Economic development, insurgency, and civil war*

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Abstract

The most common form of civil war in the post-World War II period has been a stalemated guerrilla war confined to a rural periphery of a low-income, post-colonial state. Standard contest models of conflict do not capture important and distinctive features of insurgency, and in particular the fact that guerrilla survival depends on their controlling information about who and where they are. I present a game model in which rebel control of territory depends on how many remain uncaptured by government forces. Capture becomes more likely as the rebel movement expands, due to network connections among the rebels. The model explains how and why insurgencies can remain stalemated at low levels of conflict. It also shows that standard explanations for the strong cross-national association between poverty and civil war risk – for example, that poverty makes joining a rebel band a more attractive option or that risk aversion makes the rich more fearful of conflict – are incoherent or incorrect as typically stated. I argue that more plausible explanations for the empirical regularity pose an indirect link, via the association of high income with (a) natural and social terrains inimical to guerrilla hiding, (b) possibly state military capability to conduct more efficient counterinsurgency, and (c) inability to appropriate as large a share of income through house-to-house visits by guerrillas, due in part to the mobility of human capital.

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1 Introduction

Civil war has been by far the most common and destructive form of violent military conflict in the last 60 years. About 40% of countries with a 1990 population of at least half a million have had at least one internal conflict that killed at least 1,000 people. A large number of countries have had conflicts that killed tens or even hundreds of thousands. Civil war has been the major cause of forced migrations in this period, which have produced many millions of refugees. Overall, the damage to the health, economies and lives of the survivors has been massive (Ghobarah, Huth and Russett 2003).

A growing empirical literature has established a range of interesting facts and regularities about civil war since 1945, including the following.

First, most civil wars in this period have been fought as guerrilla conflicts in which state counterinsurgent forces hunt for small, lightly armed rebel units operating in rural areas, often in rough terrain. Guerrillas tend to "control the night," while government forces operate by day and in urban strongholds in the war-affected region of the country. There are no clear front lines. Rebel units seek to ambush government units, assassinate or intimidate local government officials and other perceived collaborators, and to raise funds by collecting "revolutionary taxes" of various sorts (for example, from peasants or from businesses). Government forces may threaten or bribe locals for information about rebels, set up paramilitary "village guard" units, force peasants into "strategic hamlets," or massacre whole villages suspected of aiding or being sympathetic to the rebels. This pattern has been visible in Vietnam, Guatemala, El Salvador, Columbia, Algeria, Philippines (NPA and in Mindanao), southeast Turkey, Peru, northeast India, Burma, Thailand, Kashmir, Nepal, Indonesia (Aceh and East Timor), Mozambique, Sierra Leone, Sudan, and many other places.

Conflicts akin to the U.S. Civil War in which conventional armies fight along well-defined fronts have been quite rare. The Biafran war is the clearest instance. Still, in accord with Mao's doctrine of "people's war," the later stages of some civil wars that began as guerrilla conflicts have tended in this direction (e.g., China 1945-49, Afghanistan, Ethiopia, and Uganda 1981-86). Another occasional pattern is conflict between militias organized on ethnic or regional lines (e.g., Lebanon, Turkey 1977-80, Bosnia, Tajikistan), although these have similarities and overlaps with both guerrilla and conventional civil wars.[1]

A second striking regularity is that poor countries have been much more likely to have civil wars than richer countries. Figure 1 shows how the frequency of civil war outbreaks has varied with per capita income for 161 countries observed between 1945 and 1999 (using data from Fearon and Laitin 2003). Of the richest fifth of the country years in the sample, only about 1.5% had a civil war erupt within the next five years. By contrast, among the poorest fifth of country years, 14.3% had a civil war start in the next five years.

[Figure 1 about here]

Moreover, per capita income is the single best predictor of a country's odds of civil war outbreak, empirically dominating other factors that one might have expected to do better, such as level of democracy, degree of ethnic or religious diversity or nature of ethnic demography, or level of income inequality (Fearon and Laitin 2003).[2] Indeed, after controlling for income, none of these factors have any added purchase.

There are at least two important theoretical puzzles raised by these facts and regularities. First, how to explain what is probably the modal civil war in this period – a persistent,

[1]See Kalyvas (2004) for a discussion of types of civil warfare that makes a similar set of distinctions.

