Predation, Taxation, Investment, and Violence: Evidence from the Philippines

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Abstract

The literature relating economic activity to political violence has greedy rebels (Collier, 2000) but not greedy governments. Yet capturing tax revenue might motivate governments to control territory, just as capturing extortion revenues motivates rebels. Panel data on political violence in the Philippines distinguish government from rebel attacks, which we link to private investment across 70 provinces. To formally explore these data we expand an established theory of asymmetric substate conflict –the "information-centric" model, by adding firms, investment, taxation and predation (i.e., extortionary violence by rebels in response to investment) to the interplay of government, rebels and civilians, generating testable implications. Necessary conditions for predation are sufficient to imply "tax capture" (i.e., violence by government in response to investment.) In the context of the expanded model, these results are consistent with tax capture and predation, and weigh against a dominant role for other mechanisms linking investment and violence, such as opportunity costs or a grievance-based mechanism. The data show that increases in investment predict increases in government attacks, as well as increases in rebel attacks. The "tax capture" response reverses in the following year.

Introduction

In textbook models of economic growth and development, a powerful underlying assumption is that market exchange takes place in the context of secure property rights and human rights.[1] This marginalization is at odds both with the actual experience of many developing countries and with recent research. The 2011 World Development Report (WDR) counts a billion and a half people living in countries affected by fragility, conflict or violence, and identifies organized violence as an impediment to long-run economic growth.

The recent literature points out that violent conflict can influence a nation's development through many different channels, including the loss of human and physical capital, the shift in public spending toward the military and away from social goods like education and health care, and the weakening or destruction of political, social, and economic institutions, including property rights (Blattman and Miguel 2010).[2] Scholars and policy-makers have argued that economic growth and development can contribute to peace through a variety of different mechanisms.[3] However, economic activity could also invite rebel rent-seeking and predation (Grossman 1999; Collier 2000, Nunn and Qian 2012). The question of whether economic development fuels or reduces rebellion is of central importance to both the body of social science theory aimed at understanding the development process and to public policies aimed at shoring up fragile states (Blattman and Miguel 2010; World Development Report 2011).

[1] Such words as "civil war" and "rebellion" generally do not appear in the leading textbooks on economic growth (see, for example, Jones 2002), and one of the best-selling texts on the economics of development devotes just one paragraph to all forms of political instability including inter-state and civil wars, coups d'etat, and rebellions (Perkins et.al. 2013, 76).

[2] The link between such institutions as property rights and long-run growth has been of particular concern to economists since at least the pioneering work of Douglass North (1981). Svensson (1998), for example, extended North's work by modeling the effects of political instability on property rights and, in turn, on investment rates. Gradstein (2004) argues that the enforcement of property rights and economic growth are self-reinforcing. Building on this and related research, the WDR has emphasized the crucial role of improved governance in securing people and property if growth is to be achieved (WDR 2011, 1).

[3] Hanson, Iyengar, and Monten (2011), for example, suggest that job creation programs can suppress insurgencies by raising the opportunity costs of fighting, while counterinsurgency expert David Kilcullen has recently asserted that it is "development…by civilian agencies" which "will ultimately win the war" (Kilcullen 2010, 32). While most development agencies do not have an explicit mandate to combat violence, governments often rely on the tools of economic development to support an objective of "winning the hearts and minds" of local populations, as has recently been the case in both Afghanistan and Iraq. Since the end of the Second World War, the United States has assisted allies in major insurgency campaigns in Vietnam, Iraq, and Afghanistan, and less intensive conflicts in Central America, Somalia, and parts of the Middle East. Other countries have also fought these types of wars, including Britain (in Aden, Cyprus, Kenya and Malaya), France (in Algeria and Indochina), and the Philippines (throughout its island chain).

This article explores the relationship between economic investment and violent civil conflict by developing a unified model and testing its predictions using data from the Philippines, that for the first time allow us to distinguish rebel from government initiated violence.

The Philippines has suffered from "perpetual wars" since the arrival of the Spaniards in 1565 (Morales 2003) and continues to face domestic insurgency despite a recently negotiated peace treaty with some rebel groups. Building on the three-sided strategic model of a counterinsurgency campaign developed by Berman, Shapiro and Felter (2011, henceforth BSF), the model we incorporate additional mechanisms through which investment may affect violence. In BSF, civilians choose whether or not to provide intelligence regarding rebel activity to a government which both provides public goods and pursues rebels. We add a new strategic actor to the BSF model, firms, which choose a level of investment, that is both taxed by government and extorted by rebels.

Earlier research has identified at least three mechanisms which would predict a negative correlation between violence and investment, and two which would predict a positive correlation. The opportunity costs mechanism posits that providing better outside opportunities (i.e. employment) to rebels increases the cost of participation in the insurgency (Hanson, Iyengar, and Monten 2011; Dube and Vargas 2010). Grievance or gratitude mechanisms suggest that civilians will reward government for increased economic activity, and withdraw support for the insurgency (Gurr xx, Kilcullen 2010). The investment mechanism hypothesizes that since violence deters investment, high investment today predicts low future violence (Kapstein and Converse 2008). These three mechanisms share the prediction that increased investment correlates with decreased violence.

Rent capture, or predation, has the opposite prediction: business investment presents extortion opportunities for rebels. As a result, rebels may use violence to secure their ability to extort such activity (Grossman 1999; Collier 2000). A tax capture mechanism implies that a government which taxes investment will increase its use of coercive force to in order to enable taxation in regions with increased investment (Fearon 2008). Predation and tax capture both predict that investment will be *positively* correlated with violence. Critically, we can observe both, using data that distinguish rebel initiated violence from violence initiated by government.

Our omnibus model reveals some subtleties. First, whether rebel violence increases or decreases optimal investment levels depends on its' effects on effective taxation by government and predation by rebels. Second, investment might induce either an increase or a decrease in rebel violence; violence raises the rate at which rebels can extort but may reduce the effective incidence of their extortion by antagonizing civilians who in turn deliver territorial control to government. We show that the same incidence effect implies that rebel violence can theoretically increase investment.

We apply that expanded model to a new dataset on investment activity in the Philippines, combined with detailed data on violence. Philippine rebel groups include Communist revolutionaries operating throughout the country, Muslim separatists in the southwestern provinces of Mindanao island seeking independence, and extremist groups with ties to international terrorist organizations who engage in kidnapping for ransom and other illicit activities in the southern Philippine islands of the Sulu Sea (on the Communist insurgency see International Crisis Group 2011; on the Islamic insurgency see International Crisis Group 2008; and for an historical overview see Morales 2003). The Philippines is among the few countries during the period of this study in which economic development programs are integrated into military operations via the Armed Forces of the Philippines' "National Development Support Command" (NADESCOM), whose mission includes the deployment of economic programs to counter rebel violence and activity.

Data on investment are very difficult to come by at a subnational level in most developing countries. In the Philippines we are fortunate to have found a proxy: detailed information on the value of industrial building permits, which are available at the province level for the entire country, including poorly controlled regions. New construction requires permitting, as does ongoing renovation of existing structures.

To get a sense of these data it is helpful to see the spatial distribution of investment and political violence. The top left panel of Figure 1 displays the population distribution of Philippine provinces (averaged between 2000 and 2007). About a quarter of Filipinos live in the eight provinces surrounding Manila bay, on the west side of the northernmost island of Luzon. The long island of Cebu, in the central Philippines (which points northeast) also has high population density, with about 4m inhabitants. Provinces in northern Luzon, the eastern shore of the southern island of Mindanao, and the southwest archipelago of Sulu are relatively sparsely populated.

The top right panel illustrates the spatial distribution of investment, as measured by the value of industrial building permits (measured in 1000s of PHP per capita). Investment is generally concentrated in highly populated areas. Investment is especially high around Manila and in Cebu, and is very light in northern Luzon, along the eastern edge of the country, and in eastern Mindanao, including the Sulu Archipelago.

The bottom two panels illustrate casualties per capita caused by rebel initiated events (on the left) and government initiated events (on the right). Two clear patterns emerge. First, rebel and government initiated casualties tend to occur in the same provinces. Second, political violence and investment show a strong negative correlation across space: Investment per capita is high where violence is low, around Manila and in Cebu, while violence is high in low investment (and sparsely populated) provinces of northern Luzon, Samar (on the central east coast), and Mindanao, especially in the Muslim majority provinces of Mindanao which make up the Autonomous Region of Muslim Mindanao: the Sulu Archipelago in the southwest (Basilan, Sulu and Tawi-Tawi) and the two provinces on the west-central coast of Mindanao (Lanao del Sur and Maguindanao). Anecdotally, these high violence, low investment areas tend to have norms favoring rebels (as opposed to government), relative to the rest of the country. Informed by the negative spatial correlation between rebel violence and investment, we will build a model in which rebel predation can discourage investment.

Once we apply our analysis to data, the results are consistent with a theory of predation. The empirics are straightforward: though *levels* of investment and violence are negatively correlated, as the maps illustrate, we will see that *changes* in investment are positively correlated with changes in violence, both rebel and government-initiated. These findings thus call into question the role of investment in reducing violence. Moreover, since the measure of investment is private rather than public, and mostly domestic, predatory violence is not a symptom of economic development projects launched by foreign donors or distant governments, which might be poorly informed. The results provide empirical support for the idea that new investment motivates the use of coercive force by government (on this point see Besley and Mueller 2012).

The paper proceeds as follows. After a brief literature review we develop an omnibus theory of investment, taxation and political violence which encompasses all the mechanisms mentioned above. Section three describes the data and section four reports empirical analysis. Section five provides a Sudoku like discussion. Rather than proceeding conventionally from theoretical predictions to estimates, the argument for identification bounces like a pinball between inferences from the model and those from estimates, after which Section six mercifully concludes.

I. Investment and Violence: What's the Connection?

Understanding the origins of communal violence has been the aim of considerable academic research. Not surprisingly, economists have emphasized the self-interested nature of such conflicts, with much of the relevant literature conceptualizing such conflict as a contest for available resources (see Hirshleifer 2001; Kapstein 2002).[4]

This insight is consistent with a view that poverty is a powerful contributor to violence (see Fearon (2008) for a review of the relevant literature and a counter-argument). If the returns to production are low and the gains from rebellion are high, then fighting may be preferable to peaceful resignation.[5] Note that Mindanao region of the Philippines, the site of persistent, violent pro-Muslim rebellion, is also the poorest region of that country, with per capita income half the national average and low investment (see Figure 1).[6] Rebel predation has also been commonplace; Morales (2003), for example, notes that Mindanao rebels engaged in widespread extortion along the highways.

A commonly held view in both the academic and policy literatures on insurgency is that economic development (broadly defined here to include economic activity by both the public and private sectors) can help promote a "stable" political environment in which government authority is generally recognized and respected.[7] The academic literature attempts to be more specific, developing several distinct channels which relate economic activity to rebel violence. First, a primary

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[4] As Jack Hirshleifer puts it in *The Dark Side of the Force,* "There are two main methods of making a living . . . the way of production and exchange versus the way of predation and conflict" (Hirshleifer 2001, 1).

[5]In a related vein, Miguel, Satyanath, and Sergenti (2004) launched an influential literature that uses variation in rainfall as an instrument for analyzing the effects of changes to (agricultural) incomes on outbreaks of violence (for a literature review see Sarsons 2011). They posit that droughts lead to lower crop production and thus lower incomes, leading to greater levels of rioting, conflict, and even civil war. This research has been extended to examine the effects of rainfall on democratic stability in Africa (Bruckner and Ciccone 2011) and political stability in Egypt (Chaney 2010). Sarsons (2011), however, finds for the case of India that even in regions which are protected from rainfall fluctuations by dams, rioting still occurs in the presence of droughts, suggesting that the channel may not in fact be through incomes, or at least not through incomes alone.

[6] (see Government of the Philippines, National Statistics Coordination Board, n.d.).

[7] In the context of Afghanistan, for example, a U.S. Army War College study argues that "development is a means of turning Afghans away from the insurgency and thereby creating a stable environment in which the Afghan government can exert its authority" (Malkasian and Meyerle 2009, 6). Similarly, a report to the U.S. Senate Committee on Foreign Relations states that "foreign assistance can be a vital tool for promoting stability in Afghanistan" (U.S. Senate, 2011, 1). This type of assertion has been made by policy-makers with reference to every postwar conflict involving rebel violence, from the Malayan uprising of the 1950s to the Iraq and Afghan wars (Marston and Malkasian 2008). The concept of "winning hearts and minds" (WHAM) has featured prominently in many counterinsurgency campaigns since it originated with British General Sir Gerald Templer in the Malaya campaign of 1948-1960 (Stubbs 2008).Yet these sources are typically vague about the mechanism by which economic activity reduces rebel violence.

objective of the counterinsurgents may be to encourage the civilian population to divulge useful information and intelligence about the insurgency. To achieve this objective, counterinsurgents may use economic instruments targeted at a tactical level to motivate or reward such behavior.

Closely related is another "hearts and minds" theory of counterinsurgency, which posits that the civilian population can be "won over" to the government's side by the general provision of public goods and the promise of future economic growth, and that they stop providing recruits and resources to rebels out of gratitude or reduced grievance. A variant is the "opportunity cost" approach to insurgency, suggesting that the greater the economic growth and the better the job prospects, the more costly it becomes for rebels to engage in insurgency.

In contrast, some scholars have argued on theoretical and empirical grounds that economic activity encourages rebel violence by inducing rebels to engage in rent-seeking behavior or predation (Hirshleifer 1989; Collier 2000, Collier and Hoeffler 2004).[8] Empirical research provides mixed evidende: Hanson, Iyengar, and Monten (2011), for example, find that increased spending on labor-intensive development programs is associated with decreases in violence, while Crost et al. (xx) show that development projects are violence-inducing, and Berman, Shapiro, Felter and Callen (2011) find the opposite relationship between unemployment levels and rebel attacks, in Afghanistan, Iraq and the Philippines.

Turning specifically to investment, Kapstein and Converse (2008) find that domestic investment in newly established democracies is lower in those democracies that are overturned within their first five years of existence than in those which endure for the longer-run; in other words, domestic investors appear to predict investment-dampening political instability.[9] In a related paper, Besley and Mueller (2012) link housing prices to the frequency of killings in Northern Ireland. They find that once British forces brought some stability to Northern Ireland, housing prices began to increase. These price increases continued as British forces maintained a presence in the region, thus making a credible commitment to investors. This interaction between military forces and

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[8] Following Fearon (2004), predation in the face of renewed economic activity could reflect the insurgents' skepticism about the government's commitment to a peaceful solution. As Fearon notes, once the balance-of-power reverts to the government side it could renege on the agreement it had reached during the struggle.

