\sigma}_L, \hat{\sigma}_R)$ are less coup prone than R leaders facing a good government $(\bar{\sigma}_L, \bar{\sigma}_R)$, who are in turn less likely to stage a coup than R leaders facing a bad incumbent $(\tilde{\sigma}_L, \tilde{\sigma}_R)$.

3.4.4.2 Institution design

Figure 3.1 clearly demonstrates the trade-off between holding governments accountable and overshooting by ousting good governments. The equilibria in which the L leader stages a coup if and only if the incumbent is poorly performing (the first best L strategy), imply necessarily that the R leader will stage coups against good governments. This follows from the fact that the utility functions are dominated by the ideology component when $\phi > \max(\frac{1}{1-\alpha}, 2)$. Therefore, the first best is no longer achievable. Comparing the properties of each possible equilibrium with the first best benchmark, it can easily be established that the parameter ranges in figure 3.1 can be ordered as follows in terms of the expected quality of government $(E(Q))$:

$$
\begin{aligned}
A > A^* &> A^{**} \\
B^* &> B^{**} \\
B^* &> D^* \\
C^{**} > B^{**} &> D^{**} \\
C^{**} > E^{**} &> F^{**}
\end{aligned}
$$

This leaves three candidates for a welfare optimum. First, there is an equilibrium with low punishments and low signal precision (A), in which the L leader stages a coup if and only if the government is bad and the R leader always stages a coup attempt. These attempts are successful whenever the follower is R. Second, there is an equilibrium with intermediate punishments and high signal precision (B^*), in which both L and R leaders condition their responses on the signal. Only if the signal is favourable, the L leader attempts a coup against a bad government and the R leader attempts a coup against the good government. Against a bad government, the R leader will still stage a coup attempt regardless of the signal. Finally, there is an equilibrium with low signal precision and intermediate punishments (C^{**}), in which only R leaders stage coups and they do so if and only if the incumbent is bad. The following proposition states that only (A) or (C^{**}) can be optimal.

Proposition 4 *If $\phi > \frac{1}{1-\alpha}$, we can define thresholds $\hat{P}$, $\underline{P}$, $\bar{P} > 0$ and $\tilde{\sigma}_L(P) \geqslant \frac{1}{2}$, such that the combinations of P and σ yielding pure strategy Bayesian equilibria that (weakly) maximise $E(Q)$ are given by:*

1. *If $\alpha \leqslant \gamma$: $\underline{P} < P < \bar{P}$, $\sigma < \min(\tilde{\sigma}_L(P), \bar{\sigma}_R(P))$. In the corresponding equilibrium an L leader never stages a coup attempt, an R leader stages a coup attempt if and only if the incumbent is bad. An L follower never supports a coup; an R follower supports any coup (Equilibrium C^{**}).*
2. *If $\alpha \geqslant \gamma$: $P < \hat{P}$ and $\sigma < \bar{\sigma}_L(P) < \tilde{\sigma}_L(P)$. In the corresponding equilibrium an R leader always stages a coup. An L leader stages a coup if and only if the government is bad. An L follower never supports a coup; an R follower supports any coup (Equilibrium A)*

Proof 4 *See appendix.*

This proposition implies that it is never optimal to have open political debate if both punishments and signal precision can be manipulated. Note that the level of punishments does not affect the welfare function directly (it only affects the equilibrium chosen), whereas the signal precision has a direct impact by determining the likelihood of correct recognition of the followers (and, hence, the probability of successful coups). Given that signal precision directly enters the probability of certain equilibria, its effect should be monotonic. This means that either the highest signal precision or the lowest signal precision consistent with this equilibrium must be optimal. However, in terms of the equilibrium outcome, B^* with $\sigma = 1$ is equivalent to A. This means that A is weakly preferred to B^*, and strictly preferred, as soon as we rule out the cut-off case of perfect precision ($\sigma = 1$)). It is shown in the appendix that limiting σ is only optimal within equilibrium B^* if it is better to discourage coups. But if coups need to be discouraged, than equilibrium C^{**} beats B^*.

Comparing the remaining candidates (A and C^{**}), the advantage of the equilibrium C^{**} (intermediate punishments) is that a good government is never ousted.

The precision of the signal is sufficiently low and punishments are sufficiently high, so that the R leader only stages a coup attempt against a bad incumbent, regardless of the signal. The disadvantage is that a leader of the same ideology of the government will never challenge a bad government. He will find the punishments too high and the information he has about the followers' political stance too scarce to ever attempt a coup. In equilibrium A (low punishments) the L leader is willing to act against a bad government. However, this also implies that the R leader is willing to oust a good government under any signal. Which equilibrium dominates depends on whether $\gamma < \alpha$. If $\gamma < \alpha$, the probability of the government being good is smaller than the probability of the leaders being of type L. Hence, the optimal equilibrium has coups against bad governments staged by the L leader at the cost of introducing R-led coups against good governments. If $\gamma > \alpha$, the probability of the government being good (γ) is higher than the probability of the leader being of the L type (α). Hence, the optimal equilibrium will have no coups against the good government at the cost of not having any coups by L leaders against the bad government.

These results are consistent with some of the stylized facts. Armies should be politically neutral, and there could be a case for limiting the expected punishments. The result on political neutrality is the most robust finding, as a best case for open political affiliation was made. Also, comparing the expected quality of government under low and high factionalisation equilibria, the optimum under low factionalisation clearly dominates the optimum under high factionalisation. Therefore, institution design could in theory address the degree of factionalisation within the military. For instance, military training places emphasis on the development of a "military identity" that complements and possibly replaces any identities previously held by officers (Philip, 1985, p177-200). Also, recruitment policies may aim at attracting a homogenous set of candidates. While I focus on the neutrality of the army at the level of individual officers, the neutrality of the military as an institution may be seen an institutional arrangement that makes it easier for soldiers to identify with "military values" and weaken their factional affiliations.