[2]The finding that level of economic development is a strong (typically the strongest along with total population) correlate of violent civil strife is one of the most robust in the growing large-N literature on the subject. Some scholars used related variables such as life expectancy, education levels, or per capita energy consumption, which are closely correlated with per capita income and plausibly tap a common underlying dimension of level of economic development. See for examples Collier and Hoeffler (2004), Fearon and Laitin (2003), and Hegre and Sambanis (2006).

small, stalemated guerrilla conflict? What prevents government and rebel groups from cutting deals that would allow them to avoid the enormous costs? Second, what explains the strong association between low per capita income and high civil war risk?

I address these questions with the help of a game model in which a government and a rebel leadership simultaneously choose how many soldiers and rebels to conscript or recruit. Counterinsurgency by government forces then yields the capture or death of a fraction of the rebel group. Uncaptured rebels proceed to tax peasants or businesses in their region of operation, and to exclude the government from collecting taxes.

The model is related to the "contest models" that Grossman (1991, 2002), Hirshleifer (1995), Skaperdas (1992) and other economists have used to analyze violent conflict, but it differs in two significant respects. First, in standard formulations, contest models of conflict do not actually have any violence in them. No one can get killed or captured. In some models, conflict is assumed to destroy resources, which can be interpreted as an effect of violence. But the implications of conflict for individual fighters are not modelled, making it impossible to analyze individual decisions to participate, or the trade off between risk and potential reward of becoming a rebel. This is a significant liability when the most common "explanations" for why low-income countries are civil-war prone hold that poor young males find the option of rebellion more attractive, or that poor people are generally more aggrieved.

Second, in typical contest models almost all the explanatory action is built into the "contest success function," which relates the players' fighting efforts to the final distribution of resources. By separating the extraction of resources from the violent interaction between government and rebel forces, the model here takes a step towards "unpacking" or opening up the standard contest success function.

One benefit of this approach is that it forces us to consider what is distinctive about the mechanisms of violence in insurgency. I argue that in contrast to ordinary crime and conventional military confrontations, mafias and insurgencies face the problem that adding more fighters raises the risk of detection and thus capture for *all existing* fighters. In practice, the central problem of counterinsurgency is not to marshal adequate forces to defeat rebel units, but to gain good intelligence on who and where the active rebels are. If rebels are linked to each other, then adding more increases risks of infiltration, betrayal, and detection for large parts of the organization. I argue that this information externality of adding more members provides a natural explanation for "diminishing returns" to guerrilla warfare, which is in turn necessary to explain how this kind of deadly conflict can remain small, stable, and stalemated.

On the question of why poor countries are civil-war prone, I argue that common arguments in the empirical literature on civil war do not work. One of the main obstacles is that although richer people may have more to lose from civil strife, the fact that there is more wealth around to tax or appropriate also means that there is more to be gained by fighting. Conversely, if there is relatively little to fight for, as in an impoverished country, why fight? In contest models, the bigger the "pie," the greater the equilibrium fighting efforts. This problem tends to undermine one of the most popular arguments proposed in the empirical literature on civil war, namely, that poverty makes for civil war because in poor countries there are more poor, underemployed people who find rebellion attractive as a "job" (e.g., Collier and Hoeffler (2004)).

A possible reply holds that while there may be more to gain from rebellion in a wealthier economy, "diminishing marginal utility," or risk aversion, means that greater per capita income makes citizens less willing to run risks of capture or death in a civil conflict. I show that by itself this assumption does not solve the puzzle either. One needs to make a stronger assumption about preferences, namely that richer people are *relatively more risk averse* than poorer people. Empirical support for this stronger assumption appears to be mixed and ambiguous; at any rate it is certainly not a clear and powerful regularity.[3]

In the models presented below, the equilibrium level of insurgency and counterinsurgency is strongly influenced by the rebels' ability to collect taxes and by the government's ability to capture rebels. I argue that a plausible and internally coherent explanation for the empirical regularity is that in rich countries, large amounts of the income being generated is not easily "taxed" using simple extortion, and in poor countries rebels can more easily evade capture at given force levels, due to terrain, informational advantages of rural village as opposed to urban settings, and possibly government incompetence in running effective counterinsurgency campaigns.

In the next section I introduce a simple contest model applied to civil war, and show why it produces no "first order" result linking poverty and civil war risk. In Section 3 I discuss differences between the strategic logics of ordinary crime, mafias, insurgencies, and conventional military conflict. The main argument is that as with mafias, adding new rebels to a small insurgency increases detection and denunciation risks for existing rebels, due to their network connections. Section 4 uses this argument in a model that explicitly represents the government's efforts to capture and kill rebels. Section 5 returns to the question of civil war risk and per capita income, modifying the model to allow for the recruitment of risk-averse rebels rather than conscription. Section 6 considers why more efficient peace deals are not obtainable in equilibrium in the model, and obstacles to efficiency in the case where government and rebels interact over time and thus could in principle support cooperation by implicitly threatening to return to conflict.

