Popular Support, Denunciations and Territorial Control in Civil War*

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Abstract

I present a model of civilian cooperation with an armed group in an irregular war. Unlike previous models of interactions between civilians and combatants, in this model each civilian considers the effect of others' cooperation on territorial control in an incomplete information setting where she does not know others' motivations or cooperation choices. I find that a superior military force is not sufficient to achieve full civilian cooperation and that maximum cooperation can be attained only if this power comes with expectations of punishment for past defections. The model shows that selective post-control reprisals bring higher cooperation than indiscriminate ones and that forcing civilians to give any kind of information brings more valuable information than what is obtained through voluntary cooperation. It is also shown that communities that have a highly centralized process of decision making are expected to give their support to only one group of combatants and to be exposed to lower levels of violence.

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1 Introduction

When do civilians cooperate with an armed group in an irregular war? Attaining civilians' cooperation is perhaps the most important objective for those fighting this type of conflict. Among different strategies to achieve this goal, violence, or threats of violence, have been commonly used by combatants. The logic of coercive violence is summarized by Jeffrey Race in a description of the Vietcong's methods, "After they kill a few people, the whole hamlet is afraid and the Vietcong can force them to cooperate" (Race, 1973, 135). Along the same lines, Nordstrom states, "Civilians, rather than soldiers, are the tactical targets, and fear, brutality, and murder are the foundation on which control is constructed" (Nordstrom, 1992, 261). While similar assertions are frequently made by civil war scholars and accounts of the use of violence against civilians are found in numerous historical records, we still do not know much about what determines the effectiveness of coercion, especially under conditions of high uncertainty and high stakes common of conflict areas. Such knowledge is key to understanding the extent and types of violence that are observed in conflicts across the world. This paper presents a model of civilian cooperation with an armed group that explores these issues. The model examines how the interaction between expectations of outcomes in the battlefield, prospects of long term control, different community structures, and whether violence is perceived to be selective or indiscriminate affect the incentives of civilians to cooperate with a warring faction.

The setup of the model is one of incomplete information in which civilians act under uncertainty about other civilians' actions and motivations. The uncertainty faced by all of those involved in the conflict is an aspect that is highlighted in the civil war literature but that has been so far neglected by previous modeling exercises. A general sense of distrust is prevalent among the population as loyalties change quickly and people are careful to conceal them to avoid any harm. Denunciations, which armed groups use to acquire information, increase this uncertainty, as the denouncers' identities and the specific information given is generally kept secret. The major of Nebaj, Guatemala in 1976 describes the doubt and unpredictability that civilians experience, "It was difficult to clarify who was who. Many things were said but not verified. There were personal reprisals, political reprisals, of every type, and really it was not known who was who." (in Stoll, 1993, 75). Combatants also act in an uncertain environment. While some civilians provide militarily useful information, others take the opportunity to settle private disputes by making claims against other civilians. Distinguishing which sources of information are reliable is not always possible. The model accounts for some key aspects of this limited information environment: in the model civilians act without knowing others' cooperation choices, nor what personal benefits (if any) others obtain when they take sides, and the armed group executes operations based on information whose quality is not observed at the time it is provided.

A separate feature of the model is that allows studying the interaction between civilians and combatants considering each civilian as an strategic agent. Berman, Shapiro and Felter (2011) and Eynde (2011) also present information-sharing models in a civil war context, but they assume civilians to be one actor. This assumption presents some limitations when studying the micro-dynamics of irregular conflicts which are inherently affected by collective action problems. Military outcomes in irregular conflicts are partly determined by collective decisions of civilians and under certain circumstances, coordination among them might bring common desirable outcomes. Relaxing the unitary-actor assumption allows us to examine the possibility of coordination and the resultant aggregate levels of cooperation and violence that affect civilians. More importantly, by placing emphasis on the agency of individual non-combatants, the model is able to capture heterogeneous civilians' responses to similar conditions in the field. This is consistent with recent empirical work that shows that not all civilians respond in the same way to war events (Condra and Shapiro, 2011; Lyall, Blair and Imai, 2013).

The model yields four main results. I find that a superior military force is not sufficient to achieve full civilian cooperation and that maximum cooperation can be attained only if this superiority comes with expectations of certain punishment for past defections. The result highlights one channel through which expectations of long term control induce cooperation. Long term control increases the chances of finding and punishing previous defectors, which deters civilians from lying to a military group that will prevail. A second finding is that communities that have a highly centralized process of decision making are expected to give their support to only one of the warring factions and to experience less violence than more decentralized ones. The logic for this result is simple. Civilians' malicious denunciations expose the community to violence from all the warring factions, as none of them gets the necessary information to take control definitively. A planner concerned about the welfare of the community would choose to cooperate with only one group as this eliminates denunciations, increases the supported group's chances of taking control, and reduces the number of enemies of the community. The third result is that selective post-control retaliations bring higher cooperation than punishments that are perceived to be randomly applied. Contrary to previous hypotheses on the use of indiscriminate violence found in the literature (Kalyvas, 2006), this result holds regardless of the difficulty of applying selective violence. Finally, the model shows that forcing civilians to reveal any information, rather than allowing them to provide it voluntarily, generally increases the amount of valuable information that an armed group attains. The results gives a theoretical basis for why violence is used to extract information even when the armed forces that receive it know that some of it is of little use.

This paper is part of a growing formal literature in civil war. Previous models have studied the economic determinants of rebelion (Besley and Persson, 2008; Fearon, 2008; Dal Bó and Dal Bó, 2011), the choice of tactics by rebel groups (Bueno de Mesquita, 2013), and armed groups recruitment (Grossman, 1991; Gates, 2002; Beber and Blattman, 2011), but there has not been much work on the conditions that increase civilians' cooperation with a group of combatants. This is surprising given the large literature on insurgency and counterinsurgency that highlights the importance of noncombatants in the outcomes of irregular warfare (e.g. Mao, 1937; Galula, 1964; Thompson, 1966). The work of Mason (1996), Kalyvas (2006), Berman, Shapiro and Felter (2011) and Eynde (2011) are the exception. The key difference between the model presented here and the ones in Berman, Shapiro and Felter (2011) and Eynde (2011) is that this model relaxes the civilians-as-unitary-actor assumption, which allows for the analysis of coordination problems that affect overall levels of popular support and exposure to violence. In Mason (1996) the author proposes a decision theoretic model that captures key elements of the civilians' choice to cooperate with a warring faction. Unlike this paper, strategic considerations among civilians are not analyzed in an equilibrium framework. Kalyvas (2006) presents a game of denunciations in which two civilians provide information to the armed group that they support taking as given the level of control exercised by each of the armed organizations. This paper builds on Kalyva's initial contribution and expands his analysis in two ways. First, the model studies civilian cooperation in an incomplete and imperfect information setting where the personal motivations and actions of others civilians are not known by others and second, it endogenizes territorial control, as civilian cooperation has an effect on the ability of an armed group to defeat its enemy.

On the empirical front, the ideas developed in this paper complement those from studies that have examined conditions favorable to the use of strategic violence against civilians. In Valentino, Huth and Balsh-Lindsay (2004), the authors show that mass killings are significantly more likely during guerrilla wars than during other kinds of war. The relative power of rebels and their mobilization resources have also been shown to be important in explaining the extent of civilians killings (Wood, 2010). Other body of work does not see violence as part of a planned military strategy, but rather as the unintended consequence of organizational characteristics of armed groups (Oppenheim, Vargas and Weintraub, 2011; Weinstein and Humphreys, 2006; Weinstein, 2007). While recognizing that violence is a complex phenomenon that might be caused by numerous factors, this paper focuses in the strategic application of violence to force civilians' cooperation.