3.4.4.3 Case studies

The case of Venezuela (1992) can illustrate these results. In the late eighties the Venezuelan economy was severely hit by a decline in oil prices. Carlos Andres

Perez's government was alleged to be highly corrupt and had reneged on campaign pledges to push through a series of unpopular reforms (Norden, 2001). Against this background, Hugo Chavez staged a coup attempt in 1992. Chavez' coup failed because he did not have the support of key players within the army. Importantly, political affiliations other than links with the leading AD party (Acción Democrática) were not allowed to be shown within the military (Norden, 2001, p121). Gott (2005, p64) indicates that Chavez only knew that he had the support of about 10% of the army. He did not have any clues about the views of the remaining 90%. In terms of this model, it may have been that some conservative officers would actually have liked to oust Andres Perez as well. The failure could then be explained by the fact that Venezuela was in the high factionalisation range ($\frac{1}{1-\alpha} < \phi$). In this range, the majority of the army, which proved to be of the same ideology as the government, chose not to back a coup leader of ex ante unknown political affiliation: Hugo Chavez. In the aftermath of the failed coup, Hugo Chavez was put on trial and given a long prison sentence, but the wide-ranging amnesty powers of the president allowed the successor of President Perez to set him free after only two years (Gott, 2005, p119).

Evaluating the military institutions of Venezuela, the condition $\gamma > \alpha$ may have been satisfied in Venezuela, implying that the average quality of incumbents is sufficiently high relative to the probability of the coup leader sharing the ideology of the incumbent. As indicated in proposition 4, it is optimal to have an equilibrium with political neutrality in this range. Also, the expected punishments for a failed coup may have been sufficiently low to induce a coup attempt, assuming that Chavez anticipated his relatively mild punishment. The failure of this coup, which was due to the strong position of conservatives in the army, could not have been prevented by changing either P or σ.

3.5 A theory of political affiliation

This section develops a theory of the disclosure (or hiding) of political affiliations. This analysis endogenises "talking politics" in the army. It provides a microfoundation of earlier assumptions and suggests a specific institutional framework which can implement the equilibria found before. The proposed game boils down to an application of a standard communication game, in which I introduce a cost to eliminate cheap talk results.

3.5.1 Model

The model builds on the one introduced in section 1. The signals are now abandoned and replaced by a message from the leader. To this aim, a stage is added to the game in which the leader can send a message about his type: $\hat{I}_i \in \{R, L, N\}$. The option to announce N has to be interpreted as remaining neutral. This option can be attractive for officers if there is a cost to lying about one's type. This cost of lying is captured by ξ, satisfying $0 < \xi < \phi - 1$. The utility function of i is:

$$U_i = \begin{cases} -P + Q_k, & \text{if } i \text{ stages a failed coup} \\ \phi\iota(I_i = I_k) + Q_k - \iota(\hat{I}_i \neq I_i \& \hat{I}_i \neq N)\xi, & \text{in all other cases} \end{cases}$$

The follower can also reveal his type $\hat{I}_f \in \{R, L, N\}$. For the follower, no cost of lying is assumed (as this would only strengthen the results). The utility function of f is:

$$U_f = \phi\iota(I_f = I_k) + Q_k, \quad \text{in all other cases}$$

This game is now the same as before, augmented with a communication stage. The timing of the game is now:

1. Nature draws the type of the leader, I_i, and the type of the follower, $I_{f.}$
2. The leader announces his type $\hat{I}_i$ and the follower announces $\hat{I}_f$ simultaneously.
3. Nature draws the quality of the government, Q_g
4. The leader i receives signal s and chooses a. If $a = 0$, the game ends.
5. If $a = 1$, the follower f chooses b. If $b = 1$, i becomes the new government. If $b = 0$, g remains in power and the coup fails.
6. Pay-offs (U_i, U_f) are realised.

Solving this problem by backward induction, officers in the communication stage anticipate the positive results derived earlier. The following proposition states that followers prefer to reveal their ideology.

Proposition 5 *For $\phi > 1$, the only pure strategy equilibrium communication is separating in the follower's type.*

Proof 5 *See appendix.*

Turning to the communication strategy of the leader, it is intuitive that all messages will be uninformative in a pure strategy equilibrium. Suppose there is an equilibrium in which $\hat{I}_i(I_i) = I_i$. Then an R leader is never supported by L followers if the incumbent is bad. The L leader is always supported by L followers if the government is bad. Therefore, the R leader is strictly better off by deviating and announcing $\hat{I}_i(R) = L$. Therefore $\hat{I}_i(I_i) = I_i$ cannot be an equilibrium. This result holds regardless of the communication strategy of the followers: even if the followers reveal their types, the leader cannot rule out the followers being L when they decide to show their affiliation or not.[25]

Proposition 6 *For $1 < \phi < \frac{1}{1-\alpha}$, the only pure strategy perfect Bayesian equilibria that satisfy the intuitive criterion have $\hat{I}_i(R) = \hat{I}_i(L) \in \{L, N\}$.*

For $\phi > \{2, \frac{1}{1-\alpha}\}$, the only pure strategy perfect Bayesian equilibrium has $\hat{I}_i(R) = \hat{I}_i(L) = N$.