[9] Fielding (2003) examines investment levels in Israel and Palestine over time and finds that investment in construction and capital goods falls during those periods of the greatest "intifada" (or Palestinian uprising) violence. He further argues that a credible commitment to peace would significantly increase investment levels in those sectors. Looking at the case of Iraq, Chaney (2007) examines the price of sovereign bonds and finds that prices reflect the views of investors about the country's future political stability. Similarly, Coyne et.al. (n.d.) test the relationship between equity market prices and violence in Sri Lanka, and they find that the stock market provides a robust predictor of future peace and violence in that country.

investors promoted a reduction in violence, which further drove prices upward. These studies share the view that investment decisions made today provide an accurate reflection of political stability in the future, which we term the "predictive investment" mechanism.

As mentioned above, the "opportunity cost" (Dube and Vargas 2010) and "gratitude" [10] theories, share the opposite prediction, that increased economic activity will reduce rebel violence.

Predation, is the polar opposite to the investment theory. It builds on the work of Grossman (1999), Collier (2000), and Hirshleifer (2001). Simply stated, predation theory asserts that in an environment with weak property rights, rebels may increase the use of violence in order to extort resources. Collier argued that efforts at predation would be strongest in societies where wealth was the most concentrated, especially in the form of natural resources, though the same argument could apply to , the rebels in Mindanao, who taxed highway traffic, and to the Communist rebels in the Philippines who imposed "revolutionary taxes" on agriculture (Morales 2003).

Building on this work, along with the more recent research of Collier and Hoeffler (2004), Sambanis (2003), and Ross (2004), Crost, Felter and Johnston (2012) argue in the case of the Philippines that "if insurgents expect that [economic] development projects will weaken their position, they have an incentive to prevent their successful implementation, which may exacerbate conflict." Observing economic activity in their midst, the rebels will seek to disrupt it before the government can earn the associated political rents. Alternatively, rebels may "shake down" the investment projects as a way of gaining income. In either case, more violent episodes may be expected to occur alongside economic development programs. As Crost, Felter and Johnston (2012) note, there seems to be substantial anecdotal support for this theory, in the form of frequent attacks on both aid workers and infrastructure projects.[11]

Fortunately, in distinguishing between hypotheses we have the further benefit of being able to observe government use of violence, which we call enforcement. We will expand our omnibus

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[10] Kilcullen (2010) explains from a skeptical perspective: "There is also a belief, unfounded in reality, that development assistance generates gratitude, or "hope," in the population and thereby of itself encourages them to support the government. Field experience in both Afghanistan and Iraq, however, has shown that insurgent intimidation easily overcomes any residual gratitude effect, while historical studies have shown that in civil wars and insurgencies, popular support tends to accrue to locally powerful actors rather than to those actors the population sees as more congenial..." (p. 67). In what follows, gratitude and opportunity cost mechanisms will have similar testable implications.

[11] . In 2010 alone, for example, over 100 relief workers were killed in Afghanistan (Nordland, *New York Times*, December 13, 2010). Further, major infrastructure projects have been targeted by rebels, who have also successfully targeted the government and foreign assistance community for protection money as the price of allowing those projects to move forward (Rubin and Risen, *New York Times*, May 1, 2011). In essence, these projects have been "taxed" by the Taliban.

model to include the mutual response of enforcement and investment as well. The next section lays out all of those causal mechanisms, allowing us to interpret the Philippine data in a broadly theorized context.

II. Theoretical Framework: Investment, Predation and Taxation

To understand how investment might be related to insurgent violence we first examine the motivations and constraints of rebels, counterinsurgents, communities of noncombatants, and firms. In this section we expand the information-centric model of BSF to explicitly include four additional mechanisms by which investment could affect violence: opportunity costs, gratitude, predation by rebels, and tax capture by government.[12] Violence by rebels and enforcement activity by government –both observable in the Philippine data, will be equilibrium outcomes of a four-way strategic interaction between rebels, community, government and firms, building on a model of street gangs (Akerlof and Yellen 1994). That framework is illustrated schematically in Figure 2. We start with an informal description and state a minimal model, referring the reader to the Appendix for proofs.

Consider an environment in which rebels ambush police and military patrols, or set improvised explosive devices (IED) to attack them. They finance their operations by extorting local businesses with threats of violence; their attacks on government forces make these threats credible and undermine the ability of government to protect extortion targets. Preparations for rebel attacks are likely to be observed by noncombatant community members who could report the rebels to government forces. Those reports enable government forces to use their superior technology and equipment to disrupt rebel activity, improving government's chances of controlling the territory.

In that dangerous environment decisions must be made about five types of actions, each of which is consequential for all participants. Community members decide whether to share what they know with authorities, possibly delivering control to government if they do. That decision is influenced by how violence and consumption will affect their welfare, as well as by persistent predispositions to favor one side over another, which we model as norms of cooperation with rebels. Rebels choose levels of violence, balancing their benefits to violence in extracting concessions from government and in extorting rents from firms against the chances that violence antagonizes community members. Government decides how much to attack rebels --mindful of the

[12] For clarity we simplify the BSF model by omitting government service provision, rebel service provision, and reprisals by rebels against civilians, none of which are observable in our Philippine data. All the analytical results below would be robust to allowing service provision by government, since it is a strategic complement to m and, like m, a strategic substitute to v.

costs, the cost of violence, and the tax revenue accrued when territory is controlled. Firms choose investment levels, anticipating possible taxation or predation.

[Insert Figure 2 about here.]

More formally, that environment can be modeled as follows.

A. Assumptions

1. Players and Actions

The government, G, seeks to reduce violence through counterinsurgency effort at minimal cost (net of revenue). A rebel group, R, seeks to impose costs on government by attacking it,[13] and to extort rents. A utility maximizing community, C, can help deliver control of territory to government by anonymously sharing information about rebels. Firms, F, invest to maximize profits.

2. Sequence of Play

Information sharing by the community requires no preparation, while counterinsurgency efforts and rebel violence are less flexible, requiring pre-deployment of people and resources, so we assume that C can move last. Play proceeds in four stages:

(#1) Nature draws community norms favoring rebel (over government) control of their territory, n, from a uniform distribution $U[n_L, n_U]$; n is private to C and can be negative.[14]

(#2) G chooses a level of enforcement (counterinsurgency) effort, m. R simultaneously chooses a level of violence, v , to attempt against G, while F chooses a level of investment, I.

(#3) C decides how much information, i, to share with G, having observed m, v, and I.

(#4) Uncertainty regarding control of territory, a, is resolved, and payoffs occur. Under rebel control, they extort investments at rate $0 < \theta_R < 1$. Government taxes at rate $0 < \theta_G < 1$ under its control.

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[13] Attacks that target civilians are considered in BSF, Appendix A. Violence has to occur in equilibrium, rather than just the threat of it, since we observe violence in the data. Violence is inefficient in a Coasian sense; for it to occur conditions must preclude complete contracting between rebels and government (Fearon 2004; Powell 2006). This is not a very restrictive assumption in the Philippine setting.

[14] Assume that n_L and n_U span enough of the real line to allow $n_L \leq v + g + (\theta_R - \theta_G)I \leq n_U$ .That will ensure that the support of n is broad enough to allow neither side to fully determine information sharing through its actions.

3. Technology of control

Control of territory is represented by a binary variable, a, which is equal to one if the government controls the territory, and zero if it is controlled by rebels. The probability of government control is

$$P(a=1) = h(m)\, i,$$

where m is enforcement (counterinsurgency) effort by G, ($m \geq 0$), $h(m): R^+ \rightarrow [0,1]$ is a monotonically increasing, concave contest success function, with $h(0)= 0$ and $h \rightarrow 1$ as $m \rightarrow \infty$. Here i is the level of information that C chooses to share with G, ($1 \geq i \geq 0$). (All variables are real numbers unless otherwise specified.) Consistent with current doctrine, this makes some minimal information sharing a necessary condition for government control (U.S. Army, 2007, 1-23). Rebel control does not altogether exclude government forces. It implies that attempted rebel violence against those forces will cause them damage, that rebels can successfully extort and that government cannot tax. In contrast, attempted rebel violence in government controlled areas fails to do harm.[15]

4. Payoffs

Community: The community is a representative agent with utility affected by who controls territory. Utility is given by

$$U_C(a,n,v) = u[c - n]\, a + u[c - v](1-a).$$

If $a=1$ (government control) then the community consumes $c \geq 0$, so it attains utility $U_C = u[c - n]$, where u[.] is continuously differentiable and monotonically increasing. Community norms favoring rebel control, n, generate disutility when the government is in control.

Alternatively, if $a=0$, rebels may successfully carry out violence, $v \geq 0$, against government targets. Under rebel control, community members will attain utility $U_C = u[c - v]$. Rebel violence, v, is not directed against community members per se, but they suffer from it nonetheless, either because they are accidentally affected by crossfire (so-called "collateral damage"), or because they empathize with government employees or value government targets.[16]

Incorporating the uncertainty that C faces about a, C's payoff is the expected utility function

$$(1) \qquad EU_C(v, n, m)\big|_n = u[c - n]\, h(m)\, i + u[c - v](1-h(m)\, i).$$

[15] That stark assumption is relaxed in BSF, Appendix A.

[16] BSF generalize to allow rebel violence to affect the community when $a=1$, in two ways (in an appendix): they introduce violence directed at the community; and allow the community to suffer disutility from government suppression of that violence.

Rebels: Rebels use violence to impose costs on government, either in an attempt to extract concessions, or in an effort to overthrow the government altogether (Tilly, 1978). These attacks would typically involve targeting a patrol with an IED, ambushing a patrol with direct fire, or attacking a checkpoint. Let G's cost of rebel violence be $A(v)(1-a)$, which accounts for the damage caused by an attack. R's benefit from violence is then $U_R = A(v)(1-a)$. We assume that $A(0) = 0$ and that A is an increasing, concave function. R also gains extortion income from firms' investment, $\theta_R(v)I$, where the extortion rate θ_R is an increasing, concave function of rebel violence, v. Rebels' cost of violence is $B(v,I)$, which is increasing and convex in v.

We integrate the possibility of an opportunity cost mechanism of violence into the model by including investment, I, in rebels' cost of violence, $B(v,I)$. Assuming that investments are in capital which complements labor, those investments increase wages, which in turn raise the marginal cost of violence as rebels must pay more for recruits with an increased value of time, i.e., a positive cross-partial, $\frac{\partial^2 B}{\partial v\, \partial I} > 0$.[17] Gratitude, the idea that C will resist recruitment by rebels if the government behaves in a way that encourages investment, also implies a positive cross-partial, $\frac{\partial^2 B}{\partial v\, \partial I} > 0$.[18]

Rebels then face an expected payoff function,

$$(2) \qquad EU_R(m, v, a, I) = E[A(v)(1-a) + \theta_R(v)I(1-a) - B(v,I)] = [A(v) + \theta_R(v)I](1-p) - B(v,I),$$

$$\text{where } p \equiv h(m)\, E(i).$$

Note that $p = P(a{=}1)$ for rebels, for whom i is a random variable.

Government: The government bears the costs of violence as well as the costs of enforcement, m, while collecting revenue $\theta_G I$ if it achieves control.[19] It has expected net costs

$$(3) \qquad EC_G(v, m, a, I) = E[A(v)(1-a) + D(m) - \theta_G I\, a]$$

$$= A(v)(1-p) + D(m) - \theta_G I\, p.$$

We assume that $D(0) = 0$. We further assume that the cost function D(.) is monotonically increasing. Convexity is a reasonable assumption for D(.) for a government facing increasing

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17 We assume that all functions are twice continuously differentiable in all terms from here on in.

18 Gratitude could alternatively be modeled as reciprocation for provision of a specific service by government. Our empirical tests will not be able to reject that broader notion.

19 We remove welfare considerations from the government's objectives in order to focus on the optimal behavior of a government whose first priority is repressing violence. This assumption may fit a government more concerned about externalities of violence than it is about the welfare of residents – especially non co-ethnics or those in the periphery, or it may describe a dictatorship or dysfunctional democracy.

marginal costs in revenue generation on the one hand and diminishing returns in counterinsurgency technologies, on the other. We also assume no fixed costs to enforcement so that $D'(0) = 0$.[20]

Firms: A novel feature of the Philippine data is the availability of building permits, which measure private sector investment, inviting an extension of existing models of insurgency to include investment by private firms. These investments may be taxed by government or extorted by rebel predation, both of whom take account of the effects of their choices on revenue.

Firms' profit is $x(I) - (1+\theta_G)\, I$ under government control, and $x(I) - (1+\theta_R)\, I$ under rebel control. Successful violence increases the rate at which rebels predate, $\theta_R(v)$, which is an increasing and concave function. For instance, $\theta_R = 1$ would be equivalent to full rebel expropriation of investment. Government revenue is $\theta_G I$ if a=1; rebel revenue is $\theta_R I$ if a=0.

We assume that is $\theta_G < \theta_R(0)$ for reasons that we explain below.

Firms face expected profits

$$(4)\ E\,\Pi(v,m,I) = x(I) - I - [\theta_G p + \theta_R (1-p)]\, I,$$

where $x(I)$ is increasing and concave in I, with $x'(0) > 1 + \max(\theta_G, \theta_R)$, so that the first unit of investment is profitable. Firms invest to maximize expected profits, anticipating either taxation or rebel predation, our formalization of the predictive investment mechanism.

B. Equilibrium

We turn now to analytical results revealing how actors play, solving for subgame perfect Nash equilibrium in pure strategies, starting with the community (step #3), and proceeding by backwards induction to government, rebels and firms (step #2). The impatient reader might consider skipping to the discussion of Table 1 in Section B. below, which summarizes optimal responses.

Proposition #1: The community will share information with government if and only if the costs of violence exceed norms of noncooperation, when G expends positive effort on enforcement.
Proof: See Appendix.

[Insert Figure 3 about here.]

[20] A weaker assumption $A(n_U) > D'(0)$ is sufficient to imply a unique equilibrium in proposition #2 below. It implies that the fixed costs of m are not so high that communities maximally predisposed to not share information are never cost effective to not engage at all. See BSF for proof.

Figure 3 illustrates this logic, graphing the expected utility of community members against information revelation, *i*, on the horizontal axis (when $m > 0$). The expected utility of the representative community member is a linear function of *i*. The upper line illustrates the case in which that slope is positive, while the lower line shows the case where the slope is negative. C's best response, i^*, is to fully share information when U_C is increasing in *i*, (the positive slope in the Figure) and not to share any information otherwise. A slope of zero defines the noncooperation ("no snitching") constraint, the conditions under which the community is indifferent between sharing information with the government or staying quiet. High levels of violence and low norms favoring noncooperation both reduce that incentive.