The paper proceeds as follows. In the next section I set up the basic model. In Section 3 I present the main results. In Section 4 I explore how allowing voluntary cooperation, and the type of post-control reprisals (selective vs. indiscriminate) affect popular support to an armed group. I conclude in Section 5.

2 The Model

Consider a village whose control is being disputed by two armed groups: the *counterinsurgents* and the *rebels*. In the village there are $N > 2$ civilians and each of them has information that can help one of the groups militarily. At the beginning of the game the counterinsurgents arrive to the village and demand information from the civilians. The civilians simultaneously and independently choose whether to provide the information or to give them false or militarily useless leads. Cooperating with the counterinsurgents by providing them truthful information will be denoted by c and lying by $-c$.[1]

When the counterinsurgents arrive to the village, all civilians have one unit of utility that represents personal safety. A term b_i is added to the personal safety utility of civilian i if she chooses to give false information to the counterinsurgents. The term b_i represents the material or emotional benefit that the punishment of a personal enemy brings when the information takes the form of a malicious denunciation or the strength of ideological support for the rebels. This benefit is private information. That is, no civilian knows how strong are others' incentives to give false information to the counterinsurgents. All of them know, however, that the benefits are randomly distributed in $[0, 1]$ according to a convex and strictly increasing cumulative density function $F(.)$. Civilians learn the value of their own benefit before the cooperation choices are made. The assumptions on $F(.)$ ensure that all civilians have a positive probability of having a benefit of lying that can be very small, intermediate or large, but not as large that they would value being safe by less than what they would gain by giving false information. This captures how the desire to limit damage generally prevails over ideals or material benefits (e.g. Leites and Wolf, 1970; Migdal, 1974).

After civilians make their cooperation choices, the counterinsurgents carry out military operations based on the information that they received. I assume that a larger number of civilians giving false information to the counterinsurgents brings a higher risk for all civilians of being harmed as a consequence of the operations planned with bogus leads. In the model this is represented by having the personal safety unit of utility of all civilians multiplied by the fraction $\frac{n^c}{N}$, where n^c is the number of civilians choosing c.

To understand the logic behind having all civilians affected by the lack of cooperation with the counterinsurgents we can consider the example of lying when it takes the form of denunciations. If civilians do not reveal the identities or location of rebels but rather, point the finger at other civilians, this can inflict damage not only on those who were falsely accused, but also on the original denouncer given the possibility of reprisals from the victim's relatives or friends. It can also be that receiving low quality information increases soldiers' frustration leading to general abuses on the population. More generally, giving false information to the counterinsurgents lowers the precision of their attacks and less precision brings a higher risks for all civilians of being victims of violence. In this way, if everyone cooperates, counterinsurgents' operations are precisely targeted at the rebels and all civilians are safe from harm. On the other hand, if fewer than N cooperate, their personal safety utility is reduced to $\frac{n^c}{N}$.

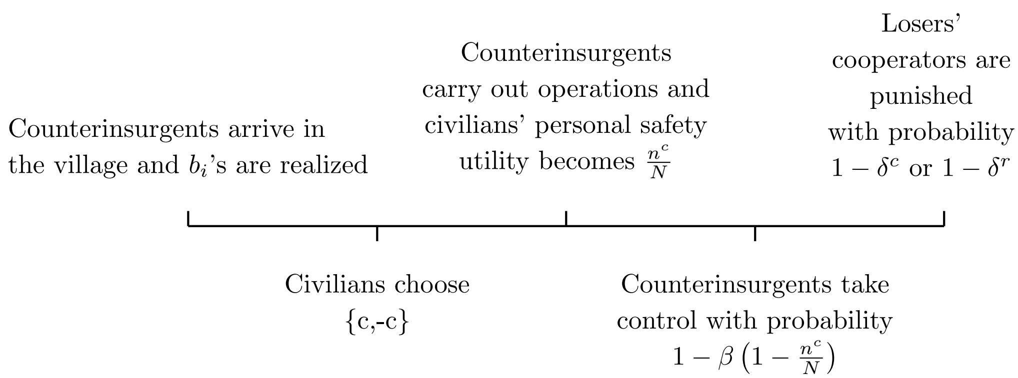
Once the counterinsurgents carry their operations, nature decides which group takes control over the village. The probability that the counterinsurgents take control is $1 - \beta(1 - \frac{n^c}{N})$, which captures how popular support shapes military outcomes. Here, $\beta \in [0, 1]$ is the probability of the rebels holding control when there is no civilian giving truthful information, which parameterizes the

[1] For expositional purposes, I have chosen the counterinsurgents to be the group that is demanding information. However, this choice does not alter substantively any of the results that follow and the rebels could have been chosen to play that role instead.

rebels' relative military power. An underlying assumption of how military outcomes are determined is that full civilian cooperation is sufficient for the counterinsurgents to gain territorial control regardless of the rebels' initial military strength.

At the end of the game there is a round of punishments carried out by the group that gains control over the village in which previous enemy cooperators are targeted. The winners, however, can not always identify them. If the rebels take control over the village, a civilian that cooperated with the counterinsurgents is punished with probability $1 - \delta^r$ and she is not with probability δ^r. Similarly, if the side gaining control over the village is the counterinsurgents, those civilians who gave erroneous information to the counterinsurgents become the victims of their retaliations with probability $1 - \delta^c$ and they are able to avoid them with probability δ^c. Those who helped the winners are not at risk of being punished. A civilian who is punished loses her personal safety utility that is left at that point. Figure 1 summarizes the sequence of events.

Figure 1: Time Line



The terms $1 - \delta^c$ and $1 - \delta^r$ can be thought of as being positively related to the local knowledge counterinsurgents and rebels have. The ability to hold control in the medium and long term can increase that local knowledge. If villagers know that control will be firmly maintained by the winners of the military contest, it is more likely that this group will eventually be able to identify past enemy informants, in which case the winners' probability of finding enemy cooperators will be high. In this way, the model separates expectations of short term and medium term control. The villagers' actions partially determine short term control, but they take as given the ability of the group that prevails in the short run to maintain that control later on.

Table 1 gives a civilian's payoffs conditional on the group that takes control and on the number of other civilians giving useful information to the counterinsurgents, which is denoted by n^c_{-i}. The bottom row gives the payoffs of a civilian i who chooses to lie to the counterinsurgents. In this case, the harm caused by the false information given to the counterinsurgents reduces her initial utility to $\frac{n^c_{-i}}{N}$ regardless of what group takes control of the village. However, if the counterinsurgents take control, they search for those who gave them false information leaving civilian i unharmed with probability δ^c or punishing her with probability $1-\delta^c$. Since she chose not to cooperate with the counterinsurgents, she gains b_i whether or not she is caught by the counterinsurgents. Her expected payoff of not cooperating when counterinsurgents take control is then $\frac{n^c_{-i}}{N}\delta^c + b_i$. If the rebels win on the other hand, she does not have any risk of losing her personal safety utility and also gains the private benefit b_i, which leaves her with an expected payoff of $\frac{n^c_{-i}}{N} + b_i$. A similar logic applies to the first row of the table.