Proof 6 *See appendix.*

This proposition explicitly states an insight used in the previous section: the leaders have an incentive to conceal their true types. For $\phi < \frac{1}{1-\alpha}$, coups against a bad incumbent are always supported by any type of followers in this parameter range. This equilibrium relies on the secrecy of political affiliation. The cost of lying (in combination with the intuitive criterion) makes sure that leaders pool by both claiming to be L or to be neutral. From an equilibrium in which both types of leaders claim to be R, only an L leader would strictly prefer to deviate under the belief that he is L. For $\phi > \frac{1}{1-\alpha}$, ideology is so important that L followers are not willing to support a coup from an unknown type. Again, the cost of lying allows us to rule out certain messages, in this case only viable equilibrium is characterised by $\hat{I}_i(R) = \hat{I}_i(L) = N$. In this case, the equilibrium of both officers claiming to be left-wing is not sustainable. As the R leader is not supported by L followers anyway in equilibrium, he would deviate to claim to be neutral or R in order to prevent the cost of lying under any out-of-equilibrium belief.[26]

[25] This argument relies on the assumption of simultaneous announcements. The condition $\xi < \phi + 1$ guarantees that the cost of lying is not too large to prevent leaders of type R to lie.

[26] All these results hold for an arbitrarily small $\xi > 0$.

3.5.2 Case studies

The insight that coup plotters should refrain from having open political affiliations is emphasized in Luttwak's (1968) practical coup manual. An illustration of this theory can be found in the biographies of generals Pinochet, Velasco and Chavez. None of these coup leaders revealed their affiliations before they successfully assumed power. Velasco had clear links with the conservative elements in society and concealed his radical left wing sympathies (Philip, 1978, p43). He could have found himself in the pooling equilibrium where leaders claim to be of the incumbent government's ideology. Chile's general Pinochet concealed his right wing ideology as well and kept a neutral profile (Philip, 1985). Hugo Chavez did not have an openly left wing agenda either when he staged his 1992 coup (Norden, 1992). In line with the earlier hypothesis that Venezuela is best described by the $\phi > \frac{1}{1-\alpha}$ region, Chavez was neutral and did not associate himself with conservative ideologies.

The communication game also justifies my so far implicit assumption that institutions can alter the actual openness of political affiliation (i.e. changing σ). As followers have an incentive to reveal their types, only appropriate institutions will prevent them from doing so. In principle, these institutions could be developed entirely within the armed forces, in line with Huntington's ideal of a professional, autonomous military (Huntington, 1981). However, the analysis in this section points at the tension between an independent army and the incentives that shape political communication within the army. This may call for targeted civilian control over the military. For instance, purging powers can be granted to a government that aims to prevent coups. As coups are more likely if the followers show their affiliation, a government that wants to avoid coups will have an incentive to discourage officers from revealing their (diverging) political views. As indicated earlier, the military in Brazil (1950-1970) and Venezuela (1980-2002) differed strongly with regard to their openness of political affiliation. One can compare the promotion structures of both militaries to illustrate the hypothesis that different degrees of open political affiliation can be implemented by varying the government's control over promotions. Throughout the period 1958-1998, Venezuelan officers were expected to be of the leading political parties' ideology or not to hold any political views at all. The Congress had strong powers over military appointments, which was seen as an explicit strategy to reduce the armies' threat to intervene (Norden, 2001, p126; Trinkunas, 2001, p171). In this context, Chavez' activities, which are reported to have started in the late seventies, had to remain secret (Norden, 2001, p122). Chavez had little information about his overall support within the army and Norden ascribes the failure of the coup partly to the unwillingness of the coup plotters to approach extra officers (Norden, p120). In contrast, at least until 1962, the Brazilian army had a largely independent promotion structure mainly based on achievement in the military academy (Stepan, 1971, p51). The limited direct influence of the government on army promotions was necessary to sustain an equilibrium in which officers were willing to share their political views.

3.6 Extensions

3.6.1 Perfectly observable types

In a first extension, I present the positive results of this model for the case in which institutions do not matter because types are directly observable. This seems an appropriate assumption if ethnicity or regional origins form the most important political dimension, as these types cannot be concealed. Going back to the full model of section 1 and reintroducing the drawing of I_i, this implies: $\mu = \sigma = 1$.

Proposition 7 *If $\phi < 1$, then there is a coup attempt if and only if $Q_g = -1$ and followers always support this coup. If $\phi > 1$, then there is a coup attempt from an R leader whenever the follower is observed to be R. There is an attempt from an L leader whenever $Q_g = -1$. The L follower only supports a coup by the L leader. The R follower supports any coup.*

This proposition is a direct corollary of earlier results. To summarise, in countries where the main conflict is along ethnic lines, military coup attempts are expected: (1) to target both well-performing and poorly performing governments; (2) to be frequent, possibly in spite of severe punishments; and (3) not to fail.