Proposition #2: A unique Nash equilibrium in pure strategies exists for this game.
Proof: See Appendix.

With a unique equilibrium solution for optimal choices of violence, enforcement, investment and information sharing, we can examine how investors, rebels and government interact, with an eye to observed patterns in the Philippines.

C. Persistent norms and the spatial pattern of investment and political violence

Consider the maps of Figure 1, which illustrated the negative spatial correlation of investment and political violence. That correlation is quite persistent, so we begin by examining how violence and investment respond to persistent predisposition of communities to favor rebels over government – including longstanding grievances, ethnic differences, religious attitudes, a history of disenfranchisement, topography that lends itself to easy rebellion or difficult enforcement, and other persistent factors, all of which we bundle into norms, *n*.

How would differences in norms across regions affect political violence?[21]

Proposition #3: In regions where norms favor rebels, communities have a lower probability of sharing information with government, rebels choose to use more violence, and government chooses to provide less enforcement, all ceteris paribus.
Proof: See Appendix.

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[21] We model norms as a random variable drawn from a uniform distribution, so what we mean by differences in norms across regions is that the endpoints of that distribution are shifted equally and in the same direction (i.e., $\Delta n_L = \Delta n_U$). Endpoints are common knowledge (though the realized *n,* in stage #4, is a random variable).

The intuition for information sharing is illustrated in Figure 3. Norms of noncooperation with government increase the chance of disutility from information sharing ($n > v$). Rebels, in turn, face a higher probability of controlling territory, which increases their return to violence –both in damage inflicted on government and in predatory rents. Since information sharing complements enforcement, government chooses to enforce less when information flow is expected to be lower. As an aid to keeping track of these results, analytical results are summarized in Table 1.

Key to our analysis is how investors respond to norms, which will depend on their expected returns to investment under government or rebel control. As we saw in the last proposition, norms favoring rebels reduce the probability of information sharing and with it the probability of government control.

We assumed above that the government taxes at a lower rate than rebels extort , ($\theta_G < \theta_R$). We can now motivate that assumption by combining an analytical result with a look back at the map. If government taxes less than rebels extort, then government control favors investment, which in turn implies that norms favoring rebels reduce investment.

Proposition #4: Investment is higher where norms favor government if and only if the government tax rate is less than the rebel extortion rate, ceteris paribus.

Proof: See Appendix.

Those two results (propositions #3 and #4) provide a way of understanding the observed spatial pattern of investment and rebel violence in the maps of Figure 1. If tax rates are indeed lower than extortion rates then norms favoring rebels predict both low investment and high rebel violence. Spatial variation in those norms would then imply a negative cross-sectional correlation of investment and rebel violence, which is what we observe in Figure 1. Without assuming that extortion rates exceed tax rates the spatial pattern of investment and rebel violence is hard to explain, since investors would flock to the tax haven that rebels offer.

Why then is government enforcement (i.e., government initiated attacks) in Figure 1 more common in peripheral, low investment areas (such as the Muslim majority provinces)? The model's answer is that enforcement effort increases in rebel violence, conditional on norms.

Proposition #5: Government enforcement, m , increases in rebel violence, ceteris paribus.

Proof: See Appendix.

The logic of the proposition is that violence increases damage costs A(*v*) for government, which increases the return to suppressing the probability of rebel control. Enforcement, *m,* strategically complements *v* in increasing *p*, so that the optimal response of government to increased violence is to increase enforcement. Graphically, this result is illustrated by the upward sloping curve best response function *m*(v,I),* in Figure 4, which graphs enforcement against violence.

Returning to the map, though the low probability of information sharing reduces the return to enforcement (through the complementarity in the technology of control –Proposition #3), that effect can be counteracted by the reduction of high levels of rebel violence typical of regions with norms favoring rebels (Proposition #5).

D. Tax capture and predatory violence

Investment occurs against a backdrop of enforcement (government attacks) and rebel violence. We've just shown that enforcement increases optimally in rebel violence. In contrast, violence declines in enforcement, as illustrated by the downward sloping best response curve *v*(m,I)* in Figure 4. Intuitively, *m* increases the probability of government control, *p*, reducing expected marginal benefits of violence, in terms of both damage and extortion revenue.

Proposition #6: Rebel violence, *v*, declines in government enforcement, *m*, ceteris paribus.
Proof: See Appendix.

How would this system respond to an exogenous increase in investment, perhaps in response to a new economic opportunity? For government the answer is straightforward: increased tax revenue provides an added incentive to control territory when investment increases, so that enforcement, *m*, rises in response to increases in *I*, as government uses it to raise its probability of achieving control. This "tax capture" response by government is the analogue to the predatory response of rebels, which has received much more attention in the literature on economic activity and political violence (Grossman 1999; Collier 2000). The next proposition captures that logic.

Proposition #7: Government enforcement increases in response to investment, ceteris paribus.
Proof: See Appendix.

The tax capture effect of increased enforcement is illustrated by the serrated best response curve *m*(v,I')* in Figure 4, which shifts vertically upward to an intersection at point B, with higher enforcement and lower violence. (This is a partial equilibrium response because the response of violence to investment must still be accounted for.)

How does rebel violence reacts to investment? Rebels face countervailing pressures in optimally choosing v. Recall that R maximizes $[A(v) + \theta_R(v)I](1-p) - B(v,I)$. Increased violence raises the extortion rate, which increases expected revenue $\theta_R(v)I(1-p)$ by raising θ_R. That is the rate effect (or 'rent-capture' effect) emphasized by Collier and Hoeffler (2004). Yet violence also reduces the probability of rebel control of territory, as it antagonizes communities (in Figure 3), lowering the expected incidence of any extortion revenue at all, by raising p. That 'expected incidence' effect is violence-reducing. Moreover, our model also allows investment to raise the marginal cost of violence through increased opportunity costs or gratitude. An exogenous increase in investment amplifies these mechanisms, so that the net effect of investment on rebel violence is ambiguous.

Proposition #8: Violence increases in investment if and only if the rate effect, $\theta_R'(v^*)(1-p^*)$, exceeds the sum of the incidence effect, $\theta_R(v^*)\, f\, h(m)$, and the opportunity cost (or gratitude) effect $\frac{\partial^2 B}{\partial v\, \partial I}$, holding enforcement constant.

Proof : See Appendix.

Figure 5 illustrates the ambiguous effect of investment on rebel violence. Point A illustrates the initial equilibrium, as in Figure 4, with point B illustrating the "tax capture" effect: an increase in enforcement due to investment (as the best response of enforcement shifts to the serrated line $m^*(v,I')$), and the accompanying decline in violence. The response of violence to investment can be either positive or negative. If predation (i.e., the rate effect) dominates, then the best response function of violence shifts to the right, as illustrated by the dotted line labeled $v^*(m,I')$, and new equilibria will be at higher rates of enforcement and violence (perhaps even greater violence than at the initial equilibrium A) at a point like C. If the incidence and opportunity cost (or gratitude) effect dominate, then the best response function of investment will shift left to lower violence, as illustrated by the dotted line labeled $v^{*\prime}(m,I')$, and new equilibria will be at lower levels of enforcement and violence (perhaps even lower enforcement than at A) at a point like D.

Figure 5 also illustrates an important analytical result: government enforcement increases in investment under much weaker assumptions than does rebel violence. A necessary condition for violence to increase in response to investment is that the v^* curve shifts up and to the right as investment increases (as the rate effect dominates in proposition #8). That is a sufficient condition for enforcement to increase, given that the v^* curve declines in violence. In other words, if investment increases violence (comparing point A to point C) despite the increase in enforcement, then that same investment must certainly have increased enforcement.

E. How enforcement and rebel violence affect investment

To close the model we solve for optimal investment choices. How would firms' investments react to increased effort by government to control the territory (through increased enforcement)? Since government taxes at a lower rate than rebels extort, increased enforcement implies higher expected net returns on investment, so investment will increase as firms avoid expected extortion.

Proposition #9: Investment increases with enforcement, holding violence constant.
Proof: See appendix.

The response of investment to rebel violence is more complicated, as it involves two countervailing forces. Violence dissuades investment by raising the extortion rate, which we termed the "rate effect." (This is the basis of the Kapstein-Converse *predictive investment* mechanism, by which expected violence depresses investment, so that increased investment is a leading indicator of reduced violence –should investors be good predictors of peace.) Yet violence also indirectly *encourages* investment by reducing the expected *incidence* of predation (since violence induces the community to share information, which raises the probability that rebels will lose control and extortion will be replaced by taxation). As in proposition #8, rate and incidence effects pull in opposite directions.

Proposition #10: Investment declines in rebel violence if and only if the rate effect, $\theta_R'(v)(1-p^*)$, exceeds the incidence effect, $(\theta_R - \theta_G) f h(m)$, holding enforcement constant.
Proof: See Appendix.

The slopes of best response functions derived in propositions #3 through #10 are summarized in Table 1, with question marks denoting the two ambiguously signed slopes.

F. Comparative statics in investment, enforcement, and violence

How do enforcement and violence respond to investment in general equilibrium? Propositions 5 through 10 have signed the best response functions conditional on the third variable (e.g., $\frac{\partial m^*}{\partial v}\Big|_I$), but the *unconditional* slopes all have ambiguous signs. That follows from the mix of strategic complements and substitutes between *m* and *v*, and *v* and *I*. Fortunately, in our data we observe measures of both rebel and government initiated violence, allowing us to estimate partial derivatives corresponding to the partial correlations in Table 1.

We can still tease out an important analytical result. Predatory violence, which the literature has emphasized, is characterized in our model by a rate effect of investment on violence that exceeds the incidence effect. In terms of Figure 5, that implies a v^* curve which shifts up and to the right in response to new investment. Whether the follow-on effects of enforcement and violence on investment are positive or negative, investment will have increased in equilibrium, so that if predation occurs (holding *m* constant) then enforcement must increase in general equilibrium (by Proposition #7). In other words, rebel predation implies government tax capture.[22]

Rebel predation also has another implication: if rebels are predatory (i.e., violence optimally increases in investment), then optimal investment must decline in violence. The logic is as follows: rebel predation requires that the rate effect dominate both the incidence and the opportunity cost effects --for rebels to increase violence when faced with new investment, despite the expected loss of incidence and the opportunity costs. Firms similarly balance rate against incidence effects when setting investment. If the rate effect dominates for rebels it must do so for firms as well, which implies that violence causes higher expected extortion rates and lower investment.

Proposition #11: If violence increases in investment, then investment must be decreasing in violence, holding enforcement constant.

Proof: See Appendix.

That proposition will provide some inferential leverage in the discussion below. We turn now to data on investment, enforcement and violence to see whether predation and tax capture are present.

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[22] The converse is not the case, as Figure 5 illustrates. Possible equilibria include a point C to the left of A, in which investment reduces violence –by inducing increased enforcement-- so that on net there is no predatory violence. Alternatively, if the incidence effect dominated we could get a general equilibrium result in the neighborhood of C, in which enforcement increased while violence declined. So tax capture is possible without predation. Though investment can cause both increases or decreases in both types of attacks, predation is sufficient for tax capture, but not necessary.

III. Data

We match data on industrial building permits (our measure of investment) to violent incident data, for eighty Philippine provinces between 2002 and 2008. Descriptive statistics are provided in Table 2. Building permits data are from the National Statistics Office of the Philippines website.[23] Industrial buildings permits have a price increasing in the value of investment. The provincial average is 65 PHP per capita. Population data are from the Philippines National Statistics Office for the 2000 and 2007 Census. Provinces averaged 2.6m inhabitants over the sample period, which is skewed by the national capital region, at 11.5m.

Data on violence come from original incident reports generated by deployed units in the Armed Forces of the Philippines (AFP) between 2002 and 2008. The resulting dataset is a complete set of information from every such incident reported to the AFP's Joint Operations Center (JOC). Specifically, the data include information on date, location, initiator (government, rebel group), casualties, and the type of casualty (government, rebel, civilian). These data are an invaluable source of information for empirical analysis of violence (Felter 2005; Crost, Felter and Johnston 2012). The AFP reports an average of 0.29 incidents per 10,000 residents per province-year, of which about two thirds are government initiated. Rebel initiated incidents account for fifty-five percent of fatalities, averaging 0.054 fatalities per 10,000 residents per province-year, while government initiated incidents average 0.044.[24] Since the identity of fatalities in irregular warfare is subject to biases we concentrate our analysis on the identity of the initiator, which we think is reported more accurately.

One concern with incident data is that more troops may simply imply more complete reporting. That would bias our estimated correlation of investment and violence in a positive direction. Berman et al (2013) find no evidence of such a bias when estimating the effects of CERP programs in IRAQ, when augmenting their estimating equation with a measure of troop strength. Crost, Felter and Johnston (2012) conduct a robustness test for bias due to troop strength by measuring effects on violence in neighboring regions and find no evidence of bias.[25]

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23 http://www.census.gov/ph/data/sectordata/databldgperm.html, accessed November 9, 2011.

24 Almost half of fatalities reported for rebel initiated incidents are among government forces (0.033), while 39% of reported fatalities in rebel initiated incidents (0.026) are civilians. Seventy-eight percent of fatalities reported in government initiated incidents are among rebels, while eighteen percent are among government forces and four percent are among civilians.

25 Crost, Felter, and Johnston (2012) express a second concern with these data. AFP units may selectively misreport casualties, exaggerating damage done by rebel groups and understating that done by their own units. This is a lesser concern for us, as our results (below) will turn out to be robust across measures of violence and hold for overall fatalities –which are less susceptible to misreporting. In any case, information gathered for Felter (2005) and Crost, Felter, and Johnston (2012) suggest that strong institutional incentives

IV. Violence and Investment in the Philippines: What Do the Data Say?

The rich data available on rebel-related violence in the Philippines allow us to test competing theories linking economic activity to both rebel and government violence, in the context of our model. We begin by revisiting the spatial correlations in the cross-section, as illustrated in Figure 1. We then estimate effects of investment on enforcement (i.e., government-initiated political violence) and rebel violence. We lack in instrument for investment, so we will lean heavily on fixed effects, and on interpretation in the context of a model.