Table 1: Ex-ante Civilians' Payoffs

Action	Counterinsurgents win	Counterinsurgents lose
c	$\frac{n^c_{-i}+1}{N}$	$\frac{n^c_{-i}+1}{N}\delta^r$
$-c$	$\frac{n^c_{-i}}{N}\delta^c + b_i$	$\frac{n^c_{-i}}{N} + b_i$

Under the model's assumptions, someone who cooperates with the winners is safe from punishment. In this way, the model captures the ability of the group that has control to protect its cooperators from enemy retaliations. This feature of territorial control gives an incentive for civilians to act in favor of the group that is receiving more cooperation from others, as that group has a higher probability of winning. Incentives to coordinate actions are also given by the way military operations affect civilians, as more people cooperating with the counterinsurgents reduces the risks created by the collateral damage of ill-informed operations. The next section shows when the incentives to coordinate support for the counterinsurgents outweigh the private benefits of defection.

The equilibrium concept that I use to solve this simultaneous game of incomplete information is Bayesian Nash Equilibrium. I concentrate on symmetric strategies represented by the function $s : [0, 1] \to \{c, -c\}$. The function $s(.)$ gives an action for a given private value of providing false information b_i. That is, all civilians that have a value of lying to the counterinsurgents of b will take the same action $s(b)$ in equilibrium.

3 Results

A civilian makes the decision to cooperate if her expected utility from doing so is greater than or equal to the utility she gets if she chooses to provide false information. The following expressions give us both of those utilities for civilian i.

$$
\begin{aligned}
U_i(c) &= E_{n^c_{-i}|p}\left[\frac{n^c_{-i}+1}{N}\left(\beta\left(1-\frac{n^c_{-i}+1}{N}\right)\delta^r + 1 - \beta\left(1-\frac{n^c_{-i}+1}{N}\right)\right)\right],\\
U_i(-c) &= E_{n^c_{-i}|p}\left[\frac{n^c_{-i}}{N}\left(\beta\left(1-\frac{n^c_{-i}}{N}\right) + \left(1-\beta\left(1-\frac{n^c_{-i}}{N}\right)\right)\delta^c\right)\right] + b_i.
\end{aligned}
\tag{1}
$$

In the expressions above, expectations are taken over the distribution of the number of civilians providing useful information other than i. Given that in equilibrium others cooperate according to $s(.)$, i expects the probability of any civilian cooperating with the counterinsurgents to be $p \equiv \int_0^1 I_c(s(b))f(b)db$, where $I_c(.)$ takes the value of one whenever its argument is c and zero otherwise and where $f(.)$ is the density function of the private benefits of lying. After rearranging some of the terms in (1), we can deduce that a civilian i will provide useful information to the counterinsurgents if and only if:

$$
\begin{aligned}
\Psi(p) \equiv\ & E_{n^c_{-i}|p}\left[\frac{n^c_{-i}}{N}\left(\beta\left(1-\frac{n^c_{-i}}{N}\right)(\delta^r - 1) + \left(1-\beta\left(1-\frac{n^c_{-i}}{N}\right)\right)(1-\delta^c)\right)\right]\\
&+ E_{n^c_{-i}|p}\left[\frac{n^c_{-i}}{N}\frac{\beta}{N}(1-\delta^r)\right] + \frac{1}{N}E_{n^c_{-i}|p}\left[\beta\left(1-\frac{n^c_{-i}+1}{N}\right)\delta^r + 1 - \beta\left(1-\frac{n^c_{-i}+1}{N}\right)\right] \geq b_i
\end{aligned}
\tag{2}
$$

The expression on the left hand side of this inequality, $\Psi(p)$, is the expected gain in the likelihood of being unharmed that cooperating with the counterinsurgents brings.

We can learn the effect of others' cooperation on the individual incentives to do so by studying the components of $\Psi(p)$. The first expected value term in $\Psi(p)$ (from left to right) is the expected gain in utility of cooperating with the counterinsurgents if the actions of i have no direct repercussions on which group takes control nor on the violence caused by the counterinsurgents' operations.[2] In what follows I will call this term *the indirect gain in utility of cooperation.* The second expected value term is the expected utility derived from increasing the chances of the counterinsurgents winning, that is, the payoffs if the counterinsurgents take control for sure. The last term in $\Psi(p)$ is the gain in utility derived by increasing the precision of counterinsurgents' operations, which are the payoffs if the counterinsurgents' initial operations did not affected the civilian. We can see that the second and third terms are non decreasing in the expected number of others cooperating with the counterinsurgents. The intuition is as follows: if i cooperates with the counterinsurgents and they win, she would only have her personal utility reduced by others' non cooperation through the damage caused by the counterinsurgents' imprecise operations. As for the third term, having sided with the counterinsurgents, she would be better off if they end up taking control over the village,

[2] Note that the action of i still affects that term through p in equilibrium.

which is more likely if others help them as well. We now only need to establish how the first term is affected by others' cooperation. The next result shows that, for most parameter combinations, the first summation term of $\Psi(p)$ is a quadratic function of p. All proofs are in the appendix.

Lemma 1. *If rebels have some military power ($\beta > 0$) and if there is a risk of being punished after cooperating with the group that is defeated ($\delta^c + \delta^r < 2$), the civilians' indirect gain in utility of cooperation with the counterinsurgents is a quadratic U-shaped function of the others' probability of cooperation p. The minimum of such function is reached at $p_{min} = \frac{\beta(2-\delta^c-\delta^r)\left(1-\frac{1}{N}\right)-(1-\delta^c)}{2\beta(2-\delta^c-\delta^r)\left(1-\frac{2}{N}\right)}$.*

The result tells us that if the rebels' military power, β, is high enough (enough to make $p_{\min} > 0$), there is a range of values of p in which more help to the counterinsurgents given by other civilians *decreases* the incentives of a given individual to support them (this range being $[0, p_{\min}]$). In this range of beliefs cooperation with the counterinsurgents is still low enough and therefore, the rebels are the likely winners. Furthermore, the more others cooperate, the less violence against civilians there is when counterinsurgents carry their operations. These two factors make noncooperation increasingly more attractive as p grows. In contrast, when $p > p_{\min}$ civilians perceive that there is enough civilian support for the counterinsurgents to prevail and therefore, they will want to cooperate with the counterinsurgents as well.

I now shift attention to finding the equilibrium probability of providing truthful information to the counterinsurgents. As indicated by (2), $s(b_i)$ must be a threshold strategy and the ex-ante probability of any civilian cooperating is the probability of that civilian having a private benefit b_i being less than or equal to $\Psi(p)$. Therefore, the equilibrium probability of cooperation with the counterinsurgents satisfies

$$F(\Psi(p)) = p. \tag{3}$$

The next result shows that there is in fact a fixed point of $F(\Psi(.))$ in $(0, 1]$.

Proposition 1. *The following statements characterize equilibria in the cooperation model*

1. *There is a symmetric Bayesian equilibrium in which the ex-ante probability of cooperation with the counterinsurgents is strictly positive.*

2. *If the rebels have some military power ($\beta > 0$), or if there is no risk of being punished after cooperating with the group that is defeated ($\delta^r + \delta^c = 2$), the equilibrium is unique.*

3. *If the rebels have no military power ($\beta = 0$) there can be at most two equilibria.*

The result shows that under no circumstances do all civilians choose to lie to the counterinsurgents. The intuition is straightforward. If all civilians are lying to the counterinsurgents, the risk of being harmed by the counterinsurgents' operations is so high that a civilian with small private value of deceiving the counterinsurgents would prefer to reduce that risk by giving truthful information. The proposition also tells us that for the substantively interesting case in which the insurgents have some military strength the equilibrium is unique. The same is true when no matter which group takes control, civilians are not punished for their previous actions ($\delta^c = \delta^r = 1$). In this case, which side takes control becomes irrelevant and civilians would only care about how much they can reduce the cost of counterinsurgents' violence (which is exactly $\frac{1}{N}$). Then the unique ex-ante equilibrium probability of cooperation would be $F(\frac{1}{N})$.