An illustration of this case is Nigeria. Nigerian politics have been dominated by ethnic conflicts ever since its independence. The Nigerian military recruited in all regions and, as is clear from the account of Alli (2000), the regional affiliations of military officers were easily observable. Typically, Northern officers dominated the army and used this position to block the South to gain more influence in politics (Luckham, 1974). First, as predicted by my model, Nigeria saw coups both against poorly performing governments and well-performing governments.[27] For instance, Nigeria's first coup, in 1966, was entirely driven by the sectional interests of Ibo officers who aimed to overthrow a government which was dominated by Muslim leaders. However, Northern officers also removed the Northern General Gowon from office in 1975, because he did not deal effectively with the economic crisis. A second prediction of our model is a high frequency of coup attempts. Nigeria faced nine coup attempts in the period 1966-2000, even though the leaders of the two (out of equilibrium) failed coups were all executed. Also, of these nine coup attempts, only two failed. Therefore, the case of Nigeria closely fits the predictions of our model. Also, the analysis may explain the empirical result of Collier and Hoeffler (2007) that ethnic dominance, in the sense that one ethnic group accounts for more than 45% of the population, leads to significantly higher coup risk. The authors do not provide an explanation for this result, but their variable ethnic dominance can be expected to be correlated with ethnic polarisation, as I discussed here.

In conclusion, the case of observable types yields several benchmark predictions that naturally lend themselves to empirical testing. However, the scope for institution design is extremely limited in this case, as political affiliations are open by default.

3.6.2 Introducing an extremist faction

Relaxing the parametric assumptions in earlier sections, coups can be undesirable for two main reasons: (1) coups could target a well-performing government, or (2) coups could replace any government with a regime that is even worse.[28] The assumption that a military government is always better than a bad incumbent means that I discarded the latter possibility earlier. The welfare function that was proposed was not sensitive to ideology. However, it is conceivable that a faction of the army does not promote the general interest and less so than the incumbent government. Such factions can be thought of as "extremists", who prefer policies that are unacceptable to society at large.

[27]The coup attempts I consider are: January 1966, July 1966, 1975, 1976, 1983, 1990, 1993, 1995. Of these attempts the 1976 and 1995 attempts failed. (Alli, 2000, p.211-224)

[28]The strong economic growth of Chile under Pinochet contrasted sharply with the economic crisis during the Allende regime. Nevertheless, it would be reasonable to adopt a social welfare function that gives more weight to the human rights abuses of the Pinochet regime than to Chile's economic growth experience.

The model can now be re-interpreted by assuming that the military consists of left-wing moderates and right-wing extremists, whereas the government is moderately left-wing. The positive results derived earlier will carry through. However, a new welfare function will now assign a positive value to the ideology of the incumbent, for instance by including ϕ ($\phi > 1$). Under this assumption, the institutions that maximise expected government quality will promote coups by moderate officers if and only if the incumbent is bad, but discourage coups by right-wing officers. This means that the first best is no longer achievable, even if factionalisation within the military is low.[29] In this parameter range, high punishments and low political openness will now be the second best optimum, as no other institutional setting prevents coups more effectively in the case of low factionalisation. Nevertheless, this equilibrium will continue to see coups by R leaders, as the followers are willing to take the risk of supporting an extremist leader if that strengthens accountability. If extremism enters the welfare function, the high factionalisation range will have a different optimal solution in comparison to the earlier results. It can be seen straightaway that it may no longer be optimal to limit punishments, as an equilibrium with high punishments and political neutrality has no coup attempts by right-wing officers and beats an optimum with limited punishments in which a right wing leader stages a coup if and only if the incumbent is poorly performing.

As an illustration, Brazil was characterised by repeated take-overs (in 1945 and 1956) initiated by moderate factions within the military who quickly organised a return to democracy until the 1964 coup saw the military taking over government for the next 21 years. The military government of Brazil was responsible for at least 339 disappearances and assassinations, on top of wide-spread torturing and jailing of political opponents. While the initial coup leader, General Castello Branco was moderate and committed to democratisation (Stepan, 1971, p234), his position in the army was too weak to prevent hard-line officers to influence his policies and eventually replace him in 1968. It can be argued that Brazil's policies did not consider a welfare improvement over the Goulart government the military replaced in 1964. My anaysis suggests that this outcome could result from the same equilibrium that underlay the relatively benign "moderator role" of

[29]The concept of "extremism" may appear to be at odds with the notion of "low factionalisation" ($\phi < \frac{1}{1-\alpha}$). Nevertheless, ideological views within the army could be close to each other, in particular if the military's corporate interests are taken into account. Furthermore, the "low factionalisation" parameter range could be consistent with substantial ideological differences (high ϕ) in combination with a sufficiently low ex ante probability of an extremist coup leader (low $1-\alpha$). In a richer game, followers could gradually learn about the distribution of ϕ in the universe of coup plotters.

the military in earlier years. If the L faction is interpreted as prodemocratic elements within the military and the R faction as officers with antidemocratic ideals and a repressive agenda, then my model suggests that any equilibrium in which L followers are willing to oust bad governments, also allows R followers to oust bad governments. Therefore, the break-down of the "moderator pattern", in which the military intervenes for short periods without fundamentally changing democratic institutions can be understood an inevitable consequence of the equilibrium underlying interventions of a moderate faction of the military. Once "moderate" officers learn about the distribution of "extremist ideologies", they may no longer be willing to support any coup leader. This may shift the equilibrium to the high-factionalisation range, in which coups are rarer and more effectively prevented by institutionalising high punishments and low political openness. In this context, fractionalisation could contribute to the demilitarisation of politics by making it harder to stage successful coups.