[3]One might "get" a certain amount of risk-seeking behavior by the poorest of the poor if one assumes that starvation is the likely alternative to joining a rebel band, but it seems implausible that this could explain much of the civil war we have seen in the last 60 years. Grossman and Mendoza (2003) develop essentially this argument to explain some anthropological observations of an association between resource scarcity and increased conflict in premodern societies where starvation was common.

2 Contest models of civil conflict

In this section I present a simple contest model applied to civil conflict, and discuss its main implications and liabilities.

Consider a game with two strategic players, a government G and a rebel leadership R. They interact in a society with a continuum of individuals (normalized to size 1), each of whom has pre-tax income $y > 0$. Total potential tax revenues are thus ty, where $t \in [0, 1]$ is a fixed tax rate.[4] Suppose that R and G simultaneously choose to conscript $\alpha \in [0, 1]$ and $\beta \in [0, 1]$ rebels and soldiers, respectively, at marginal costs c_R and c_G.[5] Let the "contest success function" be $p(\alpha, m\beta)$, which gives the share of tax revenue controlled by R when the force sizes are α and β. $m > 0$ is a parameter scaling the effectiveness of counterinsurgency. Rebel and government utility functions are then

$$\begin{aligned} u_R(\alpha, \beta) &= p(\alpha, m\beta)ty(1 - \alpha - \beta) - c_R\alpha \text{ and} \\ u_G(\alpha, \beta) &= (1 - p(\alpha, m\beta))ty(1 - \alpha - \beta) - c_G\beta. \end{aligned}$$

The standard assumption is that, holding the other side's force level constant, more rebels or more soldiers gets one more territory and tax revenue, though at a diminishing rate ($p_1 > 0$, $p_{11} < 0$, $p_2 < 0$, and $p_{22} > 0$).

Little more than inspection of the utility functions is necessary to understand how varying per capita income will affect equilibrium levels of conflict. Notice that increasing y (without changing anything else) increases the marginal returns to rebellion for R, and to

[4] We could assume that individuals can hide their income at marginal cost $h \in (0, 1)$, in which case government and rebels optimally set tax rates at $t = h$.

[5] For completeness assume that if R and G choose α and β such that $\alpha + \beta > 1$, then their realized force sizes are $\alpha' = \alpha/(\alpha + \beta)$ and $\beta' = \beta/(\alpha + \beta)$ respectively. This is unimportant however since α and β such that $\alpha + \beta > 1$ cannot be best replies given the utility functions below.

counterinsurgency for G. That is, if $\alpha(\beta)$ was R's optimal force size given β before increasing y, then diminishing returns ($p_{11} < 0$) implies that after increasing y, $\alpha(\beta)$ will be larger.[6] The same logic holds for G, and the net effect in equilibrium is that higher y implies that a higher percentage of the population will be employed as rebels and soldiers fighting them.

This is the exact opposite of the empirical regularity, but it is a general feature of contest models (including wars of attrition). On first glance it does have a certain logical appeal. Isn't it natural to think that rational actors would fight harder and more for a bigger prize? Don't scholars in the civil war literature routinely "explain" the association between oil production (or other natural resources) and civil war by arguing that these increase the value of winning? Why wouldn't the same be true of the size of the economy?

On a second glance, it should be noted that increasing per capita income y while holding constant c_R and c_G is equivalent to saying that the marginal cost of conscripting, feeding, and supplying combatants is lower in rich countries. Not surprisingly, if it is effectively cheaper to man armed forces, equilibrium levels of conflict will be higher. But surely these costs would be *higher* in richer countries. If we assume that they increase proportionally with income – say the marginal cost of conscription is $c_i y$ instead of c_i, $i \in \{G, R\}$ – then varying income clearly has zero effect on equilibrium levels of conflict. In this case, we can divide y out of the utility functions above without changing R or G's incentives at all.