It can also be of interest to examine under what conditions everyone would decide to help the counterinsurgents. The next proposition shows that military power and expectations of punishment to previous defectors are both crucial when trying to achieve full cooperation.

Proposition 2. *The ability of counterinsurgents of always punishing those who lied to them ($\delta^c = 0$) and rebels having no military power ($\beta = 0$) are necessary conditions for an equilibrium with complete cooperation. Moreover, if both of those conditions hold, there is an equilibrium in which everyone cooperates with the counterinsurgents.*

The result suggests that complete cooperation with the counterinsurgents can not be achieved only by having a vastly superior military force that will guarantee short term control. Similarly, it is not sufficient for civilians to know that they will be punished with certainty after lying to induce their cooperation. If there is even a small chance that the rebels would control the village in the absence of civilians' help, that would be enough to deter cooperation for those that have a strong interest in deceiving the counterinsurgents. It can also be shown that in the case where there is an equal probability of having any benefit of lying to the counterinsurgents in $[0, 1]$, having a completely dominant military force together with certainty of punishments to previous defectors are sufficient conditions to attain full cooperation. This highlights the importance of complementing a strong military with expectations of long term control.

While counterinsurgents having a substantial military advantage does not guarantee that all civilians will help them, intuitively the next proposition shows that having a stronger military does not reduce the amount of cooperation that the counterinsurgents receive. Similarly, a higher probability of a civilian that lied to the counterinsurgents escaping their retaliation does not increase the equilibrium probability of cooperation.

Proposition 3. *The ex-ante probability of cooperating with the counterinsurgents in any equilibrium is:*

1. *Weakly decreasing in the rebels' military power, β*
2. *Weakly decreasing in the probability of avoiding counterinsurgents' reprisals after counterinsurgents take control, δ^c*

3. *Weakly increasing in the probability of avoiding rebels' reprisals after the rebels take control,* δ^r.

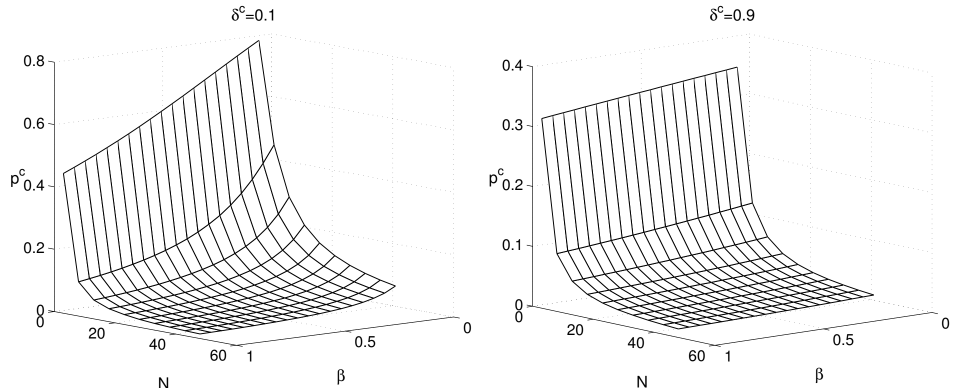
Changes in the size of the population also affect cooperation choices. For the case in which both groups do not punish their enemy's informants, we saw that the probability of cooperating with the counterinsurgents was $F(\frac{1}{N})$, which is decreasing in the size of the population. The logic for the negative relationship between population size and cooperation with the armed group is simple. In a populated area, the effect of the cooperation of one civilian on the risks associated to ill-informed operations is small. The argument however, could be applied also to situations in which civilians have some chance of being punished for having cooperated with the group that loses control. In a large village, the actions of one civilian have a small effect on the levels of violence brought by false denunciations and also on the outcome of the military contest. Therefore, we expect to see cooperation levels decreasing in the size of the population generally. This is what we see in Figure 2. The figure plots the equilibrium probabilities as a function of the rebels' military power and population size for the case when the private benefits of lying to the counterinsurgents are uniformly distributed. For all possible levels of the rebels' military strength and for two different probabilities of the counterinsurgents punishing the rebels' informants, the probability of cooperation decreases in the size of the population.[3]

The model then provides a new mechanism that accounts for the displacement of civilians in conflict-afflicted regions. The more civilians are displaced, the more likely is that the ones who stay will cooperate with a group that pretends to gain territorial control. An observable implication is that an armed group would exert pressure on the population to leave areas where it is less likely that the civilians would cooperate with them. That is, in places where militarily their enemy is strong and where civilians' expectations of being punished for lying to them are low. Recent findings in the literature on displacement are consistent with those expectations. In a case study in the municipality of Apartadó, Colombia, Steele finds that in neighborhoods that supported an insurgent-associated political party, the Patriotic Union, during elections, more people left their homes than in other areas (Steele, 2011). Through interviews, the author finds evidence of a concerted effort by right-wing paramilitaries to force displacement where the Patriotic Union gained more votes. The events occurred during the first half of the nineties when the United Self Defence Forces of Colombia (the paramilitaries) started an expansion in the municipality, which had been until then a stronghold of the main left insurgent groups. In those areas the insurgents were militarily more powerful and there were no strong expectations of long term control by the incoming paramilitaries. The mechanism highlighted by the model can complement one in which the paramilitaries are trying to "dry the sea in which the fish swim," where by forcing civilians to reallocate, shelter and the flow of supplies to the rebels is reduced.

The graphs also shows that stronger counterinsurgents' forces (lower β's) generate a larger

[3]The same patterns hold for other values of δ^c.

Figure 2: Probability of Cooperating with Counterinsurgents: Comparative Statics



increase in cooperation levels when there are high expectations of counterinsurgents being able to punish the liars. This is represented by the steeper slope of the probability of cooperation with respect to β that we see in the right hand side graph relative to the one on the left.[4] This again is explained by the fact that changes on relative military power are only important when civilians are directly affected by which group takes control. As mentioned earlier, if there are no differences on the perceived risks of cooperating with the counterinsurgents when they or their enemy take control, military power should not importantly affect their cooperation choices.

The previous observations showed the importance of expectations of long term control and raw military power and how they complement each other when civilians decide to cooperate. In this type of conflict, it is crucial for an armed group to convince civilians that their side is more powerful *and* that they will retain control over the area. The role of expectations has been emphasized many times by counterinsurgent practitioners. Oliver Lyttelton, British Colonial Secretary in 1951, for example, notes, "You cannot win the war without the help of the population, and you cannot get the support of the population without at least beginning to win the war." This demands, he continues, to fight a war "waged with two instruments, propaganda and armed forces" (in Nagl, 2005, 76). In terms of the model, the counterinsurgents should increase as much as possible their military strength (lowering β) and simultaneously, they need to make civilians believe that they will find out who cooperated with the enemy, possibly by creating expectations of long term control (lowering δ^c).