Table 3 reports results using the 560 province-years available for analysis, covering the period 2002 through 2008. Column (1) reports the coefficient from a cross-sectional regression of incidents $(m+v)$ on industrial building permits, pooling 560 observations. The coefficient is negative and highly statistically significant, reflecting the pattern we observed in Figure 1: violence and investment have a negative spatial correlation. Revisiting our interpretation of that correlation, in light of the full set of predictions reported in Table 1: norms favoring rebels are more common in the sparsely populated provinces and in the Muslim majority provinces of Mindanao (anecdotally); those norms predict higher violence ($dv^*/dn > 0$, column two, row one) and lower investment if extortion exceeds taxation ($dI^*/dn < 0$, column four, row one); rebel violence also predicts high government violence ($dm^*/dv > 0$, column three, row two). Note that the spatial predictions for investment and government enforcement are ambiguous in the model, so that the data reveal two insights: first, extortion rates likely exceed taxation rates –as we assumed, so that investment declines rather than increases in norms favoring violence (proposition #4); second, enforcement reacts more to rebel violence (proposition #5) than it is dissuaded by norms (proposition #3), and enforcement does not completely reverse the norm-induced increase in rebel violence (proposition #6). Recall that the model used norms to represent all time-invariant characteristics of provinces, which more broadly might include terrain, infrastructure, access to markets, effectiveness of service provision by government relative to that by rebels, and other persistent factors.

The most important conclusion from the spatial pattern of investment and violence is that firms perceive taxation as preferable to predation when investing –otherwise they would invest more in rebel-influenced areas.[26]

mean the magnitude of such selectivity is likely small. The JOC relies on accurate reporting to plan future operations, so that misreporting could mean risking the lives of AFP members.

[26] In the narrow context of the model that is a statement about rates. A broader interpretation might be that firms prefer the predictability and low risk associated with government control over a more arbitrary and potentially violent predatory system of extortion.

Column (2) of Table 3 reports estimates of the same correlation in first differences, holding fixed the time-invariant characteristics of provinces. The coefficient on fatalities switches from negative in the cross-section (as we saw in the spatial pattern of Figure 1), to positive. That positive coefficient evokes the pattern described as predation in the literature, in which investment predicts increased violence. In columns (3) and (4) we report the result of disaggregating that predicted increase in violence into that violence initiated by government and that initiated by rebels. While both coefficients are positive, the larger statistically significant coefficient is due to government initiated violence. Columns (5) through (7) suggest the same pattern, though they are estimated with less precision: the pattern of investment predicting violence in first differences comes from both government initiated and rebel initiated violence.

In order to understand these simple correlations we turn now to estimating the slopes of best response functions for government and rebel initiated violence (enforcement and violence) predicted by the model.

Consider an estimating equation relating enforcement to investment. While the spatial (i.e., cross-sectional) correlation of enforcement and investment is negative, as we have seen, it includes the effects of persistent factors such as norms. By estimating (6) with a fixed effect $a(n_i)$ we remove the effects of persistent factors and trends so as to recover the coefficient β_1 , which reflects the effects of changes in investment on changes in enforcement, as derived in proposition #7, and discussed above in terms of comparative statics.

(6) $$m_{it} = \alpha(n_i) + \beta_1 I_{it} + \beta_2 v_{it} + d_t + \varepsilon_{it}$$

Recall that, as illustrated in Figure 5, proposition #7 predicts that β_1 is positive: enforcement increases in investment because the returns to enforcement increase in tax revenue available. Conditional on fixed effects and violence, investment likely generates more exogenous variation than does enforcement, but we may nevertheless be concerned about omitted variable bias, given that we can't rule out exogenous variation in enforcement. By proposition #9 that bias would be positive, as investment increases in enforcement. In that sense a positive estimate of β_1 is consistent with two predictions of the model.

Table 4 reports estimates of β_1 in columns (3) through (7) for various measures of enforcement, including government initiated incidents, total fatalities in government initiated incidents, and, of those, for fatalities among government forces, rebels and civilians. (Coefficients are estimated using a first-differenced specification rather than fixed-effects because the residual is nonstationary in levels, as the note to the table explains.) Coefficients are statistically significant and positive for fatalities (column 6) and rebel fatalities (column 10). The correlation of total fatalities and investment is illustrated in the left panel of Figure 7, with each dot representing a change in both building permits and fatalities in a province over a one year period. Table 4A reflects estimates of the same coefficient for the subsample excluding Zambales (which is an outlier with a spike in investment and a moderately large population of about 700 thousand). Results are qualitatively the same, though with smaller t-ratios.

Overall the left panels of the two tables tell a clear story about enforcement and investment: while these two variables are negatively correlated spatially, changes in investment are positively correlated with changes in enforcement, as illustrated in Figure 4, both with and without rebel violence held constant. Our preferred interpretation is that enforcement increases in investment –an unambiguous prediction of the model. Yet another possible interpretation is that investment increases in enforcement –also an unambiguous prediction of the model (Proposition #9). While these two refutable implications of the model are consistent with the data we cannot tell which one the data supports. We return to this issue below in our discussion, where we will attempt to infer whether factors shifting I^* or m^* are likely to be generating more variance.

All we can infer is that the data reject that two conditions can simultaneously be true: that government is indifferent to investment (strictly speaking, to tax revenue) when making enforcement decisions, and that investors are indifferent as to who controls territory –government or rebels.

Another persistent pattern in Table 4 (and Table 4A) is that rebel violence is positively correlated with enforcement, both in the cross section and in the time series, and both unconditionally and conditional on investment. In the context of the model that implies a shifting v^* curve (in Figure 4) tracing out an upward sloping m^* curve, both across Philippine provinces and within provinces over time.

We now turn to predation, or more generally to the relationship between investment and rebel violence, which can be estimated for the first time holding enforcement constant. Hypotheses about predation, opportunity costs and gratitude would all be expressed in this correlation. We know from Figure 1 that investment is negatively correlated with violence spatially, which might suggest that violence reduces investment (a dominant rate effect), or that investment reduces violence (a dominant incidence, opportunity cost, grievance or gratitude effect). Yet that inference is potentially confounded by persistent effects such as positive norms towards rebels, which increase rebel violence and depress investment.

Equation (7) defines a linear coefficient γ_1 relating investment to rebel violence which holds time-invariant factors such as norms constant, and holds measured enforcement constant,

(7) $$v_{it} = \delta(n_i) + \gamma_1 I_{it} + \gamma_2 m_{it} + l_t + \eta_{it} .$$

Unlike the corresponding coefficient predicting enforcement in equation (6), theory does not allow us to sign γ_1 . Even if we could distinguish the direction of causality between investment and violence in (7), both the effect or violence on investment and the effect of investment on violence are theoretically ambiguous, because rate and incidence effects pull in opposite directions. The only clear result we have is Proposition 11, which states that if the rate effect dominates, then violence must increase in investment (holding enforcement constant), which implies that investment must decline in violence (again holding enforcement constant). The converse is not true: if the incidence effect dominated then both derivatives could be negative.

Table 5 reports that regressions of changes in measures of rebel violence on changes in industrial building permits yield persistent but weak partial positive correlations. All five measures are positive, in columns (3)-(12), but only one is marginally significant (at the 10% level), and becomes insignificant when enforcement is included in the regression. The evidence in Table 5A, which excludes the large outlier province of Zambales, is clearer. All five partial regression coefficients on investment are again positive, with two of them significant at the 5% level (incidents and civilian fatalities).[27]

Concluding that, in differences, the partial correlation of violence and investment is positive, proposition #11 forces a choice: the derivatives $\frac{\partial v^*}{\partial I} \big|_m$ and $\frac{\partial I^*}{\partial v} \big|_m$ must have opposite signs. We revisit this point in the next section.

[27] As discussed above, a possible explanation for the positive correlation of violence with investment is that investment induces troop presence, which in turn generates more reporting of incidents by construction. We think that this is unlikely, based on our experience with similar data in other countries, where measures of troop presence did not affect results (Berman et al., 2013). Following Crost, Felter and Johnston (2012) we also provide a robustness test. Deploying more troops to one province requires taking some away from another. If increased troop strength creates more reported incidents by construction, then reported violence should decline in neighboring provinces. We test this hypothesis and find no evidence of spillovers. We estimate the specification in Table 5 using permits in province i, and average violence in other provinces in the same geographic region in year t. There are seventeen such regions in the Philippines. The resulting coefficients are either statistical zeros, or positive. Results are available upon request.

V. Discussion

In terms of the model, we've interpreted the evidence as tax capture by government and predation by rebels, both in response to investment. If anything, the former correlation is stronger than the latter, as predicted by the theory. In this section we discuss another possible interpretation of the regression results –a dominant incidence effect. We then return to discuss the broader implications of a dominant rate effect literature.

The positive correlation of changes in violence with changes in investment admits a reverse causal interpretation, in which violence shocks are exogenous and investment optimally increases in violence (which occurs if the incidence effect dominates the rate effect, in Proposition #10 – violence reduces the probability of rebel control, encouraging investment). We find that interpretation unlikely for four reasons: First, on empirical grounds, we think that fixed effects (our estimation procedure) are much less likely to absorb high frequency changes in investment opportunities than shifts in the local technology of, or returns to, violence.

Second, evidence of predatory violence in response to economic activity exists not only in the literature in general (Collier 2000), but in the Philippines in particular, where Crost, Felter and Johnston (2012), find that exogenous announcement of forthcoming government sponsored community driven development projects in rural Philippine municipalities predicted increased rebel violence.

A final reason follows from proposition #11. Recall that if rebels are predatory (i.e., violence optimally increases in investment), then investment must decline in violence (rather than increase), because predatory violence required a dominant rate effect. Combined with the measured positive partial correlation between violence and investment, the proposition implies that if violence were to decline in investment, then investment must increase in violence. Though a dominant incidence effect is theoretically possible, we've found no anecdotal or empirical evidence for it in the Philippines or in the literature. If investment increased in rebel violence it would be hard to explain the cross-sectional correlations evident in Figure #1, in which violent areas in the Philippine periphery tended to have low investment. We have found nobody who has ever claimed that investors flock to areas with high rebel violence because of the incidence effect.

If we accept the inference that rate effects dominate, three conclusions follow: First, neither incidence effects, nor opportunity cost mechanisms, nor a gratitude mechanism can be the dominant force relating rebel violence to investment in the rural Philippines. Rebel predation must instead be dominant. Second, by proposition #11, the Converse-Kapstein mechanism by which investment should be a leading indicator of reduced violence, must be important theoretically, even if we have not found direct evidence of a negative contemporaneous correlation of investment and violence in our data. Third, to reiterate the point of Figure 5, if rebel violence increases in investment, then government enforcement must increase even more, both as a direct response to investment and as in indirect response to rebel violence.

Finally, concluding that rate effects dominate provides an indirect inference about tax capture. The positive correlation between investment and violence must be the result of shifts in the I^* curve mapping out an upward sloping v^* curve in I-m space (since by Proposition #11 the I^* curve is downward sloping). So exogenous variation shifting I^* must dominate exogenous variation shifting v^*. That would happen if investment conditions varied relatively often, which should not be surprising in an open economy. Table 6 indicates that this is true both with and without m held constant. Moreover, the model unambiguously predicts that the m^* curve is upward sloping in m-v space, as illustrated in Figure 5 and implied by Proposition #5. So by similar reasoning, the positive partial correlation of v^* and m^* in Tables 4-7 implies that exogenous variation shifting the v^* curve must dominate variation that shifts the m^* curve (which is again evident both conditional on I and and unconditionally). That might happen, for instance, if rebel initiatives were subject to local politics and conditions, while government enforcement initiatives were subject to national campaign decisions, or entirely reactive. Combining those patterns, exogenous variation shifting the I^* curve must dominate exogenous variation shifting the m^* curve in I-m space, where both are upwards sloping (Propositions #7 and #9). From that we must infer that the positive correlation of investment and enforcement reported in Table 4 is evidence of tax capture (the positive slope of the m^* curve).

Dynamics

Our model is static, but the data allow us a peek at dynamics as well. If investment creates persistent economic returns then we would expect both government and rebels to use violence to establish access to future revenue streams when the investment takes place. In future periods they might conduct another round of conflict, or a Coasian bargain may be possible, or future conflict might be deterred by the winning side, (or in principle opportunity costs might preclude rebel violence – though the evidence above weighs against opportunity costs being a dominant mechanism). We can check by estimating an equation I which past investment predicts current violence.

Results of estimating those equations are reported in Tables 6 and 7 which retain the format of Tables 4 and 5, but with last year's value of building permits on the right hand side rather than the concurrent value. Interestingly enough, lagged investment predicts a *decline* in current enforcement of about the same magnitude as the concurrent increase we saw in Table 4. That decline is highly statistically significant for all fatalities and for the two subcategories government fatalities and rebel fatalities. One possible interpretation is that government response sometimes requires a year, contradicting proposition #7 (or proposition #9).[28] We find that unlikely as the Philippine military has a fairly agile national counterinsurgency force, and investment is easily predicted, given the permitting process. An alternative interpretation is that one period of enforcement is sufficient to deter future rebel violence (perhaps by signaling capacity or commitment) so that the optimal enforcement response need only last a year.

Table 7 also reiterates the message of Table 5. Like current investment, lagged investment shows no evidence of a negative correlation with violence, providing no supporting evidence for predictive investment, opportunity cost, and grievance (or gratitude) mechanisms. If we repeat the analysis for the sample excluding Zambales province, we obtain essentially the same results (available upon request). Overall, the combination of concurrent and lagged results suggest that, in a simple dynamic extension of our model, tax capture occurs in the same year as investment and that the increase in enforcement is fully reversed within a year, with no long term effect on violence (perhaps due to deterrence).

VI. Conclusions

Some governments, and their allies, have turned to economic programs alongside other instruments as part of their strategy to reduce rebel violence. Underlying this approach is often a view that once a degree of prosperity is achieved, people will become hopeful about the future, making political choices that in turn spur stability and economic growth. Growth might become self-reinforcing should it increase the opportunity cost of violence for rebels and motivate noncombatants to cooperate with government in its efforts to expel rebels. Recent studies have attempted to develop a theoretical underpinning to that logic, and test it. Yet about half of the empirical studies at the subnational level are inconsistent with the coarse hypothesis that all economic activity is violence-

[28] In general equilibrium enforcement could decline as an indirect response to investment if investment caused rebel violence to decline, which in turn reduced necessary enforcement (proposition #5). Yet that explanation is undermined by results in Table 7 showing no response of rebel violence to lagged investment.

reducing, including studies of asymmetric conflicts like that in the Philippines (Berman and Matanock, forthcoming).

We examine the relationship of investment to violence using data and theory that explicitly allow for government initiated violence. We expand a standard theory of counterinsurgency to a four-sided game, including for the first time firms who make investments, 'tax capture' by government, and rebel predation. In the context of the model, the data yield a number of findings. Most importantly, the combination of empirical estimates and theory leads us to conclude that that investment yields violence initiated by government (tax capture) as well as violence initiated by rebels (predation). Our findings are also consistent with the idea that predation and tax capture are the dominant mechanisms linking investment to rebel violence, rather than opportunity costs, gratitude, grievances or predictive investment. Nevertheless, the results imply that investors prefer regions controlled by government to those controlled by rebels so that investment today should predict low violence in the future.