3.7 Interpretation

3.7.1 Ordering political institutions

An important limitation of the theoretical framework introduced in this paper is its seemingly paradoxical assumptions about the strength of political institutions. It was argued that the military could be a de facto moderator if political institutions are sufficiently weak. However, the subsequent analysis argued that for the military to be an effective arbitrator, political institutions must be sufficiently strong to generate credible civil military institutions. Such institutions can both ban open political affiliations and credibly implement punishments for failed coup plotters. Given that the incumbent could have an obvious incentive to severely punish failed coup plotters, restraint in punishment could be a sign of relatively strong political institutions. In the example of Nigeria discussed earlier, all failed coup plotters were executed. Therefore, the poor coup performance of Nigeria could partially be due to poor political institutions as well. As a corollary, the military will be a poor arbitrator of domestic politics if political institutions are very weak. Hence, my theoretical framework suggests an ordering of political institutions. The analysis in this paper is most relevant if political institutions are in an intermediate range, sufficiently strong to constrain the behaviour of the military, but sufficiently weak to legitimise military interventions in politics. These institutional capabilities may change over time and the next subsection considers the recent break-down of the moderator pattern in more detail.

3.7.2 The breakdown of the "moderator pattern"

It seems appropriate to revisit the central idea that military coups can effectively hold governments accountable. I argued that this idea was widely spread and de facto military influence over domestic politics remains strong. Therefore, I believe that this is an adequate assumption to make in modelling coup behaviour and understanding the evolution of civil-military institutions. Policy makers have recently become more sceptical about the beneficial effects of military intervention, as exemplified by the increasing constraints to the legitimacy of military power over politics. While a wide range of factors, including the end of the Cold War could have contributed to this trend, my framework incorporates three explanations for such a shift in ideas. First, my model implicitly assumed a failure in holding governments accountable by other means than coups. If democracies have become more effective, then military coups may have become superfluous. Second, it may be that political elites or social planners have overestimated the expected quality of military interventions in the past. The experience of the brutal military regimes in Latin America or, more recently, in Burma, may have lowered the expectations about military rule. Finally, my model also suggests that the so-called "moderator pattern of civil military relations", in which the military intervenes for short periods without fundamentally changing democratic institutions, is only one possible outcome of the underlying equilibrium. Once officers are willing to support a leader of unknown quality against a bad government, they take the risk of supporting a leader with a hidden extremist agenda. The coup experiences of Brazil and Chile demonstrated how relevant this risk is. Ultimately, this risk is weighed against the cost of a poorly performing government. For this reason, coups may become less attractive as societies become more prosperous and moderate officers are no longer willing to bet on the ideology (or quality) of a military coup leader.

3.8 Conclusion

This paper analyses the circumstances under which coups are aligned with the general interest. The analysis is based on three crucial assumptions. First, a military leader is assumed to be of average quality, so that a military intervention leads to higher government quality if the government is poorly performing. Second, it is assumed that the military is factionalised and politicised. Third, punishments are not conditional on government quality.

The main results are derived under the assumption that political affiliation is not directly observable. Focusing on the expected government quality as the objective function, the military is best in performing its role as a check on the government if ideological cleavages within the military are sufficiently limited and coup plotters are sufficiently likely to share the government's ideology. Once ideology becomes more important, the optimal institutional set-up has low or intermediate levels of punishments and no open political affiliation. This setting prevents coups against good governments that are driven by the factional interests of the opposition, while the sufficiently low punishments can induce the army to intervene if the government is poorly performing. In the special case of perfectly observable political affiliation, the model yields an equilibrium with high government turnover, in which coups are staged both against well performing and poorly performing governments.

The most important limitation of the current paper is probably its strong assumption on the form that punishments can take. It would be interesting to collect systematic data on how leaders of failed coups are punished and to develop a model that endogenises punishment and explains empirical patterns. The framework developed in this paper could provide a useful starting point for this analysis. A second, very natural extension would be to endogenise the quality of government (e.g. as a moral hazard problem). Nevertheless, the results of such an exercise can be expected to be qualitatively similar to the ones derived here.

The analysis in this paper can help to understand the factors that contribute to civilian control over the army. It was argued that the risk that is inherent to the moderator pattern of civil-military relations can explain the breakdown of this pattern. It also highlights how a combination of factionalisation and uncertainty about political views within the military can be an important driver of gradual demilitarisation of politics.

3.9 Appendix to Chapter 3

Proof of proposition 1

Write $U_i(a, I_i, s, Q_g)$ and $U_f(b, I_f, I_i, Q_g|a = 1) = U_f(b, I_f, I_i, Q_g)$.

Solve by backward induction by first deriving the strategy of the follower.

$E[U_f(1, L, L, Q_i)] = \phi$,

$U_f(0, L, L, -1) = \phi - 1$, $U_f(0, L, L, 1) = \phi + 1$.

$E[U_f(1, R, L, Q_i)] = 0$,

$U_f(0, R, L, -1) = -1$, $U_f(0, R, L, 1) = 1$.

Therefore both types of followers support a coup attempt by L iff $Q_g = -1$. Anticipating this, the L leader has:

$U_i(1, L, L, -1) = U_i(1, L, R, -1) = \phi$,

$U_i(0, L, R, -1) = U_i(0, L, L, -1) = \phi - 1$,

$U_i(0, L, R, 1) = U_i(0, L, L, 1) = \phi + 1$.

For the R leader this becomes:

$U_i(1, R, L, -1) = U_i(1, R, R, -1) = \phi$,

$U_i(0, R, R, -1) = U_i(0, R, L, -1) = \phi - 1$,

$U_i(0, R, R, 1) = U_i(0, R, L, 1) = 1$.

Therefore both R and L leaders stage a coup attempt if and only if $Q_g = -1$.