[4] This follows from

$$\frac{\partial \Psi(p)}{\partial \delta^c \partial \beta} = -p\left(p\left(1-\frac{2}{N}\right)-\left(1-\frac{1}{N}\right)\right) \geq 0.$$

The same is true if we examine the relationship between military power and civilians' cooperation for different δ^rs since

$$\frac{\partial \Psi(p)}{\partial \delta^r \partial \beta} = -\left(p^2\left(1-\frac{2}{N}\right)-p\left(1-\frac{1}{N}\right)\right) \geq 0.$$

The negative effect of the size of the population on cooperation that we see in Figure 2 comes as a straightforward consequence of the collective action problems faced by the civilians in these environments. When some civilians do not give useful information to the counterinsurgents aiming to gain a private benefit, they are eliminating the outcome in which no one in the village is harmed. Defection is more likely if people perceive that their actions are less important at determining outcomes, which is what happens in large populations. This suggest that if there is only one agent in charge of deciding the level of cooperation with the counterinsurgents, she would choose complete cooperation. The next result shows that this is indeed the case.

Proposition 4. *The centralized cooperation decision involves all civilians cooperating with the counterinsurgents.*

This optimal benchmark gives us an idea of how communities in which by culture or tradition centralize their political decisions choose whether to give their support to an armed group. In light of this interpretation, the result tells us that when civilians follow a leader who decides on the groups' participation, we should observe a consistent support for one of the armed actors. Moreover, the overall levels of violence that they experience should be lower, as consistent support for one group increases the group's chances of taking control without the collateral damage brought by poorly informed operations, and eliminates the need to exert ex-post reprisals. This is in line with what Kaplan finds using data from Colombia (Kaplan, 2012). The author finds that a higher frequency of shamans' visits in a municipality is associated with a significant reduction in its homicide rate. The interpretation of these findings by the author emphasizes the role played by shamans and local leaders in maintaining social cohesion, and how their authority is used to encourage members to avoid being involved in cycles of denunciations (Kaplan, 2012, 7).

4 Variations

The baseline model makes the assumption that retaliations for previous defections by a particular group only affect civilians that cooperated with the enemy. The model also assumes that civilians are not allowed to remain silent when the counterinsurgents arrive in the village. Here, I relax both of them. As it will be seen, the counterinsurgents' behavior implied by the assumptions is consistent with an strategy that maximizes truthful information sharing by civilians. The results suggest that counterinsurgents in the model should commit to applying selective threats, and force villagers to give any type of information rather than waiting for the information to be given voluntarily.

4.1 Indiscriminate Punishments

We have examined civilians' provision of information to the counterinsurgents when rebels and counterinsurgents search for their enemies' cooperators to punish them after taking control of the village. In the baseline model all punishments are *selective* in the sense that those who do not cooperate with the losers are never at risk of being harmed. This assumption is consistent with the view of students of civil wars and practitioners that selective violence is generally superior when it comes to attain civilians' support relative to the use of violence that is not clearly linked to previous actions carried by the victims (Kalyvas, 2006).

The model is able to capture the superiority of selective violence over indiscriminate violence. The logic is as follows. If the counterinsurgents take control over the village and engage in punishments that appear to affect those who gave truthful information but also those who lied, the incentives to refrain from giving false information are necessarily diminished. As a result, the probability of giving truthful information under selective violence will be as large as the probability of cooperation when counterinsurgents use indiscriminate violence.

We can see this in the model by modifying slightly the baseline setup. I will use the term *indiscriminate violence* to denote a situation in which a group punishes those who cooperated with its enemy *and* those who did not with the same probability. This probability is denoted by $1 - \widetilde{\delta}^c$ for the counterinsurgents and by $1 - \widetilde{\delta}^r$ for the rebels. Armed groups have been hypothesized to engage in random punishments when information is scarce or more generally, when the cost of selectivity is high (Kalyvas, 2006, 147). In those situations, armed groups might still feel the need to exert violence on the civilian population for previous defections. Selective violence is, as before, captured by the probability of punishing exclusively enemy cooperators ($1 - \delta^c$ and $1 - \delta^r$). The next result shows that the use of selective violence dominates the use of indiscriminate violence regardless of the strategy used by the rebels and the ability to punish past enemy informants of both groups with any type of violence.

Proposition 5. *The probability of cooperating with the counterinsurgents when they use selective violence in any equilibrium is greater than or equal to the one that is attained when they use indiscriminate violence.*

The proposition highlights the importance of civilians' beliefs on the type of reprisals that the counterinsurgents will take. If civilians think that the counterinsurgents would put effort in finding and punishing only those that gave them false information, cooperation would follow. What happens then when counterinsurgents do not have enough human or capital resources to successfully implement post-control selective violence? Given that it was proven (as part of the proof in Proposition 5) that when using indiscriminate violence the probability of cooperation increases with $\widetilde{\delta}^c$, the best counterinsurgents can do under this strategy is to commit not to punish anyone at all.

According to Kalyvas, when counterinsurgents' resources are low and the rebels cannot protect the people who lied to the counterinsurgents, we should see that counterinsurgents will be more likely to use the cheapest method of punishment, which is indiscriminate violence (see Kalyvas, 2006, Ch.6). The conditions stated by Kalyvas can be captured by the model if we choose a low β

and a high δ^c. In such a scenario, rebels are less likely take control over the village so those who lied to the counterinsurgents cannot be protected by the rebels, and also, the counterinsurgents would find very hard to find those who lied to them if they try to do so. In the extreme case when β is zero and δ^c is one, it is easy to show that if counterinsurgents use selective violence, the probability of civilians helping them is $F(\frac{1}{N})$. In contrast, if they choose random violence applied at a rate $1 - \widetilde{\delta}^c$ (with $\widetilde{\delta}^c < 1$), they would obtain a probability of cooperation of $F(\frac{\widetilde{\delta}^c}{N})$, which is smaller. Counterinsurgents that want to maximize cooperation would never choose indiscriminate violence under these circumstances contradicting Kalyva's claim. Even if the rebels cannot win and if the counterinsurgents can never find their enemies' cooperators, applying indiscriminate violence is self-defeating, as doing so still takes away some of the benefits of sharing truthful information *relative* to lying. While it is true that some of the guilty who escape punishment under selective violence do get punished under indiscriminate violence, civilians are likely to be hurt regardless of their action under this type of punishment. What Kalyva's hypothesis seems to miss is that whether rebels are strong or not and that no matter what the accuracy of targeting is when trying to be selective, random punishments tend to equalize the costs and benefits of choosing to help either side, while selective violence increases the costs of failing to cooperate.

In Downes (2007) it is also mentioned factors that affect the use of indiscriminate violence that appear as exogenous variables in the model. According to Downes, indiscriminate violence is effective when applied to a small population that is concentrated in a small geographical area, as the armed group can kill or imprison everyone, eliminating any source of potential rebel support. While the model shows that for all population sizes selective violence attains a cooperation that is as high as the one obtained with indiscriminate violence, the model suggests one way in which smaller populations could have experienced indiscriminate violence more often. Smaller populations are preferred by the counterinsurgents of the model because all the benefits of cooperating with them are decreasing in population size, while the private benefit of lying is independent of this variable. It can be argued that by applying indiscriminate violence before demanding cooperation, counterinsurgents could reduce the size of the population, effectively increasing the cooperation of those civilians who are left. Future empirical work should examine whether random violence is more likely to occur before control is gained and whether selective violence is more likely once control is being consolidated as the model suggests.

4.2 Voluntary Provision of Information

The baseline model is consistent with cases where civilians are forced to provide any information to the counterinsurgents. In this section I study the case where civilians are allowed to remain silent, making the options of lying or cooperating with the counterinsurgents voluntary.