Our study leaves open the question of whether tax capture is desirable. On the one hand, it is violent. On the other, empirical results suggest that it is temporary. Without measuring the long term benefits of governance by government as opposed to rebels we cannot say if residents are better off suffering a violent transition from the latter to the former. Given the current policy concerns with the negative externalities of ungoverned space within countries (including terrorism, infectious diseases, smuggling, human trafficking and the like) we would argue that further research on the net benefits of incentivizing a geographical expansion of effective governance should be a priority question for research.

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Figure 1: Population, Investment and Political Violence in Philippine Provinces

Note: Clockwise from top left: population, industrial building permits/capita, casualties from government-initiated violence and casualties from rebel-initiated violence.

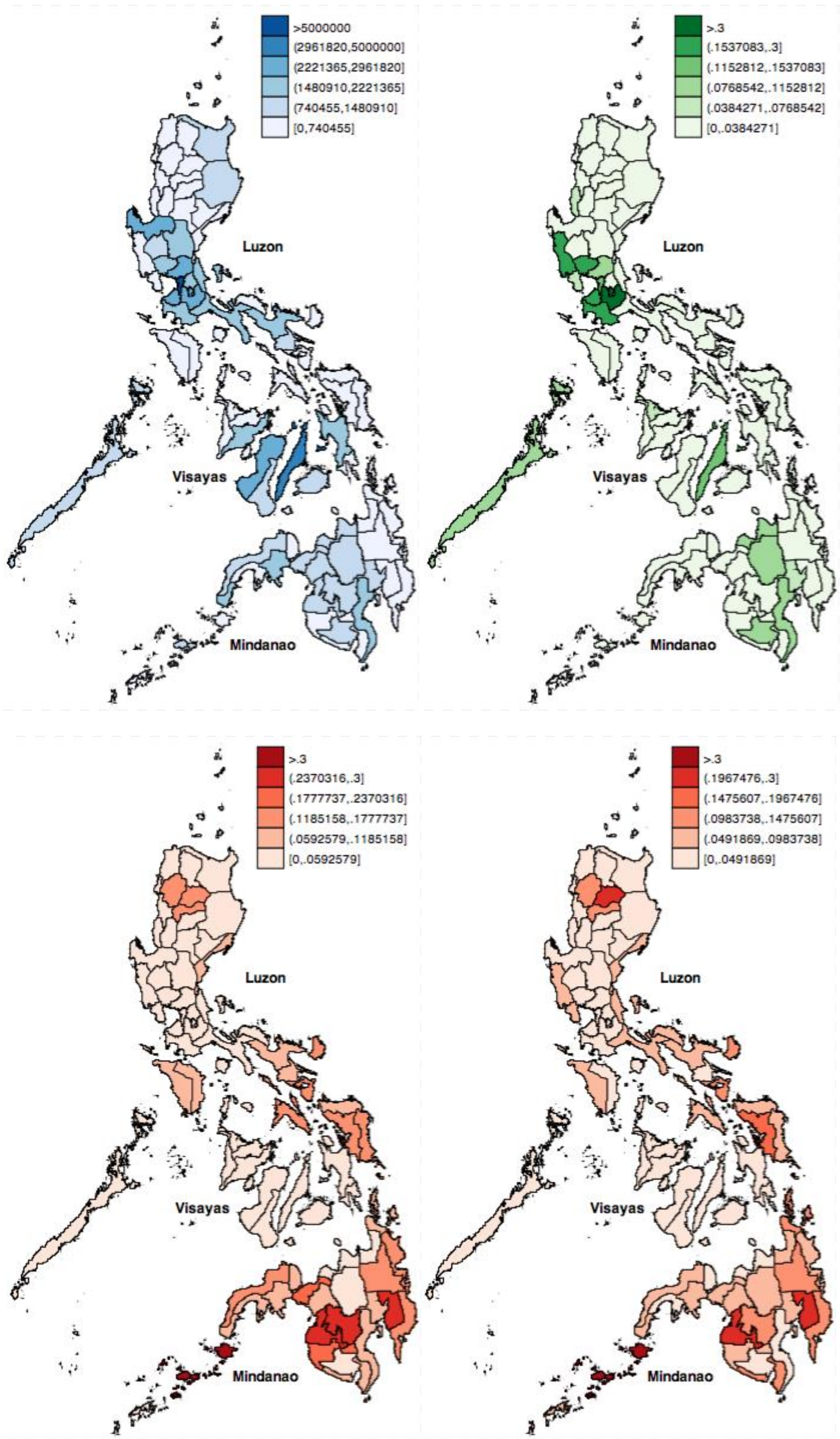


Figure 2: Predation and taxation in a model of asymmetric conflict

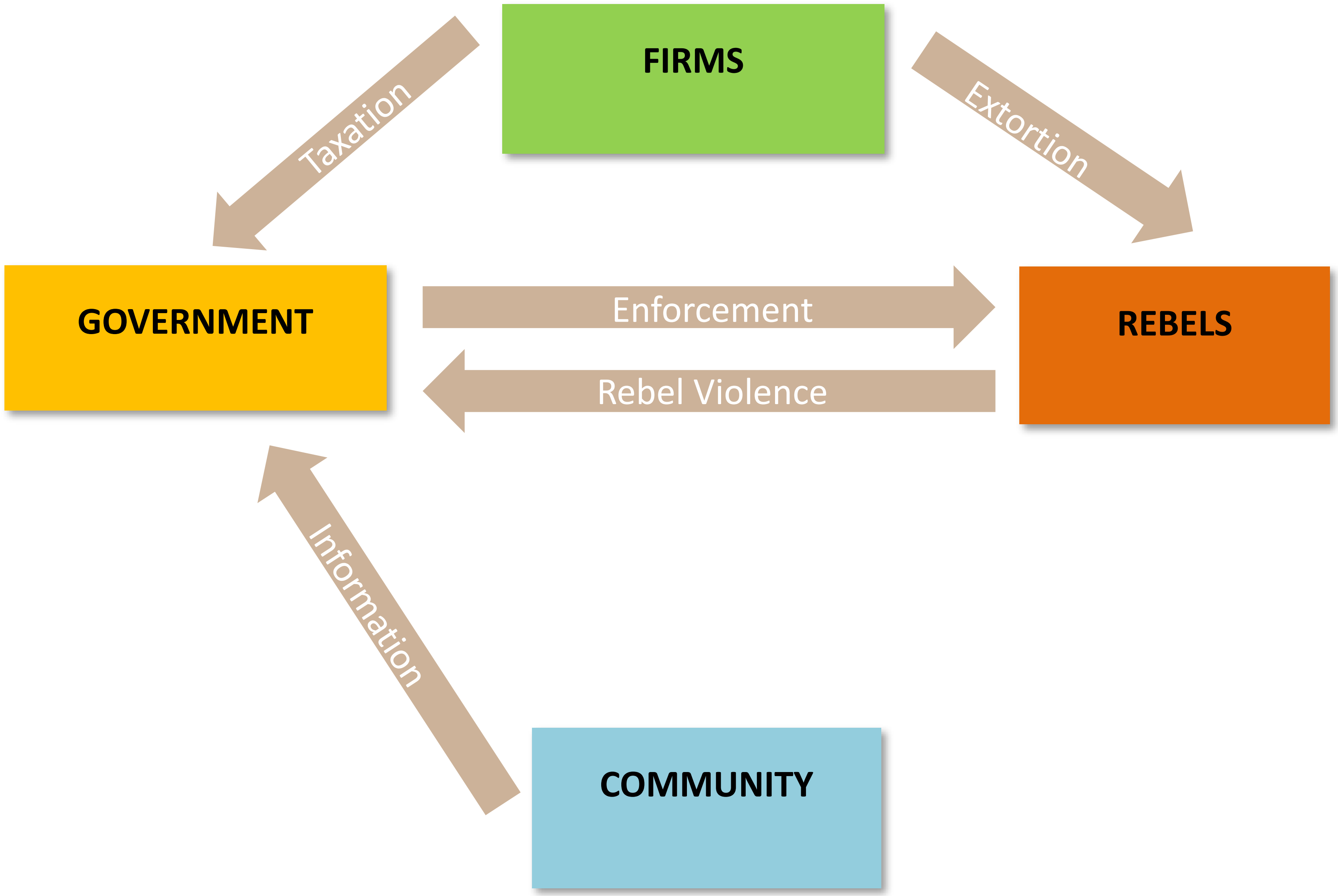


Figure 3: Utility of noncombatant community from information-sharing

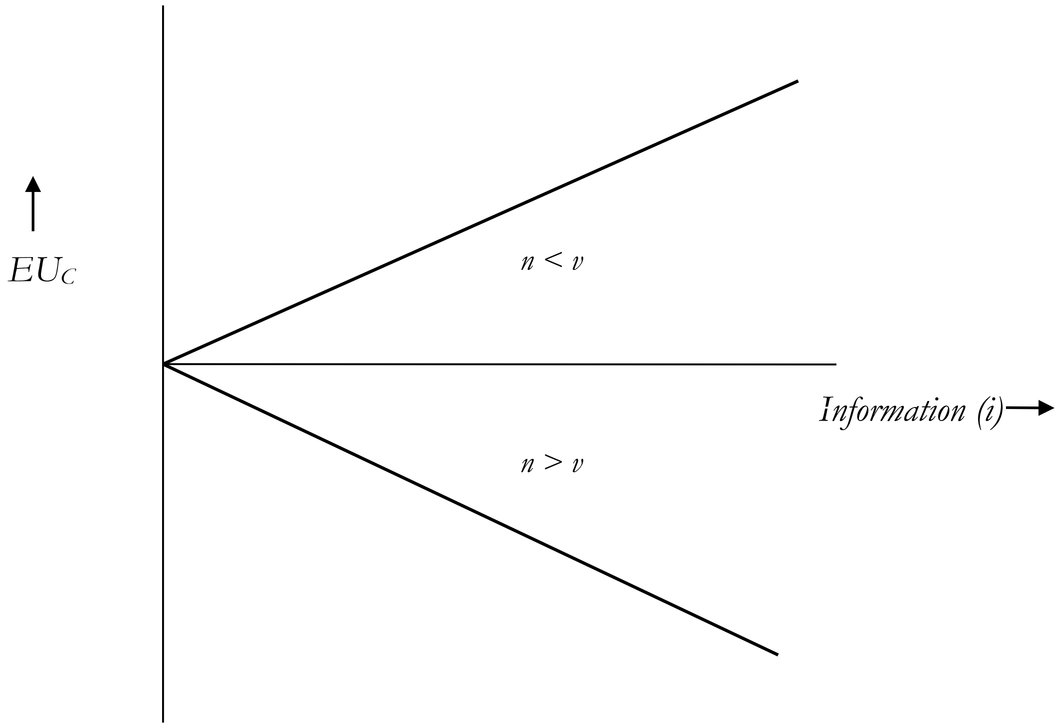


Figure 4: Best response functions of enforcement and violence

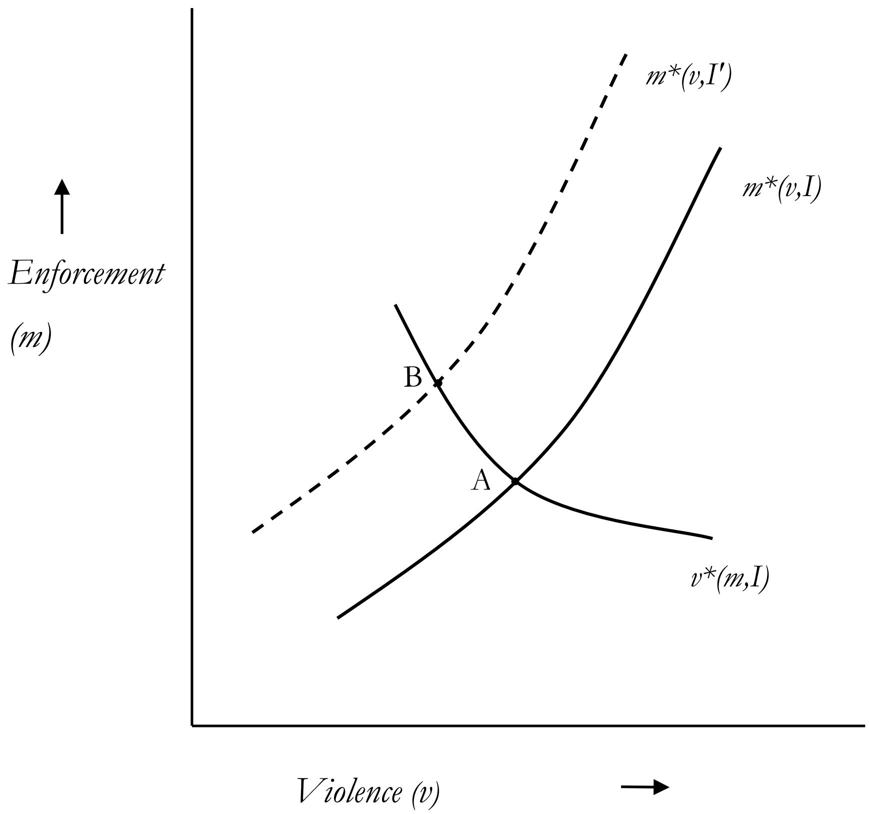


Figure 5: Tax capture and predation in response to investment

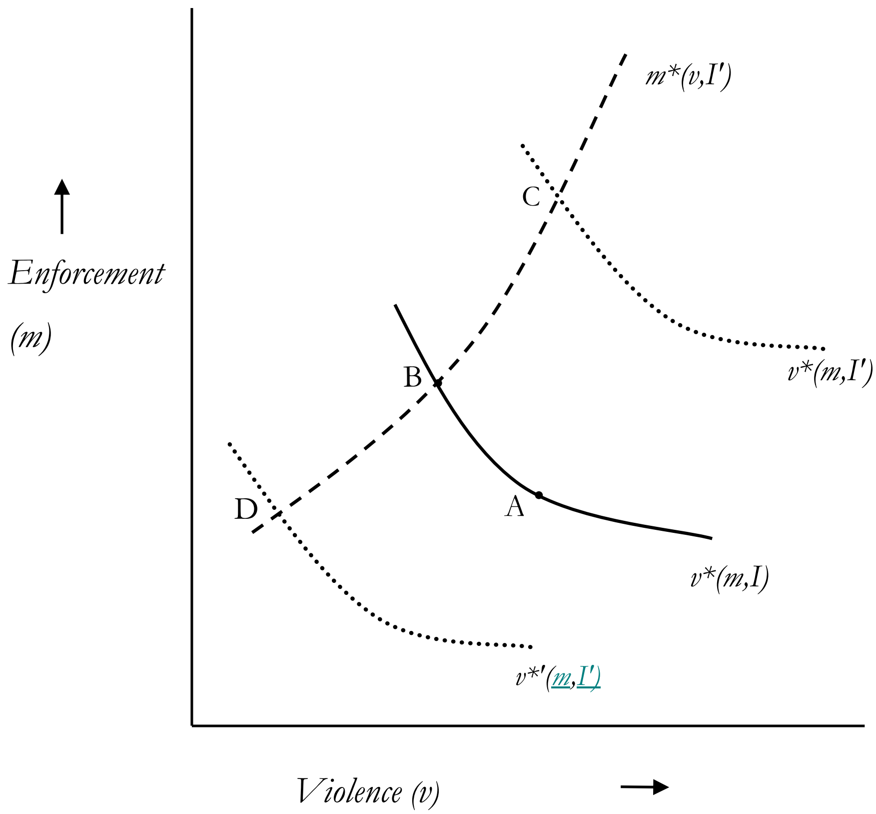
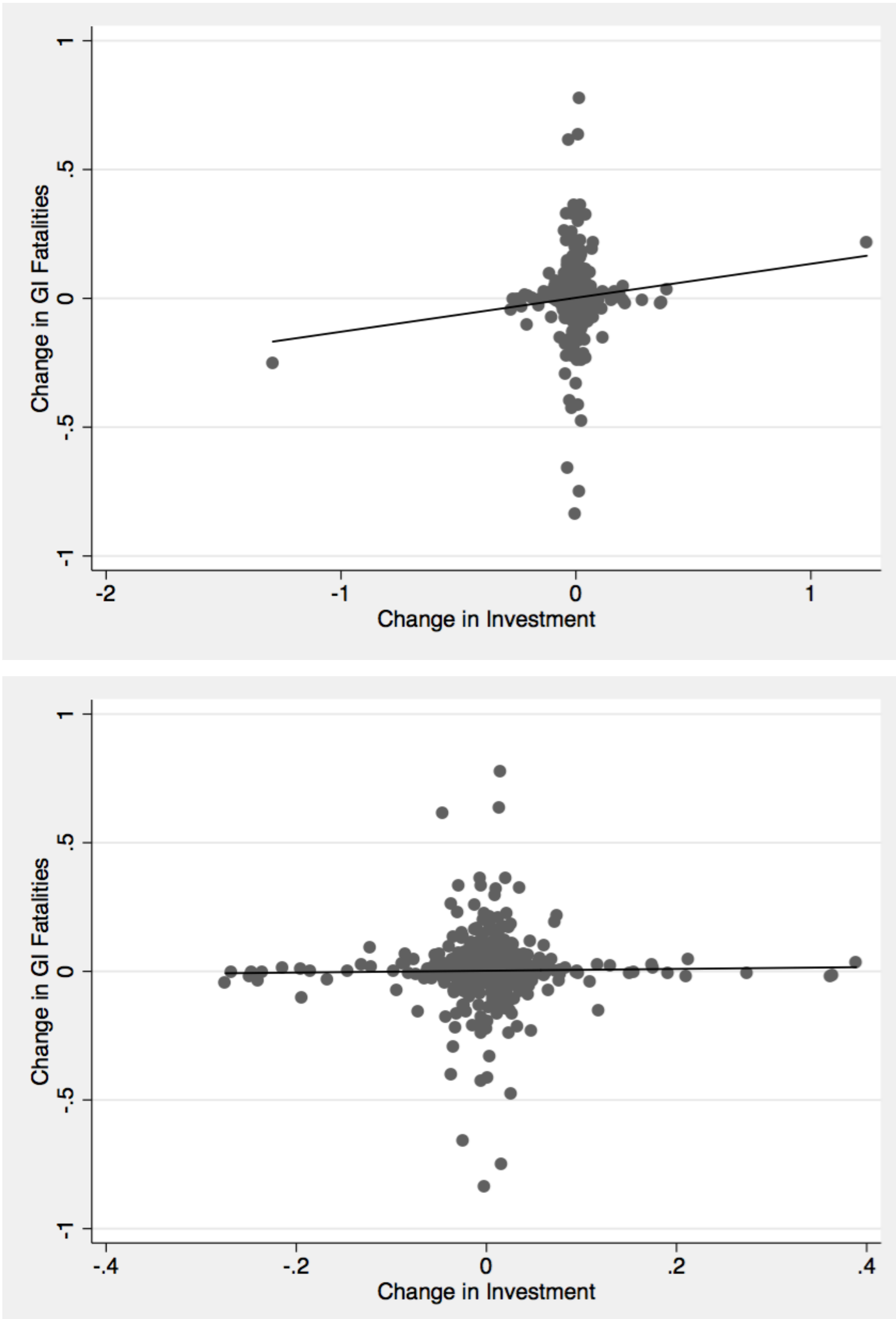
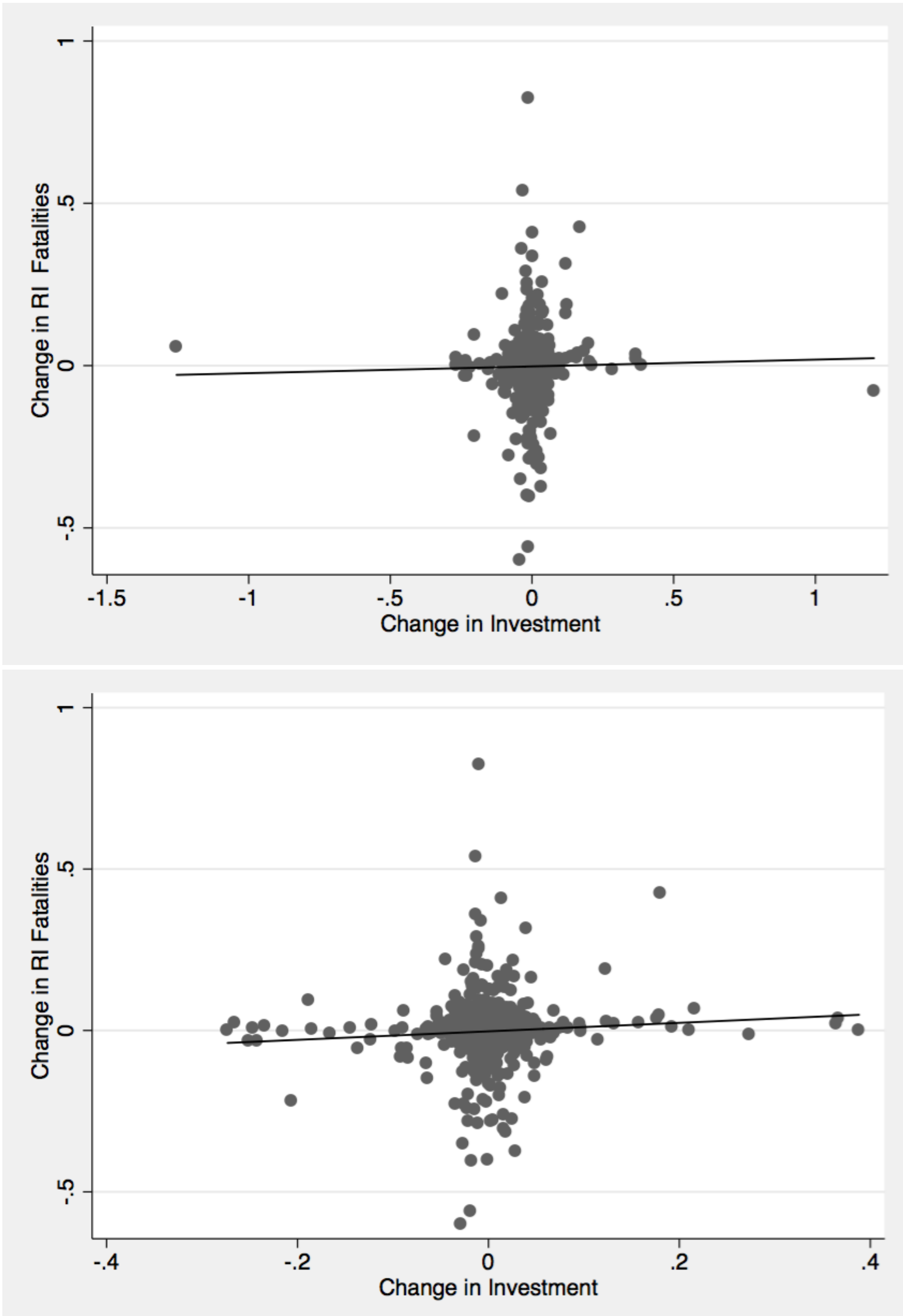


Figure 6: Investment and Govt. Initiated Violence



Note: Top panel illustrates regression coefficient of building permits, Table 4, column (6), for full sample. Bottom panel illustrates regression coefficient of building permits, Table 4A, column (6), for sample excluding Zambales province.

Figure 7: Investment and Rebel-Initiated Violence



Note: Top panel illustrates regression coefficient of building permits, Table 5, column (6), for full sample. Bottom panel illustrates regression coefficient of building permits, Table 5A, column (6), for sample excluding Zambales province.

Table 1: Optimal choices

	Community information sharing (i*)	Rebel initiated violence (v*)	Government initiated violence (m*)	Firms' Investment (I*)
Norms favoring rebels (n)	-	+	-	-
Rebel initiated violence (v)	-		+	? #
Government initiated violence (m)	0	-		+
Investment (I)	0	? #	+	
if no predation	0	-	+	

Notes: The table lists the derivatives dy*/dx of the column variables y with respect to the row variables x, when all other row variables are held constant (as well as norms). For example, the top right positive sign indicates that $di^*/dn|_{v,m,,I,} < 0$. Community information sharing is not listed as a row since rebels, government and firms make choices anticipating optimal response by communities in a later stage.