Proof of proposition 2

See main text for a proof of the existence of the pooling equilibrium. Note that this equilibrium holds for any out-of-equilibrium belief. There is also a pure strategy separating equilibrium in which only the R type stages a coup attempt and only R type followers support coups, and there can also a mixed strategy equilibrium. These equilibria are all Pareto dominated by the pooling equilibrium from the perspective of the military leaders and followers. In the pooling equilibrium bad governments are always ousted by both L and R leaders, whereas in the separating equilibrium only R leaders will attempt a coup if $Q_g = -1$, which only succeeds if they are supported by R followers. It is clear that both L and R leaders are worse of in this equilibrium. The same reasoning can be applied to prove that mixed strategy equilibria are dominated. Also, the mixed strategy equilibria break down for lower values of ϕ than the pooling equilibrium, as they imply a probability of a coup leader being L which is smaller than α.

Proof of proposition 3

If $Q_g = 1$, only R followers will support a coup. Anticipating these reactions, the optimal strategy of the leader can be derived.

Write $U_i(a, I_i, s, Q_g)$ and $U_f(b, I_f, I_i, Q_g|a = 1) = U_f(b, I_f, t, Q_g)$. $I_i = L$ is fixed here. Staging a coup against a good incumbent following an L signal is optimal if:

$E\left[U_i(1, R, L, 1)\right] > U_i(0, R, L, 1)$

$\Leftrightarrow \frac{\sigma\beta}{\sigma\beta+(1-\sigma)(1-\beta)}(-P+1) + \frac{(1-\sigma)(1-\beta)}{\sigma\beta+(1-\sigma)(1-\beta)}(\phi) > 1$

$\Rightarrow \sigma < \frac{(1-\beta)(\phi-1)}{\beta P+(1-\beta)(\phi-1)} \equiv \bar{\sigma}_L(P)$

Staging a coup against a good incumbent following an $R-$signal is optimal if:

$E\left[U_i(1, R, R, 1)\right] > U_{i,R}(0, R, R, 1) \Leftrightarrow$

$\frac{(1-\sigma)\beta}{\sigma(1-\beta)+(1-\sigma)\beta}(-P+1) + \frac{\sigma(1-\beta)}{\sigma(1-\beta)+(1-\sigma)\beta}(\phi + 2\kappa - 1) > 1$

$\Rightarrow \sigma > \frac{\beta P}{\beta P+(1-\beta)(\phi-1)} \equiv \bar{\sigma}_R(P)$

Define $\underline{\mathrm{P}} \equiv \frac{(1-\beta)(\phi-1)}{\beta}$. $\underline{\mathrm{P}} > 0$ for $\phi > 1$. The following results can be derived:

$P < \underline{\mathrm{P}} \Rightarrow \bar{\sigma}_R(P) < \frac{1}{2} < \bar{\sigma}_L(P)$

$P > \underline{\mathrm{P}} \Rightarrow \bar{\sigma}_L(P) < \frac{1}{2} < \bar{\sigma}_R(P)$

Proposition follows from here.

Proof of proposition 4

$\phi > \frac{1}{1-\alpha}$ implies that the L follower never supports any coup attempt in equilibrium. For a pooling equilibrium, this result follows from the proof of proposition 3. We can rule out separating equilibria as well for $\phi > \frac{1}{1-\alpha}$. If the L follower only supports a coup with some probability as to make the $L-$initiator indifferent for $s = R(L)$, then the R leader will always stage a coup for $s = R(L)$ (as the R follower has a stronger incentive to stage a coup) and the expected utility of supporting a coup for an L follower will be even lower than in the case where both types always stage a coup. If the L follower tries to make R indifferent at $s = R(L)$, then L will no longer stage coups at this signal as L's outside option is better than $R's$. This implies that the expected pay-off for the L follower from supporting a coup is lower than in the case where both types always stage a coup.

Knowing that L followers will never support a coup and R followers will support any coup, I derive the optimal strategy for the leaders. I focus on the R leader first. Write

$U_i(a, I_i, s, Q_g)$ and $U_f(b, I_f, I_i, Q_g|a = 1) = U_f(b, I_f, t, Q_g)$. The optimal strategy of the follower is described by:

- $E[U_i(1, R, L, -1)] > U_i(0, R, L, -1) \Leftrightarrow \sigma < \frac{(1-\beta)(\phi+1)}{\beta P+(1-\beta)(\phi+1)} \equiv \tilde{\sigma}_L(P)$
- $E[U_i(1, R, R, -1)] > U_i(0, R, R, -1) \Leftrightarrow \sigma > \frac{\beta P}{\beta P+(1-\beta)(\phi+1)} \equiv \tilde{\sigma}_R(P)$
- $E[U_i(1, R, L, 1)] > U_i(0, R, L, 1) \Leftrightarrow \sigma < \frac{(1-\beta)(\phi-1)}{\beta P+(1-\beta)(\phi-1)} \equiv \bar{\sigma}_L(P)$
- $E[U_i(1, R, R, 1)] > U_{i,R}(0, R, R, 1) \Leftrightarrow \sigma > \frac{\beta P}{\beta P+(1-\beta)(\phi-1)} \equiv \bar{\sigma}_R(P)$

Define $\underline{P} \equiv \frac{(1-\beta)(\phi-1)}{\beta}$, $\bar{P} \equiv \frac{(1-\beta)(\phi+1)}{\beta}$ and $\mathring{P} \equiv \frac{(1-\beta)}{\beta}\sqrt{(\phi-1)(\phi+1)}$ (for$\phi > 1$).