Let n^o denote the number of civilians that choose not to give any information to the counterinsurgents. It is assumed that those civilians do not affect the chances of any group taking control and that because of this, they will not be punished by the winners.[5] I also assume that after the counterinsurgents carry their operations, civilians' utility falls to $\frac{n^c+\tau n^o}{N}$ with τ being in $[0,1)$. Note that if everyone remains silent, there is still collateral damage created by the counterinsurgents lacking reliable information and therefore the utility of all civilians become τ. The parameter τ then represents the ability of the counterinsurgents to avoid affecting civilians when carrying their operations in the absence of information. Intuitively, this ability can never be as good as when people do cooperate which justifies why τ is strictly less than one.

The expected utility of remaining silent is then

$$U_i(o) = E_{n^c_{-i},n^o_{-i}|p,p^o}\left[\frac{n^c_{-i}+\tau(n^o_{-i}+1)}{N}\right].$$

Now the expectation is taken over the distribution of the number of civilians that cooperate with the counterinsurgents and the number of those that remain neutral other than i. These numbers and the number of other civilians that give false information to the counterinsurgents follow a multinomial distribution with parameters $(p, p^o, 1-p-p^o, N-1)$.

Allowing people to remain silent will generally reduce the amount of cooperation that counterinsurgents receive as the next result shows.

Proposition 6. *When civilians are allowed to remain silent the following holds*

1. *If there is a risk of being punished by helping the counterinsurgents ($\delta^r < 1$) and the rebels have some military power ($\beta > 0$), there is a threshold $\widetilde{\tau}$ in $(0,1)$ such that for $\tau \geq \widetilde{\tau}$ there is a unique equilibrium in which no one cooperates with the counterinsurgents and the probability of remaining silent is strictly less than one.*

2. *For all other parameter combinations, the highest probability of cooperation that can be achieved in any equilibrium is the same as the one obtained when people are forced to reveal information.*

When civilians are allowed to remain silent the level of cooperation will be less than or equal than to the level when they are forced to give any kind of information. Moreover, it can be proven that this also holds when we compare the centralized solutions. An agent that maximizes all civilians' welfare when they are allowed to remain silent would not have anyone giving false information as before.

What the model suggests then is that counterinsurgent forces have strong incentives to force civilians to reveal any information when they suspect civilians have it, even when an important fraction of them ends up lying. Counterinsurgent forces that are restricted from forcing civilians

[5] The assumptions made in this section are again consistent with selective post-control retaliations where both groups will not punish someone who did not actively helped their enemies.

to reveal any information and that try to avoid affecting civilians when carrying their operations (high τ) can only rely on increasing their relative military power to attain control, as generally, no civilian would give them voluntarily useful information. In this case, the probability of the counterinsurgents prevailing is just $1 - \beta$. The incentive to force civilians to speak gives one additional way in which violence affects civilians in these conflicts. Civilians will be victims of violence when being forced to say something if one of the sides suspects that they have valuable information that is not being revealed.

Whether forcing civilians to speak is a more convenient choice for the counterinsurgents than just plainly relying on military strength depends on how costly it is for them to execute actions based on false leads. Such costs are not limited to the actual resources spent in the military operations planned with noisy information; they can also include the damage done to innocent civilians while executing those operations. The baseline model captures a conflict environment where these costs are low, as it is the case when paramilitary forces or non-democratic governments are searching for rebel units. In these cases, the costs related to violent extraction of information and messy operations are lower than when democratic governments are held accountable by the general public for civilians' casualties and ineffective attacks.

5 Concluding Remarks

This is the first model of conflict in a limited information environment that focuses on the individuals' decisions to provide cooperation under the threat of violence. The formal study of the micro-dynamics of irregular conflicts is growing, but so far attention has been almost exclusively directed at the internal organization of rebel groups and their tactics. The importance of civilians in these types of conflicts demands an examination of how they act under the conditions of extreme uncertainty and high stakes of irregular wars.

The model's results highlight the complementary nature of short and medium term expectations of territorial control when applying coercive violence. To entice cooperation, counterinsurgent forces that are militarily strong still need to make civilians believe that they will be able to punish past defectors with precision. For people to think that these selective post-control punishments are possible, they need to believe that control by the counterinsurgents will not be short-lived.

Counterinsurgent forces that have to rely mainly on voluntary cooperation or that are part of a temporary occupation army with a fixed deadline to leave the area of operations appear to have a serious disadvantage when trying to obtain information from civilians. It is worth mentioning, however, that the model does not explore how non-coercive methods affect civilians' cooperation choices, and future work should explore how the provision of public goods and other non-coercive tactics can be effectively applied when the use of violence against civilians is not a viable option.

Future work should also continue to study under what conditions indiscriminate reprisals can be consistent with a rational strategy of an armed group that tries to maximize information sharing by civilians. We saw that there are reasons to believe that there is a complementarity between the use of pre-control indiscriminate violence and threats of post-control selective punishments. Forcing civilians to leave their place of residency by applying indiscriminate violence can increase the cooperation of those who stay. Similarly, we can think that indiscriminate violence is used whenever an armed group expects the equilibrium probability of cooperation to be low. If rebels who live among the population are harmed and captured in greater numbers through the use of indiscriminate violence than what they are by relaying on expected civilians' information, then indiscriminate violence would be likely used. It is important to emphasize that indiscriminate violence should occur before it has been decided which group takes territorial control. The model indicates that post-control indiscriminate violence on the other hand is always ineffective relative to selective retaliations. This suggest that instances where indiscriminate reprisals have occurred after groups have taken territorial control could be explained by factors that inhibit optimal behavior within armed groups (Kalyvas, 2006; Weinstein and Humphreys, 2006; Weinstein, 2007).

Proofs

Proof of Lemma 1. Notice that n^c_{-i} follows a binomial distribution with parameters $(N-1,p)$. Using the fact that $E_{n^c_{-i}|p}[n^c_{-i}] = (N-1)p$ and $E_{n^c_{-i}|p}[(n^c_{-i})^2] = (N-1)p(1-p) + ((N-1)p)^2$, we can see that the first term of $\Psi(p)$ is

$$\left(1-\frac{1}{N}\right)\left(p^2(2-\delta^c-\delta^r)\beta\left(1-\frac{2}{N}\right)+p\left((1-\delta^c)-\beta(2-\delta^c-\delta^r)\left(1-\frac{1}{N}\right)\right)\right).$$

Since $\beta > 0$ and $\delta^c + \delta^r < 2$, this expression reaches a global minimum at $p_{\min}$. □

Proof of Proposition 1. Note that with a finite population

$$\Psi(0) = \frac{1}{N}\left(1-\beta(1-\delta^r)\left(1-\frac{1}{N}\right)\right) > 0$$

and that, since $F(.)$ is strictly increasing, $F(\Psi(0))$ is positive. Also it is easy to check that

$$\Psi(1) = (1-\delta^c)\left(1-\frac{1}{N}\right)\left(1-\frac{\beta}{N}\right)+\frac{1}{N} \leq 1 \tag{4}$$

and therefore, $F(\Psi(1)) \leq 1$. Since $F(.)$ is convex, it is continuous and by the continuity of $F(\Psi(.))$, there is at least one fixed point of $F(\Psi(.))$ in $(0,1]$.