If the partial derivative $\frac{\partial v^*}{\partial I}\Big|_m$ is positive then $\frac{\partial I^*}{\partial v}\Big|_m$ must be negative, by Proposition #11.

Table 2: Descriptive Statistics

	Obs	Weight	Mean	Std. Dev.	Min	Max
			LEVELS			
Incidents / 10K	560	579984131	0.2920597	0.4027358	0	4.444788
Govt Initiated Incidents (GI)	560	579984131	0.1885914	0.2638765	0	3.232574
Total GI Fatalities	560	579984131	0.0437253	0.094605	0	1.346906
Govt Fatalities	560	579984131	0.0076726	0.0276077	0	0.4872676
Rebel Fatalities	560	579984131	0.0343113	0.0740779	0	1.212215
Civilian Fatalities	560	579984131	0.0017414	0.0086107	0	0.1195494
Rebel Initiated Incidents (RI)	560	579984131	0.1018476	0.1734013	0	1.610619
Total RI Fatalities	560	579984131	0.0543291	0.0969217	0	0.9267434
Govt Fatalities	560	579984131	0.0267594	0.0539714	0	0.6771753
Rebel Fatalities	560	579984131	0.0063105	0.0282851	0	0.7116066
Civilian Fatalities	560	579984131	0.0212592	0.0424385	0	0.3781036
Value of Industrial Building Permits per Capita (PHP)	560	579984131	0.0654696	0.1018505	0	1.295499
Lagged Value of Industrial Building Permits per Capita	480	502363824	0.0696258	0.1073403	0	1.295499
Population	560	579984131	2604672	2986180	15974	1.15E+07
FIRST DIFFERENCES						
Incidents / 10K	480	502363824	0.0117517	0.2558822	-1.697044	1.618357
Govt Initiated Incidents (GI)	480	502363824	0.01189	0.1866488	-1.849644	1.63037
Total GI Fatalities	480	502363824	-0.0019671	0.0891239	-0.8093589	0.8093589
Govt Fatalities	480	502363824	0.0009655	0.0307652	-0.462789	0.4064789
Rebel Fatalities	480	502363824	-0.0027906	0.0690093	-0.5395726	0.5395726
Civilian Fatalities	480	502363824	-0.000142	0.0126537	-0.1195494	0.1195494
Rebel Initiated Incidents (RI)	480	502363824	-0.0001129	0.1165021	-0.8959716	0.7241455
Total RI Fatalities	480	502363824	-0.0055969	0.0885958	-0.6095483	0.8589457
Govt Fatalities	480	502363824	-0.0030554	0.0523314	-0.6095483	0.609367
Rebel Fatalities	480	502363824	-0.0001815	0.0369223	-0.5984372	0.7116066
Civilian Fatalities	480	502363824	-0.00236	0.0461349	-0.2863266	0.3781036
Value of Industrial Building Permits per Capita (PHP)	480	502363824	-0.00132	0.1087733	-1.284107	1.27067
Lagged Value of Industrial Building Permits per Capita	400	422998661	0.0018524	0.1153617	-1.284107	1.27067

Note: Each observation is a province–year, over the seven years 2002 through 2008, for 80 provinces, NT= 560 for levels and 480 for first differences less 80 for lagged variables. All population figures are extrapolated based on the censuses of 2000 and 2007. Means and standard deviations are weighted by estimated population. The variable "weight" reports the sum of weights over all NT province-years.