It follows that $\underline{P} < \mathring{P} < \bar{P}$ for $\phi > 1$. The following results can be derived:

- $P < \underline{P} \Rightarrow \tilde{\sigma}_R < \bar{\sigma}_R < \frac{1}{2} < \bar{\sigma}_L < \tilde{\sigma}_L$
- $P > \bar{P} \Rightarrow \bar{\sigma}_L < \tilde{\sigma}_L < \frac{1}{2} < \tilde{\sigma}_R < \bar{\sigma}_R$
- $\mathring{P} < P < \bar{P} \Rightarrow \bar{\sigma}_L < \tilde{\sigma}_R < \frac{1}{2} < \tilde{\sigma}_L < \bar{\sigma}_R$
- $\underline{P} < P < \mathring{P} \Rightarrow \tilde{\sigma}_R < \bar{\sigma}_L < \frac{1}{2} < \bar{\sigma}_R < \tilde{\sigma}_L$.

Similar thresholds can be derived for the L leader, for the case in which the L follower does not support any coup attempt:

- $E[U_i(1, L, L, -1)] > U_i(0, L, L, -1) \Leftrightarrow \sigma < \frac{(1-\beta)}{\beta P+(1-\beta)} \equiv \hat{\sigma}_L(P)$
- $E[U_i(1, L, R, -1)] > U_i(0, L, R, -1) \Leftrightarrow \sigma > \frac{\beta P}{\beta P+(1-\beta)} \equiv \hat{\sigma}_R(P)$

Define $\hat{P} = \frac{(1-\beta)}{\beta}$, it can now be shown that:

- $P < \hat{P} \Rightarrow \hat{\sigma}_R < \frac{1}{2} < \hat{\sigma}_L$
- $P > \hat{P} \Rightarrow \hat{\sigma}_L < \frac{1}{2} < \hat{\sigma}_R$

A number of results restricting the set of possible parameter combinations can be derived by comparing the relevant expressions:

- $\bar{P} > \hat{P}, \forall \phi$
- $\hat{\sigma}_L < \bar{\sigma}_L \Leftrightarrow \phi > 2, \forall P > 0$
- $\hat{\sigma}_L < \tilde{\sigma}_L, \forall \phi, P > 0$
- $\hat{\sigma}_R > \bar{\sigma}_R \Leftrightarrow \phi > 2, \forall P$
- $\hat{\sigma}_R > \tilde{\sigma}_L \Leftrightarrow P > \frac{(1-\beta)}{\beta}\sqrt{\phi+1} \equiv \ddot{P}$
- $\hat{\sigma}_R > \bar{\sigma}_L \Leftrightarrow P > \frac{(1-\beta)}{\beta}\sqrt{\phi-1} \equiv \dddot{P}$

- $\hat{P} < \ddddot{P} \Leftrightarrow \phi > 2$

I will now derive the optimal strategies for each player in all parameter ranges for $\max\{2, \frac{1}{1-\alpha}\} < \phi$.[30] Using the parameter restrictions derived above, it can be shown that this parameter range has: $\hat{P} < \ddddot{P} < min(\ddot{P}, \underline{P}) < max(\ddot{P}, \underline{P}) < \mathring{P} < \bar{P}$. We now have ten relevant equilibria. These equilibria are shown in figure 3.1.

1. $P < \hat{P}$ and $\sigma < \bar{\sigma}_L$:

   L always stages a coup iff incumbent is bad. R always stages a coup. (A)

2. $P < \ddddot{P}$ and $\max(\hat{\sigma}_L, \hat{\sigma}_R) < \sigma < \bar{\sigma}_L$:

   L always stages a coup iff incumbent is bad and $s = R$. R always stages a coup. (A^*)

3. $\hat{P} < P < \underline{P}$, $\sigma < \min(\bar{\sigma}_L, \hat{\sigma}_R)$:

   L never stages a coup. R always stages a coup. (A^{**})

4. $P < \ddot{P}$ and $max(\bar{\sigma}_L, \hat{\sigma}_R) < \sigma < \tilde{\sigma}_L$:

   L always stages a coup iff incumbent is bad and $s = R$. R stages a coup if incumbent is bad or if $s = R$. (B^*)

5. $\ddddot{P} < P < \mathring{P}$, $\max(\bar{\sigma}_L, \bar{\sigma}_R) < \sigma < \min(\hat{\sigma}_R, \tilde{\sigma}_L)$:

   L never stages a coup, R stages a coup iff incumbent is bad or $s = R$. (B^{**})

6. $\underline{P} < P < \bar{P}$, $\sigma < \min(\tilde{\sigma}_L, \bar{\sigma}_R)$:

   L never stages a coup, R iff incumbent is bad. (C^{**})

7. $\sigma > \max\{\tilde{\sigma}_L, \hat{\sigma}_R\}, \forall P$

   L stages a coup iff the government is bad and $s = R$. R stages a coup iff $s = R$. (D^*)

8. $\ddot{P} < P$, $\max(\tilde{\sigma}_L, \bar{\sigma}_R) < \sigma < \hat{\sigma}_R$:

   L never stages a coup, R stages a coup iff $s = R$. (D^{**})

9. $\mathring{P} < P$, $\max(\tilde{\sigma}_L, \tilde{\sigma}_R) < \sigma < \bar{\sigma}_R$:

   L never stages a coup, R stages a coup iff incumbent is bad and $s = R$. (E^{**})

[30] I do not consider the parameter range $\frac{1}{1-\alpha} < \phi < 2$ in the main section. This range has $\underline{P} < \hat{P} < \mathring{P} < \bar{P}$. Perfect accountability is no longer achievable. $\frac{1}{1-\alpha} < \phi$ implies that there can be no equilibrium in which the L follower supports a coup attempt. The optimum will have both R and L leaders staging coups if and only if the government is bad. This requires $\underline{P} < P < \hat{P}$ and $\sigma < \min\{\hat{\sigma}_L, \bar{\sigma}_R, \tilde{\sigma}_L\}$. The last result rules out the following parameter range: $\hat{\sigma}_R < \tilde{\sigma}_L < \bar{\sigma}_R$.