Next, I show the second statement of the proposition. Using (4), note that if $\beta > 0$ then $F(\Psi(1))$ is strictly less than 1. If $\delta^r+\delta^c < 2$, by Lemma 1 and by the fact that the second and third terms in the left hand side of inequality (2) are linear in p, $\Psi(.)$ is quadratic in p and has a global minimum. Since $\Psi(.)$ and $F(.)$ are both convex, $F(\Psi(.))$ is also convex, and both $\Psi(.)$ and $F(\Psi(.))$ reach their global minimums at the same point, $p'_{\min}$. If $p'_{\min} < 0$, $F(\Psi(.))$ is monotonically increasing with no inflection points in [0,1], so there is only one point where $F(\Psi(.))$ and the identity function intersect. If $p'_{\min} > 0$ and $F(\Psi(p'_{\min})) > p'_{\min}$, $F(\Psi(.))$ and the identity function cannot intersect in $[0,p'_{\min}]$, but by the same argument as in the previous case, they intersect at one point in $(p'_{\min},1]$. If $F(\Psi(p'_{\min})) \leq p'_{\min}$, $F(\Psi(.))$ is monotonically decreasing in $[0,p'_{\min}]$ and, therefore, $F(\Psi(.))$ and the identity function intersect at one point. By the convexity of $F(\Psi(.))$, there cannot be any other intersection between those two functions in $(p'_{\min},1]$. If $\delta^r+\delta^c = 2$, $F(\Psi(.))$ is constant and equal to $F(\frac{1}{N})$ and so, the unique equilibrium probability is $F(\frac{1}{N})$.

Finally, if $\beta = 0$, $F(\Psi(.))$ can be 1 (when $\delta^c = 0$) and there would be an equilibrium with complete cooperation. Convexity of $F(\Psi(.))$ guarantees that there is at most one additional equilibrium in (0,1). □

Proof of Proposition 2. If in equilibrium $p = 1$, this implies $F(\Psi(1)) = 1$ and, given that $F(.)$ is a one to one function and that $F^{-1}(1) = 1$, this is equivalent to $(1-\delta^c)\left(1-\frac{\beta}{N}\right) = 1$.

Since both δ^c and β are in $[0,1]$, they have to be both zero. If δ^c and β are 0, using (2) we get $\Psi(p) = p\left(1-\frac{1}{N}\right)+\frac{1}{N}$. Expression (3) is satisfied with $p=1$. $\square$

Proof of Proposition 3. Applying the Implicit Function theorem we see that

$$\frac{dp}{dx} = -\frac{F'(\Psi(p))\frac{\partial\Psi(p)}{\partial x}}{F'(\Psi(p))\frac{\partial\Psi(p)}{\partial p}-1}$$

for p in $(0,1)$ and x being any exogenous variable in the model. In equilibrium the denominator in the right hand side of the previous expression is negative. If not, the convexity of $F(\Psi(p))$ would be violated. Therefore, $\frac{dp}{dx}$ and $\frac{\partial\Psi(p)}{\partial x}$ have the same sign.

To prove the first statement of the proposition note that

$$\begin{aligned}
\frac{\partial\Psi(p)}{\partial\beta} &= p(1-\delta^c)\left(p\left(1-\frac{2}{N}\right)-\left(1-\frac{1}{N}\right)\right)+(1-\delta^r)\left(p^2\left(1-\frac{2}{N}\right)-p\left(1-\frac{1}{N}\right)+\frac{2p-1}{N}\right)\\
&\leq p(1-\delta^c)\left(p\left(1-\frac{2}{N}\right)-\left(1-\frac{1}{N}\right)\right)+(1-\delta^r)\left(p^2\left(1-\frac{2}{N}\right)-p\left(1-\frac{1}{N}\right)+\frac{p}{N}\right)\\
&= p(1-\delta^c)\left(p\left(1-\frac{2}{N}\right)-\left(1-\frac{1}{N}\right)\right)+p(1-\delta^r)\left(1-\frac{2}{N}\right)(p-1)\\
&\leq 0.
\end{aligned}$$

As for the second statement, we see that

$$\frac{\partial\Psi(p)}{\partial\delta^r} = \beta\left(1-\frac{1}{N}\right)\left(p\left(1-\frac{3}{N}\right)-p^2\left(1-\frac{2}{N}\right)+\frac{1}{N}\right)\geq 0$$

and

$$\frac{\partial\Psi(p)}{\partial\delta^c} = -p\left(1-\frac{1}{N}\right)\left(p\left(1-\frac{2}{N}\right)+1-\beta\left(1-\frac{1}{N}\right)\right)\leq 0.$$

$\square$

Proof of Proposition 4. The objective function of an aggregate welfare maximizer is:

$$\sum_{i\in C}\frac{n^c}{N}\left(\beta\left(1-\frac{n^c}{N}\right)\delta^r+1-\beta\left(1-\frac{n^c}{N}\right)\right)+\sum_{i\in -C}\left(\frac{n^c}{N}\left(\beta\left(1-\frac{n^c}{N}\right)+\left(1-\beta\left(1-\frac{n^c}{N}\right)\right)\delta^c\right)+E[b_i]\right)$$

Where C and $-C$ denote the set of individuals that cooperate with the counterinsurgents and the set of the ones who do not, respectively. Since $E[b_i]$ is a constant in $(0,1)$ for all i, which I will call $E[b]$, and all other terms in the parentheses that multiply n^c are less than or equal than 1, it follows that

$$\frac{n^{c2}}{N}\left(\beta\left(1-\frac{n^c}{N}\right)\delta^r+1-\beta\left(1-\frac{n^c}{N}\right)\right)+\frac{(N-n^c)n^c}{N}\left(\beta\left(1-\frac{n^c}{N}\right)+\left(1-\beta\left(1-\frac{n^c}{N}\right)\right)\delta^c\right)$$
$$+(N-n^c)E[b]\leq n^c+(N-n^c)E[b]=NE[b]+n^c(1-E[b]).$$

If we evaluate the objective function at $n^c=N$, we obtain N, which is the maximum of the function $NE[b]+n^c(1-E[b])$. Also, since $NE[b]+n^c(1-E[b])<N$ for all $n^c\neq N$, the objective function will be strictly less than N for all those values of n^c. We conclude that the unique maximizer of the objective function is $n^c=N$. □

Proof of Proposition 5. If rebels are applying indiscriminate violence with an associated probability of $1-\widetilde{\delta}^r$ and the counterinsurgents are also using indiscriminate violence with an associated probability of $1-\widetilde{\delta}^c$, the new expected payoffs for revealing information to the counterinsurgents and the ones for lying are

$$U_i(c)=E_{n^c_{-i}|p}\left[\frac{n^c_{-i}+1}{N}\left(\beta\left(1-\frac{n^c_{-i}+1}{N}\right)\widetilde{\delta}^r+\left(1-\beta\left(1-\frac{n^c_{-i}+1}{N}\right)\right)\widetilde{\delta}^c\right)\right],$$
$$U_i(-c)=E_{n^c_{-i}|p}\left[\frac{n^c_{-i}}{N}\left(\beta\left(1-\frac{n^c_{-i}}{N}\right)\widetilde{\delta}^r+\left(1-\beta\left(1-\frac{n^c_{-i}}{N}\right)\right)\widetilde{\delta}^c\right)\right]+b_i.$$

Then, civilian i gives truthful information to the counterinsurgents if and only if

$$\widetilde{\Psi}_1(p)\equiv\frac{\widetilde{\delta}^c}{N}-\frac{\beta}{N}(\widetilde{\delta}^c-\widetilde{\delta}^r)\left(1-\frac{1}{N}\right)(1-2p)\geq b_i.$$

It can be shown that there is at least one probability of cooperation that satisfies the fixed point equation $F(\widetilde{\Psi}_1(p))=p$.