Table 3: Investment and violence by initiator

	LEVELS	FIRST DIFFERENCES					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Left hand side variable	All Incidents	All Fatalities	GI Fatalities	RI Fatalities	All Incidents	RI Incidents	GI Incidents
Value of industrial building permits	-1.017***	0.141***	0.0942**	0.0439	0.108*	0.0432	0.0514
	(0.294)	(0.0436)	(0.0421)	(0.0341)	(0.0579)	(0.0533)	(0.0444)
Constant	0.317***	0.0413***	0.0105	0.0308**	0.0409	0.0153	0.0256*
	(0.0565)	(0.0144)	(0.00678)	(0.0125)	(0.0253)	(0.0150)	(0.0140)
Observations	560	480	480	480	480	480	480
R-squared	0.068	0.044	0.034	0.040	0.023	0.017	0.036
Mean DV	0.409	0.279	-0.00197	-0.00560	0.0118	0.0119	-0.000113

All specifications include a complete set of year indicators. Regressions are weighted by estimated population. Robust standard errors in parentheses, clustered by province. First differenced specifications are chosen over fixed effects because of suspected nonstationarity of incidents per capita in levels (Breitung panel unit root test has p=0.925 for rejecting a null hypothesis of a unit root in levels of per capita incidents, allowing for demeaning and trends. For changes in per capita incidents that statistic is p=0.000, lambda=-4.85.) *** p<0.01, ** p<0.05, * p<0.1

Table 4: Government Violence and Investment

	LEVELS		FIRST DIFFERENCES									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Left hand side variable	GI Incidents	GI Incidents	GI Incidents	GI Incidents	GI Fatalities	GI Fatalities	GI Govt Fatalities	GI Govt Fatalities	GI Rebel Fatalities	GI Rebel Fatalities	GI Civilian Fatalities	GI Civilian Fatalities
Value of industrial building permits	-0.659***	-0.352***	0.0432	0.0202	0.0942**	0.0851*	0.0281*	0.0267	0.0696***	0.0622**	-0.00349	-0.00385
	(0.193)	(0.116)	(0.0533)	(0.0566)	(0.0421)	(0.0455)	(0.0156)	(0.0163)	(0.0264)	(0.0288)	(0.00339)	(0.00359)
All RI Fatalities		1.600***		0.524***		0.208*		0.0310		0.168**		0.00836
		(0.244)		(0.195)		(0.111)		(0.0379)		(0.0803)		(0.00871)
Constant	0.183***	0.0518***	0.0153	-0.000810	0.0105	0.00408	0.00122	0.000264	0.00841	0.00323	0.000843	0.000586
	(0.0307)	(0.0158)	(0.0150)	(0.0142)	(0.00678)	(0.00694)	(0.00159)	(0.00223)	(0.00630)	(0.00607)	(0.000981)	(0.00101)
Observations	560	560	480	480	480	480	480	480	480	480	480	480
R-squared	0.075	0.392	0.017	0.077	0.034	0.075	0.015	0.023	0.035	0.080	0.010	0.014
Mean DV	0.266	0.266	0.0119	0.0119	-0.00197	-0.00197	0.000965	0.000965	-0.00279	-0.00279	-0.000142	-0.000142

All specifications include a complete set of year indicators. Regressions are weighted by estimated population. Robust standard errors in parentheses, clustered by province. First differenced specifications are chosen over fixed effects because of suspected nonstationarity of incidents per capita in levels (Breitung panel unit root test has p=0.925 for rejecting a null hypothesis of a unit root in levels of per capita incidents, allowing for demeaning and trends. For changes in per capita incidents that statistic is p=0.000, lambda=-4.85.) *** p<0.01, ** p<0.05, * p<0.1

Table 4A: Government Violence and Investment – Zambales Province Excluded

	LEVELS		FIRST DIFFERENCES									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Left hand side variable	All GI Incidents	All GI Incidents	All GI Incidents	All GI Incidents	All GI Fatalities	All GI Fatalities	GI Govt Fatalities	GI Govt Fatalities	GI Rebel Fatalities	GI Rebel Fatalities	GI Civilian Fatalities	GI Civilian Fatalities
Value of industrial building permits	-0.805***	-0.439***	-0.000866	-0.0430	0.0407*	0.0238	0.00724	0.00461	0.0396*	0.0260	-0.00611	-0.00679
	(0.205)	(0.123)	(0.0615)	(0.0506)	(0.0238)	(0.0213)	(0.00738)	(0.00759)	(0.0203)	(0.0182)	(0.00502)	(0.00529)
All RI Fatalities		1.583***		0.532***		0.213*		0.0331		0.172**		0.00865
		(0.245)		(0.196)		(0.112)		(0.0381)		(0.0807)		(0.00882)
Constant	0.191***	0.0577***	0.0156	-0.000255	0.0105	0.00414	0.00135	0.000364	0.00829	0.00317	0.000864	0.000607
	(0.0311)	(0.0159)	(0.0151)	(0.0142)	(0.00685)	(0.00697)	(0.00161)	(0.00222)	(0.00635)	(0.00612)	(0.000991)	(0.00102)
Observations	553	553	474	474	474	474	474	474	474	474	474	474
R-squared	0.090	0.397	0.018	0.079	0.025	0.069	0.008	0.017	0.028	0.075	0.011	0.015
Mean DV	0.266	0.266	0.0119	0.0119	-0.00197	-0.00197	0.000965	0.000965	-0.00279	-0.00279	-0.000142	-0.000142

All specifications include a complete set of year indicators. Regressions are weighted by estimated population. Robust standard errors in parentheses, clustered by province. First differenced specifications are chosen over fixed effects because of suspected nonstationarity of incidents per capita in levels (Breitung panel unit root test has p=0.925 for rejecting a null hypothesis of a unit root in levels of per capita incidents, allowing for demeaning and trends. For changes in per capita incidents that statistic is p=0.000, lambda=-4.85.) *** p<0.01, ** p<0.05, * p<0.1

Table 5: Rebel Violence and Investment

	LEVELS		FIRST DIFFERENCES									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Left hand side variable	All RI Incidents	All RI Incidents	All RI Incidents	All RI Incidents	All RI Fatalities	All RI Fatalities	RI Govt Fatalities	RI Govt Fatalities	RI Rebel Fatalities	RI Rebel Fatalities	RI Civilian Fatalities	RI Civilian Fatalities
Value of industrial building permits	-0.363***	-0.231***	0.0514	0.0233	0.0439	0.0247	0.0183	0.000458	0.0126*	0.0110	0.0130	0.0133
	(0.113)	(0.0631)	(0.0444)	(0.0506)	(0.0341)	(0.0374)	(0.0142)	(0.0165)	(0.00733)	(0.00757)	(0.0210)	(0.0204)
All GI Fatalities		1.083***		0.299***		0.204**		0.190**		0.0173		-0.00290
		(0.237)		(0.0962)		(0.0810)		(0.0821)		(0.0144)		(0.0409)
Constant	0.134***	0.0669***	0.0256*	0.0224*	0.0308**	0.0286**	0.00991*	0.00792	0.00925	0.00907	0.0116*	0.0116*
	(0.0270)	(0.0152)	(0.0140)	(0.0131)	(0.0125)	(0.0125)	(0.00548)	(0.00549)	(0.00581)	(0.00583)	(0.00671)	(0.00677)
Observations	560	560	480	480	480	480	480	480	480	480	480	480
R-squared	0.055	0.396	0.036	0.087	0.040	0.081	0.029	0.130	0.020	0.022	0.028	0.028
Mean DV	0.141	0.141	-0.000113	-0.000113	-0.00560	-0.00560	-0.00306	-0.00306	-0.000181	-0.000181	-0.00236	-0.00236

All specifications include a complete set of year indicators. Regressions are weighted by estimated population. Robust standard errors in parentheses, clustered by province. First differenced specifications are chosen over fixed effects because of suspected nonstationarity of incidents per capita in levels (Breitung panel unit root test has p=0.925 for rejecting a null hypothesis of a unit root in levels of per capita incidents, allowing for demeaning and trends. For changes in per capita incidents that statistic is p=0.000, lambda=-4.85.) *** p<0.01, ** p<0.05, * p<0.1

Table 5A: Rebel Violence and Investment – Zambales Province Excluded

	LEVELS		FIRST DIFFERENCES									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Left hand side variable	All RI Incidents	All RI Incidents	All RI Incidents	All RI Incidents	All RI Fatalities	All RI Fatalities	RI Govt Fatalities	RI Govt Fatalities	RI Rebel Fatalities	RI Rebel Fatalities	RI Civilian Fatalities	RI Civilian Fatalities
Value of industrial building permits	-0.428***	-0.228***	0.104**	0.0917**	0.0793*	0.0707*	0.0193	0.0115	0.0188*	0.0180*	0.0412**	0.0412**
	(0.131)	(0.0747)	(0.0491)	(0.0437)	(0.0432)	(0.0393)	(0.0225)	(0.0211)	(0.00970)	(0.00943)	(0.0191)	(0.0186)
All GI Fatalities		1.084***		0.308***		0.210**		0.191**		0.0184		0.000639
		(0.240)		(0.0973)		(0.0814)		(0.0824)		(0.0145)		(0.0415)
Constant	0.137***	0.0671***	0.0245*	0.0212	0.0298**	0.0276**	0.00960*	0.00760	0.00929	0.00910	0.0109	0.0109
	(0.0276)	(0.0158)	(0.0140)	(0.0130)	(0.0124)	(0.0124)	(0.00549)	(0.00549)	(0.00585)	(0.00588)	(0.00666)	(0.00673)
Observations	553	553	474	474	474	474	474	474	474	474	474	474
R-squared	0.062	0.396	0.040	0.093	0.041	0.084	0.028	0.130	0.021	0.023	0.032	0.032
Mean DV	0.141	0.141	-0.000113	-0.000113	-0.00560	-0.00560	-0.00306	-0.00306	-0.000181	-0.000181	-0.00236	-0.00236

All specifications include a complete set of year indicators. Regressions are weighted by estimated population. Robust standard errors in parentheses, clustered by province. First differenced specifications are chosen over fixed effects because of suspected nonstationarity of incidents per capita in levels (Breitung panel unit root test has p=0.925 for rejecting a null hypothesis of a unit root in levels of per capita incidents, allowing for demeaning and trends. For changes in per capita incidents that statistic is p=0.000, lambda=-4.85.) *** p<0.01, ** p<0.05, * p<0.1

Table 6: Government Violence and Past Investment

	LEVELS		FIRST DIFFERENCES									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Left hand side variable	All GI Incidents	All GI Incidents	All GI Incidents	All GI Incidents	All GI Fatalities	All GI Fatalities	GI Govt Fatalities	GI Govt Fatalities	GI Rebel Fatalities	GI Rebel Fatalities	GI Civilian Fatalities	GI Civilian Fatalities
Lagged value of building permits	-0.722***	-0.451***	-0.0699	-0.0721	-0.0740***	-0.0749***	-0.0196***	-0.0198***	-0.0473***	-0.0481***	-0.00705	-0.00707
	(0.192)	(0.132)	(0.0445)	(0.0443)	(0.0224)	(0.0227)	(0.00632)	(0.00649)	(0.0150)	(0.0158)	(0.00760)	(0.00760)
All RI Fatalities		1.438***		0.568***		0.260*		0.0467		0.210**		0.00285
		(0.224)		(0.190)		(0.146)		(0.0480)		(0.105)		(0.00927)
Constant	0.192***	0.0531***	0.00870	0.0161	-0.0282***	-0.0248**	-0.00227	-0.00166	-0.0251***	-0.0223***	-0.000868	-0.000831
	(0.0314)	(0.0183)	(0.0199)	(0.0154)	(0.0106)	(0.00955)	(0.00193)	(0.00194)	(0.00914)	(0.00823)	(0.000982)	(0.000981)
Observations	480	480	400	400	400	400	400	400	400	400	400	400
R-squared	0.096	0.350	0.021	0.077	0.027	0.077	0.011	0.023	0.027	0.084	0.014	0.014
Mean DV	0.266	0.266	0.0119	0.0119	-0.00197	-0.00197	0.000965	0.000965	-0.00279	-0.00279	-0.000142	-0.000142

All specifications include a complete set of year indicators. Regressions are weighted by estimated population. Robust standard errors in parentheses, clustered by province. First differenced specifications are chosen over fixed effects because of suspected nonstationarity of incidents per capita in levels (Breitung panel unit root test has p=0.925 for rejecting a null hypothesis of a unit root in levels of per capita incidents, allowing for demeaning and trends. For changes in per capita incidents that statistic is p=0.000, lambda=-4.85.) *** p<0.01, ** p<0.05, * p<0.1

Table 7: Rebel Violence and Past Investment

Left hand side variable	(1) All RI Incidents	(2) All RI Incidents	(3) All RI Incidents	(4) All RI Incidents	(5) All RI Fatalities	(6) All RI Fatalities	(7) RI Govt Fatalities	(8) RI Govt Fatalities	(9) RI Rebel Fatalities	(10) RI Rebel Fatalities	(11) RI Civilian Fatalities	(12) RI Civilian Fatalities
Lagged value of building permits	-0.374***	-0.186***	-0.0135	0.00708	0.00376	0.0184	9.10e-05	0.0141	-0.000462	0.000438	0.00413	0.00390
	(0.112)	(0.0590)	(0.0189)	(0.0229)	(0.0158)	(0.0174)	(0.0111)	(0.0115)	(0.00510)	(0.00513)	(0.0135)	(0.0137)
All GI Fatalities		1.073***		0.278***		0.198**		0.189**		0.0122		-0.00318
		(0.246)		(0.103)		(0.0889)		(0.0946)		(0.0156)		(0.0379)
Constant	0.146***	0.0717***	-0.00761	0.000233	-0.0130	-0.00745	-0.00932	-0.00399	-0.00712	-0.00678	0.00341	0.00332
	(0.0319)	(0.0205)	(0.0176)	(0.0149)	(0.0123)	(0.0115)	(0.00631)	(0.00525)	(0.00510)	(0.00523)	(0.00740)	(0.00741)
Observations	480	480	400	400	400	400	400	400	400	400	400	400
R-squared	0.066	0.370	0.031	0.081	0.008	0.058	0.021	0.138	0.013	0.014	0.012	0.012
Mean DV	0.141	0.141	-0.000113	-0.000113	-0.00560	-0.00560	-0.00306	-0.00306	-0.000181	-0.000181	-0.00236	-0.00236

All specifications include a complete set of year indicators. Regressions are weighted by estimated population. Robust standard errors in parentheses, clustered by province. First differenced specifications are chosen over fixed effects because of suspected nonstationarity of incidents per capita in levels (Breitung panel unit root test has p=0.925 for rejecting a null hypothesis of a unit root in levels of per capita incidents, allowing for demeaning and trends. For changes in per capita incidents that statistic is p=0.000, lambda=-4.85.) *** p<0.01, ** p<0.05, * p<0.1

Appendix: Proofs of Propositions

Proposition #1: The community will share information with government if and only if the costs of violence exceed norms of noncooperation.

Proof: The community chooses i on the closed interval [0,1] to maximize expected utility,

$$\max_{0\leq i\leq 1} EU_C(i, n, v, m)\Big|_n = u[c - n]\, h(m)\, i + u[c - v](1\text{-}h(m)\, i) ..$$

Note that since the probability of control is proportional to information shared, monitoring and information are complements. Since C chooses i, $\frac{\partial p}{\partial i} = h(m)$, so the first order condition for C is

$$0 \geq \frac{\partial EUc}{\partial i} = u[c - n]\, h(m) - u[c - v]h(m),$$

which implies that either $m = 0$ or that the best response function of the community is

$$(4)\quad i^* = \begin{cases} 0 \text{ if } u\,[\,c - n] \leq u[c - v] \;\leftrightarrow\; n \geq v \\ 1 \text{ if } u[\,c - n\,] > u[\,c - v] \;\leftrightarrow\; n < v \end{cases}$$

where the equivalent conditions to the right follow from u(.) being strictly monotonic. Prop. #2 of BSF rules out the case where $m = 0$.