10. $\underline{P} < P$, $\sigma < \tilde{\sigma}_R$:

    L and R never stage a coup. (F^{**})

It can be seen easily that the following ranking must hold between these equilibria if we focus on expected government quality $E(Q)$: $A > A^* > A^{**}$, $B^* > B^{**}$, $B^* > D^*$, $C^{**} > B^{**} > D^{**}$, $C^{**} > E^{**} > F^{**}$. We can now focus on equilibria (A), (B^*) and (C^{**}):

$E(Q|A) = \gamma(1-(1-\beta)(1-\alpha)) + (1-\gamma)(-\beta)$

$E(Q|B^*) = \gamma(1-(1-\beta)(1-\alpha)\sigma) + (1-\gamma)(-\beta-(1-\beta)\alpha(1-\sigma))$

$\frac{dE(Q|B^*)}{d\sigma} = (1-\beta)(\alpha-\gamma)$

$E(Q|C^{**}) = \gamma + (1-\gamma)(-\alpha-\beta(1-\alpha))$

Comparing (A) and (B^*), we find that both equilibria are equivalent for $\sigma = 1$. This is intuitive, as under perfect information coups will only take place if the leader observes that the follower is of type R and all coups that are attempted will succeed. Therefore, an equilibrium in which L always stages a coup if the government is bad and R always stages a coup becomes equivalent in terms of the outcome to an equilibrium in which L always stages a coup if the government is bad and the followers are R and the R leader always stages a coup if the followers are R. As soon as the precision of the signal becomes weaker in equilibrium (B^*), there are two effects. First, the weaker signal decreases the number of coups that the R leader attempts against the good government. On the other hand, the weaker signal also decreases the number coups that the L leader stages against the bad government. If it is optimal in equilibrium (B^*) to have low signal precision (because $\frac{dE(Q)}{d\sigma} < 0$), then we can look at the extreme case of $\sigma = \frac{1}{2}$, even though it is inconsistent with this equilibrium. It can be verified that equilibrium (C^{**}) is preferred to the hypothetical equilibrium (B^*) with $\sigma = \frac{1}{2}$ if and only if $\gamma > \alpha$. As a consequence, the same will hold for the best possible equilibrium (B^*). It can now be derived that:

- $(B^*) > (A) \Longleftrightarrow \alpha < \gamma$
- $(C^{**}) > (A) \Longleftrightarrow \alpha < \gamma$
- $(C^{**}) > (B^*) \Longleftrightarrow \alpha < \gamma$

This implies that either (C^{**}) or (A) are optimal. (C^{**}) is optimal for $\gamma > \alpha$, (A) is optimal for $\alpha > \gamma$.

Proof of proposition 5 and 6

The R follower would like to reveal his type in order to attract coup attempts against the incumbent. The L follower can always block a coup attempt so has no strategic incentives in the communication stage. As soon as the L follower chooses a pure strategy message, there is an separating equilibrium in which the R follower chooses a different pure strategy message. This result holds regardless of the communication strategy of the leader.

First consider $\phi < \frac{1}{1-\alpha}$. It follows from the analysis in the main text that pure strategy equilibria can only take the form of pooling equilibria, in which $\hat{I}_i(R) = \hat{I}_i(L) = \omega$ where $\omega \in \{L, R, N\}$ and appropriate out-of-equilibrium beliefs are specified. Of these equilibria, $\omega = R$ fails to meet the intuitive criterion (Cho, Kreps, 1987). Suppose we have an equilibrium with $\hat{I}_i(R) = \hat{I}_i(L) = R$, supported by the out-of-equilibrium belief of the L follower $\Pr(I_i = L \mid \hat{I}_i = L) = 0$. Then L receives a strictly higher utility from announcing L if the belief would be be $\Pr(I_i = L \mid \hat{I}_i = L) = 1$, as L does no longer pay cost ξ. R would not receive higher utility from announcing L under the same belief $\Pr(I_i = L \mid \hat{I}_i = L) = 1$, as his coup attempt is supported anyway in the original equilibrium and he has to pay a cost ξ for lying. Now consider $\phi > \frac{1}{1-\alpha}$. In this parameter range, it is never optimal for the L follower to support a coup attempt against a bad leader if both L and R types stage such coups in equilibrium. Therefore, the only incentive for the leader to hide his affiliation comes from the cost of lying. Suppose we have an equilibrium with $\hat{I}_i(R) = \hat{I}_i(L) = R$. Then L can save ξ by deviating to announcing L. The out-of-equilibrium beliefs of the L follower cannot prevent L from taking such an action, as the L follower does not support a coup against the bad leader in equilibrium. The same holds for R in an equilibrium where $\hat{I}_i(R) = \hat{I}_i(L) = L$. Therefore, the only pure strategy pooling equilibrium has $\hat{I}_i(R) = \hat{I}_i(L) = N$. Finally, the equilibria described in proposition 6 need to be supported by appropriate out-of-equilibrium beliefs. The belief that the probability of the deviator being L is α supports all equilibria.

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