Now, if the rebels use indiscriminate violence while the counterinsurgents use selective violence with an associated probability of punishment of $1-\delta^c$ the expected payoffs are

$$U_i(c)=E_{n^c_{-i}|p}\left[\frac{n^c_{-i}+1}{N}\left(\beta\left(1-\frac{n^c_{-i}+1}{N}\right)\widetilde{\delta}^r+\left(1-\beta\left(1-\frac{n^c_{-i}+1}{N}\right)\right)\right)\right],$$
$$U_i(-c)=E_{n^c_{-i}|p}\left[\frac{n^c_{-i}}{N}\left(\beta\left(1-\frac{n^c_{-i}}{N}\right)\widetilde{\delta}^r+\left(1-\beta\left(1-\frac{n^c_{-i}}{N}\right)\right)\delta^c\right)\right]+b_i.$$

Civilian i cooperates with the counterinsurgents if and only if

$$\widetilde{\Psi}_2(p) \equiv p^2\beta(1-\delta^c)\left(1-\frac{1}{N}\right)\left(1-\frac{2}{N}\right)+p\left(1-\frac{1}{N}\right)\left((1-\delta^c)\left(1-\beta\left(1-\frac{1}{N}\right)\right)+\frac{2\beta}{N}(1-\widetilde{\delta}^r)\right)$$
$$+\frac{1}{N}\left(1-\beta(1-\widetilde{\delta}^r)\left(1-\frac{1}{N}\right)\right) \geq b_i.$$

Following the proof of Proposition 1, it can be shown that there is at least one probability of cooperation that solves $F(\widetilde{\Psi}_2(p)) = p$.

Note that

$$\widetilde{\Psi}_2(p) - \widetilde{\Psi}_1(p)\mid_{\widetilde{\delta}^c=1} = p^2\beta(1-\delta^c)\left(1-\frac{1}{N}\right)\left(1-\frac{2}{N}\right)+p\left(1-\frac{1}{N}\right)\left((1-\delta^c)\left(1-\beta\left(1-\frac{1}{N}\right)\right)\right) \geq 0.$$

This shows that the largest probability of cooperation obtained in any equilibrium when counterinsurgents use selective violence is as high as the one obtained when they do not punish anyone and when the rebels use indiscriminate violence. Since $\frac{\partial \widetilde{\Psi}_1(p)}{\partial \widetilde{\delta}^c} > 0$, this shows that for all δ^c, $\widetilde{\delta}^c$ and $\widetilde{\delta}^r$, cooperation under selective violence is at least as high as cooperation under indiscriminate violence when rebels use indiscriminate violence as well.

Following the same steps above, it can be shown that $\Psi(p)\mid_{\delta^c=1} - \widetilde{\Psi}_3(p)\mid_{\widetilde{\delta}^c=1} = 0$, where $\widetilde{\Psi}_3(p)$ is the expected gain of cooperating with the counterinsurgents when the rebels use selective violence and the counterinsurgents use random violence. Since, as part of the proof of Proposition (3) we saw that $\frac{\partial \Psi(p)}{\partial \delta^c} \leq 0$ and since $\frac{\partial \widetilde{\Psi}_3(p)}{\partial \widetilde{\delta}^c} > 0$, the proposition is proved. □

Proof of Proposition 6. I first check that there is an equilibrium with no cooperation when $\delta^r < 1$, $\beta > 0$, and τ is high. In such an equilibrium $n^c = 0$, and therefore, someone who remains silent would do so (rather than lying to the counterinsurgents) if and only if the following inequality holds:

$$E_{n^c,n^o|p,p^o}\left[\frac{\tau(n^o_{-i}+1)}{N}\right] \geq E_{n^c,n^o|p,p^o}\left[\frac{\tau n^o_{-i}}{N}(\beta+\delta^c(1-\beta))\right] + b_i.$$

This expression is equivalent to

$$\widetilde{\Psi}_o(p^o) \equiv p^o\tau\left(1-\frac{1}{N}\right)(1-\beta)(1-\delta^c)+\frac{\tau}{N} \geq b_i.$$

We can check that $F(\widetilde{\Psi}_o(0)) \geq 0$ and $F(\widetilde{\Psi}_o(1)) < 1$. By continuity and convexity of $F(\widetilde{\Psi}_o(.))$ there is only one p^o in $[0,1)$ that satisfies $F(\widetilde{\Psi}_o(p^o)) = p^o$. For this to be an equilibrium probability it is also required that no one who remains silent has an incentive to deviate to cooperating. Such condition is captured by the following inequality

$$E_{n^c,n^o|p,p^o}\left[\frac{\tau(n^o_{-i}+1)}{N}\right] \geq E_{n^c,n^o|p,p^o}\left[\frac{\tau n^o_{-i}+1}{N}\left(\beta\left(1-\frac{1}{N}\right)\delta^r+1-\beta\left(1-\frac{1}{N}\right)\right)\right],$$

which is equivalent to

$$\Upsilon(\tau) \equiv \frac{\tau((N-1)p^o(\tau)+1)}{N} - \frac{\tau(N-1)p^o(\tau)+1}{N}\left(\beta\left(1-\frac{1}{N}\right)\delta^r+1-\beta\left(1-\frac{1}{N}\right)\right) \geq 0.$$

Following the initial steps of the proof of Proposition 3 one can show that $\frac{\partial p^o}{\partial \tau} > 0$. Moreover, $\Upsilon(0) < 0$ and $\Upsilon(1) > 0$, and $\frac{\partial \Upsilon(\tau)}{\partial \tau} > 0$, so there is a $\widetilde{\tau}$ in $(0,1)$ such that for all $\tau > \widetilde{\tau}$, there will be a unique equilibrium in which no one cooperates and in which people remain silent with probability p^o.

Now I proof the second statement of the proposition. In any equilibrium in which the expected utility of cooperation is strictly larger than the expected utility of remaining silent, no one would remain silent and a civilian would cooperate if and only if (2) holds. Therefore, the highest probability of cooperation would be the same as the one obtained in the baseline model.

If civilians are indifferent between cooperating and remaining silent and some of them cooperate in equilibrium the following equality needs to hold

$$E_{n^c,n^o|p,p^o}\left[\frac{\tau(n^o_{-i}+1)+n^c_{-i}}{N} - \frac{\tau n^o_{-i}+n^c_{-i}+1}{N}\left(\beta\left(1-\frac{n^c_{-i}+1}{N}\right)\delta^r+1-\beta\left(1-\frac{n^c_{-i}+1}{N}\right)\right)\right] = 0. \tag{5}$$

After taking the expectation and calculating the partial derivative of the left hand side of this inequality with respect to p^o we obtain

$$\left(1-\frac{1}{N}\right)\tau\beta(1-\delta^r)\frac{1}{N}.$$

This expression is strictly positive for $\delta^r < 1$, $\beta > 0$, and $\tau > 0$. When the expression is positive an increase in the probability of remaining silent has to be offset by a reduction of the probability of cooperating to ensure that (5) holds. The maximum probability of cooperation in any equilibria in which civilians are indifferent between cooperating and remaining silent will be obtained then when no one cooperates. If either $\beta = 0$ or $\delta^r = 1$ the expected utility of cooperating is strictly larger than the expected utility of remaining silent and therefore, we again would obtain a cooperation probability that is the same as the one in the baseline model. Finally, if $\tau = 0$ and civilians are indifferent between cooperating and remaining silent, the probability of cooperation satisfies the equation $F(\Psi(p^c))-p^o = p^c$ and therefore is less than or equal that the one in the original game. $\square$

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