Note: In proofs below it will be useful to define $p^* \equiv p(i^*, m)$, the probability of government control, anticipating optimal information sharing by the community. If $m > 0$ then

$E(i^*) = P(i^*=1) = P(n < v) = F(v) = (v - n_L)f$,

where $f = \frac{1}{n_U - n_L}$, the density of the uniform distribution, so that

$$(5)\qquad p^* = (v - n_L)\, f\, h(m) \text{ if } m > 0\,,$$
$$\text{or } p^* = 0 \text{ if } m = 0.$$

Proposition #2: A unique Nash equilibrium in pure strategies exists for this game.

Proof: First we show that all choice variables in steps #2 and #3 have best response functions, then we invoke concavity and convexity of objective functions to show existence and uniqueness.

For a proof that enforcement, m, is strictly positive see BSF. Note that this resolves the ambiguity in step #3 so that i^* is determined by equation (4) and p^* by equation (5).

The proof of uniqueness requires continuing backwards through the sequence of play to step #2 (in which government, rebels and firms make simultaneous choices). The government anticipates optimal behavior of C and minimizes expected costs by optimally choosing m, trading off reductions in expected damage against the marginal costs of counterinsurgency. G solves

$$\min_{m \geq 0} EC_G(v, m, p^*, I) = A(v)[1-p^*] + D(m) - \theta_G I p^*,$$

where p^* is defined in (5) above. The first order condition for m is $0 \leq \frac{\partial EC_G}{\partial m} = -[A(v) + \theta_G I](v - n_L) f h'(m) + D'(m)$, which for an interior solution equates the marginal cost of counterinsurgency effort to the marginal benefit in reduced expected violence costs and increased expected tax revenue. Solving for enforcement, $\frac{\partial^2 EC_G}{\partial m^2} = -[A(v) + \theta_G I](v - n_L) f h''(m) + D''(m) > 0$. (Recalling that $v > n_L$ and $h''(m) < 0$ by assumption.) Thus m has a unique interior solution $m^* > 0$, given v and I, defining a best response function for enforcement $m^*(v, I)$.

Rebels choose a level of violence to maximize expected violence costs imposed on government, anticipating optimal behavior of C. $\max_{v \geq 0} EU_R(v, m, p^*, I) = [A(v) + \theta_R(v) I](1-p^*) - B(v, I)$.

The first order condition $0 \geq \frac{\partial EU_R}{\partial v} = [A'(v) + \theta_R'(v) I](1-p^*) - [A(v) + \theta_R(v) I] f h(m) - \frac{\partial B(v,I)}{\partial v}$, indicates how rebels weigh the marginal benefit of increased violence against the increased probability of government control and increased marginal costs. The second order condition, $\frac{\partial^2 EU_R}{\partial v^2} = [A''(v) + \theta_R''(v) I](1-p^*) - 2[A'(v) + \theta_R'(v) I] f h(m) - \frac{\partial^2 B(v,I)}{\partial v^2} < 0$, so that v^* is a unique maximum (due to the concavity of A(.) and θ_R, and the convexity of B(.)), given v. Thus the first order condition defines R's best response function $v^*(m,I)$. Since $A(0) = 0$ and $A' > 0$, v^* must be positive.

Firms solve $\max_{0 \leq I}$ $E\,\Pi(v,m,p^*,I) = x(I) - I - [\theta_G p^* + \theta_R(v)[1-p^*]]\, I$ which yields a first order condition

$$0 \leq \frac{\partial}{\partial I} E\Pi(v,m,p^*,I) = x'(I) - 1 - [\theta_G p^* + \theta_R(v)[1-p^*]].$$

The concavity of $x(.)$ implies a negative second derivative, which together with a condition on the profitability of the first unit implies a unique interior maximum at some positive level of investment I. Thus the first order condition holds with equality, defining a best response function $I^*(m,v)$.

Collecting first order conditions for the four players, equilibrium will be characterized by five equations in five unknowns.

We have a closed form solution for optimal information sharing by C in stage #3

$$i^* = \begin{cases} 0 \text{ if } n \geq v \\ 1 \text{ if } n < v \end{cases}.$$

In stage #2, three equations in three unknowns determine best response functions $m^*(v, I)$ for G, $v^*(m, I)$ for R in and $I^*(m, v)$ for F, in stage #2:

$$0 = \frac{\partial EC_G}{\partial m} = -[A(v) + \theta_G I](v - n_L) f h'(m^*) + D'(m^*),$$

$$0 = \frac{\partial EU_R}{\partial v} = [A'(v^*) + \theta_R'(v^*)I](1-p^*) - [A(v^*) + \theta_R(v^*)I]\, f\, h(m)\,) - \frac{\partial B(v,I)}{\partial v}, \text{ and}$$

$$0 = \frac{\partial}{\partial I} E\,\Pi(v,m,a,I) = x'(I^*) - 1 - [\theta_G p^* + \theta_R(v)(1-p^*)]\,.$$

Though in general we cannot solve closed form solutions for m^*, v^* and I^*, the concavity of EU_R and $E\Pi$ and the convexity of EC_G ensure existence of a unique Nash equilibrium for the game.[29]

Proposition #3: In regions where norms favor rebels, communities have a lower probability of sharing information with government, rebels choose to use more violence, and government chooses to provide less enforcement, all ceteris paribus.

Proof: A shift in norms towards rebels is a change in the endpoints of the uniform distribution $F(n)$, in which $\Delta n_L = \Delta n_U$. Note that this shift leaves $f = \frac{1}{n_U - n_L}$, the density of the uniform distribution, unchanged. The probability that communities share information is $E(i^*) = P(i^*=1) = P(n < v) = F(v) = (v - n_L)f$, so the effect on information sharing of a shift in norms toward rebels is given by $dE(i^*)/\, dn_L|_{m,g,v} = -f$. The effect on violence of a shift in norms is $dv^*/\, dn_L|_{m,I} = -\frac{\partial^2 EU_R}{\partial v \partial n_L}\Big|_{m,I} \Big/ \frac{\partial^2 EU_R}{\partial v^2}\Big|_{m,I}$, by the implicit function theorem. The denominator is negative (see proposition #2) and the numerator is $-\,d[A'(v) + \theta_R'(v)I](1-p^*)/\, dn_L|_{m,I} = -\,[A'(v) + \theta_R'(v)I]\, f\, h(m) < 0$, so $dv^*/\, dn_L|_{m,I} > 0$. For government, the effect on enforcement is $dm^*/\, dn_L|_{m,g,I} = -\frac{\partial^2 EC_G}{\partial m \partial n_L}\Big|_{v,I} \Big/ \frac{\partial^2 EC_G}{\partial m^2}\Big|_{v,I}$. The denominator is positive and the numerator is $[A(v) + \theta_G I]\, f\, h'(m^*) > 0$, so $dm^*/\, dn_L|_{m,g,I} < 0$.

Proposition #4: Investment is higher where norms favor government if and only if the government tax rate is less than the rebel extortion rate, ceteris paribus.

Proof: $dI^*/\, dn_L|_{m,v} = -\frac{\partial^2 E\pi}{\partial I \partial n_L}\Big|_{m,v} \Big/ \frac{\partial^2 E\pi}{\partial I^2}\Big|_{m,v}$. The denominator is negative because of the concavity of $x(.)$. The numerator is the cross partial derivative $\frac{\partial^2 E\pi}{\partial I \partial n_L}\Big|_{m,v} = (\theta_R - \theta_G)\, dp^*/\, dn_L = -(\theta_R - \theta_G) f\, h(m)$. So $\text{sgn}\,(dI^*/\, dn_L|_{m,v}) = \text{sgn}\,(\theta_G - \theta_R)$.

Proposition #5: Government enforcement increases in rebel violence, ceteris paribus.

29 See Mas-Collel, Whinston, and Green, proposition 8.D.3.

Proof: The government chooses a level of enforcement, m^*, that solves the first order condition 0 = $\frac{\partial EC_G}{\partial m}$ = $-[A(v)+ \theta_G I]\ (v - n_L)\, f\, h'(m^*) + D'(m^*)$, , which equates the marginal cost of enforcement to the marginal benefit in reduced expected costs of violence and increased expected tax revenue. The cross partial $\frac{\partial^2 EC_G}{\partial m \partial v}\Big|_v = -A'(v)\ (v - n_L)\, f\, h'(m) - [A(v) + \theta_G I]\, f\, h'(m) < 0$, and $\frac{\partial^2 EC_G}{\partial m^2} = -[A(v) + \theta_G I]\ (v - n_L)\, f\, h''(m) + D''(m) > 0$, so that $\frac{\partial m^*}{\partial v}\Big|_I > 0$, by the implicit function theorem.

Proposition #6: Rebel violence declines in government enforcement, ceteris paribus.

Proof: The first order condition $0 = \frac{\partial EU_R}{\partial v} = [A'(v) + \theta_R'(v) I](1-p^*) - [A(v) + \theta_R(v) I]\, f\, h(m) - \frac{\partial B(v,I)}{\partial v}$, indicates how rebels weigh the marginal benefit of increased violence against the increased probability of government control and increased marginal costs. The second order condition, $\frac{\partial^2 EU_R}{\partial v^2} = [A''(v) + \theta_R''(v) I](1-p^*) - 2[A'(v) + \theta_R'(v) I]\, f\, h(m) - \frac{\partial^2 B(v,I)}{\partial v^2} < 0$, (due to the concavity of A(.) and θ_R, and the convexity of B(.)), given *I*. To sign how rebels' optimal choice of violence responds to counterinsurgency effort, *m*, we calculate $\frac{\partial^2 EU_R}{\partial v \partial m}\Big|_I = -[A'(v)+\theta_R'(v) I](g + v - n_L) f\, h'(m) - [A(v) + \theta_R(v) I]\, f\, h'(m) < 0$, so that $\frac{\partial v^*}{\partial m}\Big|_I < 0$ by the implicit function theorem.

Proposition #7: Government enforcement increases in investment, ceteris paribus.

Proof: The government chooses a level of enforcement, m^*, that solves the first order condition 0= $\frac{\partial EC_G}{\partial m}$ = $-[A(v)+ \theta_G I]\ (v - n_L)\, f\, h'(m^*) + D'(m^*)$, , which equates the marginal cost of enforcement to the marginal benefit in reduced expected costs of violence and increased expected tax revenue. $\frac{\partial^2 EC_G}{\partial m \partial I}\Big|_v = -\theta_G\ (v - n_L)\, f\, h'(m) < 0$, and $\frac{\partial^2 EC_G}{\partial m^2} = -[A(v) + \theta_G I]\ (v - n_L)\, f\, h''(m) + D''(m) > 0$, so that $\frac{\partial m^*}{\partial I}\Big|_v > 0$, by the implicit function theorem.

Proposition #8: Violence increases in investment if and only if the rate effect, $\theta_R'(v^*)(1-p^*)$, exceeds the sum of the incidence effect, $\theta_R(v^*)\, f\, h(m)$, and the opportunity cost (or gratitude) effect $\frac{\partial^2 B}{\partial v\, \partial I}$, holding enforcement constant.

Proof: The slope of $\frac{\partial v^*}{\partial I}\ |_m$ has the same sign as the cross partial $\frac{\partial^2 EU_R}{\partial v \partial I}\ |_m$ since EU_R is concave in violence. Rebels set violence according to the first order condition $0 = \frac{\partial EU_R}{\partial v} = [A'(v) + \theta_R'(v)I](1-p^*) - [A(v) + \theta_R(v)I]\,f\,h(m) - \frac{\partial B(v,I)}{\partial v}$. The cross partial derivative $\frac{\partial^2 EU_R}{\partial v \partial I}\ |_m = \theta_R'(v^*)(1-p^*) - \theta_R(v^*)\,f\,h(m) - \frac{\partial^2 B}{\partial v\,\partial I}$, which reflects how the marginal utility of violence for rebels is influenced by increased investment. The first term captures the rate effect, which is positive, the second captures the incidence effect, which is negative, and the third reflects the increased marginal cost of violence for rebels when investment is high, which is positive (by assumption). Thus $\text{sgn}(\frac{\partial v^*}{\partial I}\ |_m) = \text{sgn}\ [\theta_R'(v^*)(1-p^*) - \theta_R(v^*) f\,h(m) - \frac{\partial^2 B}{\partial v\,\partial I}]$.

Proposition #9: Investment increases with enforcement, holding violence constant.

Proof: The firm's first order condition is $0 = \frac{\partial}{\partial I} E\Pi(v,m,a,I) = x'(I^*) - 1 - [\theta_G p^* + \theta_R (1-p^*)]$, and the second order condition is negative, as in the proof of Proposition #4 above. The cross partial derivative $\frac{\partial^2 E\Pi}{\partial I\,\partial m}\ |_v = (\theta_R - \theta_G)(v - n_L) f\,h'(m)$ has the same sign as $\theta_R - \theta_G$, which is positive by assumption. By the implicit function theorem, $\frac{\partial I^*}{\partial m}\ |_v > 0$.

Proposition #10: Investment declines in violence if and only if the rate effect, $\theta_R'(v)(1-p^*)$, exceeds the incidence effect, $(\theta_R - \theta_G) f\,h(m)$, holding enforcement constant.

Proof: To solve $\frac{\partial I^*}{\partial v}\ |_m$ we require the cross partial $\frac{\partial^2 E\pi}{\partial I \partial v}\ |_m = (\theta_R - \theta_G) f\,h(m) - \theta_R'(v)(1-p^*)$. The second derivative of expected profits in investment is negative (see proof of proposition #5) so by the implicit function theorem the slope $\frac{\partial I^*}{\partial v}\ |_m$ will have the same sign as this cross-partial derivative. $\text{sign}(\frac{\partial I^*}{\partial v}\ |_m) = \text{sign}\ [(\theta_R - \theta_G) f\,h(m) - \theta_R'(v)(1-p^*)]$.

Proposition #11: If violence increases in investment, then investment must be decreasing in violence, holding enforcement constant.

Proof: $\frac{\partial v^*}{\partial I}\ |_m > 0$ implies $\theta_R'(v^*)(1-p^*) > \theta_R f\, h(m) + \frac{\partial B(v,I)}{\partial v}$ (by proposition #8). $\frac{\partial B(v,I)}{\partial v} > 0$ and $\theta_G f$ $h(m) > 0$ so subtracting both from both sides implies that $\theta_R'(v^*)(1-p^*) - \frac{\partial B(v,I)}{\partial v} > (\theta_R - \theta_G) f\, h(m)$, and that $\theta_R'(v^*)(1-p^*) > (\theta_R - \theta_G) f\, h(m)$. Thus $\frac{\partial I^*}{\partial v}\ |_m < 0$ (by proposition #10).