This result travels across a variety of alternative specifications. For example, suppose that G and R have to hire labor rather than conscript it. Since the model as it stands does not involve any risk of death or jail for combatants, both G and R can offer a wage of $w = y$ (or infinitesimally more) to attract fighters, and this clearly leads to equilibrium levels of α and β being independent of y. Or suppose that incomes vary in the population, with y_i distributed by a cumulative distribution function F. If the shape of F does not change as

[6] Diminishing returns also ensures that $\alpha(\beta)$ is unique.

per capita income $\bar{y}$ changes, we can again factor $\bar{y}$ out of the expressions for u_G and u_R, meaning that income level does not affect any marginal trade-offs and thus equilibrium force sizes.

To be more specific, let $w = (1-t)F^{-1}(\alpha+\beta)$ be the market-determined wage for rebels and soldiers when R hires α rebels and G hires β soldiers (for simplicity I am assuming that neither rebels nor soldiers pay taxes). At this wage, the $\alpha+\beta$ poorest fraction of the society prefers to sign up on one side or the other, while the $1-\alpha-\beta$ richer (or more productive) fraction prefers to work in the regular economy. $u_R(\alpha,\beta)$ then becomes $p(\alpha, m\beta)t\int_{\alpha+\beta}^{1} F^{-1}(z)dz - w\alpha$. To examine the effect of changing per capita income without changing anything else (such as the shape of the income distribution), we define $F_0(y/\bar{y}) = F(y;\bar{y})$ as the "base" distribution. Then the market clearing condition becomes $\alpha+\beta = F(\frac{w}{1-t};\bar{y}) = F_0(\frac{w}{\bar{y}(1-t)})$, and thus $w = \bar{y}(1-t)F_0^{-1}(\alpha+\beta)$. Using $F^{-1}(z) = \bar{y}F_0^{-1}(z)$, substitution into u_R yields

$$u_R(\alpha,\beta) = p(\alpha, m\beta)t\int_{\alpha+\beta}^{1} \bar{y}F_0^{-1}(z)dz - \bar{y}(1-t)F_0^{-1}(\alpha+\beta)\alpha.$$

Per capita income can be factored out of the rebel group's preferences without affecting any trade offs, and so does not affect equilibrium force levels. The same is true for the government.

Changing the *shape* of the income distribution does affect incentives for rebellion and counterinsurgency in the basic contest model. Holding per capita income constant while increasing inequality lowers marginal recruitment costs for both government and rebels, since there are more relatively poor people around and the total tax base is the same. Thus, greater inequality associates with higher equilibrium force levels.[7] In principle this could

[7]But not necessarily greater inefficiency, which in this model comes from the fact that rebels and soldiers are not producing what they could. Greater inequality at a given per capita level means that there are more

help explain the empirical regularity if richer countries are systematically more equal than poorer countries. The ambiguous empirical support for the Kuznet's curve suggests that there is some tendency in this direction, but it is not very strong. Also, as noted above, more unequal countries have not been more prone to civil war in the last 60 years, at least using standard cross-national inequality measures.

On the other hand, this analysis suggests that the "bigger prize" argument for why oil producers appear to have been more civil war-prone does not work unless recast as an argument about oil making for big inequalities. If oil revenues are monopolized by a small group that controls the state, then $t\bar{y}$ is large relative to the marginal cost of recruiting rebels and soldiers, which favors larger rebellions, according to the model.[8]

To sum up, the contest model approach points to two main effects of per capita income on the propensity for civil conflict. On the one hand, more income means more revenue for rebels to appropriate and government forces to defend. But on the other hand, the marginal costs of staffing a rebel or government force will be greater in a richer country. These effects work in opposite directions, tending to give the result of no net impact. This is a simple point, but I have not seen it stated or explored in the literature applying contest models to conflict.[9]

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rebels and soldiers, but they would have been less productive in the regular economy anyway. Adding direct damage to the economy from conflict would change this, however, and in practice these effects are surely far larger than that of labor displacement.

[8]Fearon and Laitin (2003) and Fearon (2005) argue that oil exports favor civil war by increasing the "prize" value of capturing the state or region, and because, conditional on income level, oil producers tend to have less developed state administrative apparatuses and capabilities. Humphreys (2005) considers a broader array of possible mechanisms. Olsson and Fors (2004) consider a contest model of civil conflict in which the ruler controls natural resource rents; greater resource rents make for more conflict in their model, by the same logic as that described here.

[9]Grossman and Mendoza (2003, 747-48) may be alluding to the issue when they write that "Surprisingly, the commonsensical hypothesis that resource scarcity causes a large allocation of time and effort to appropriative competition is not easy to formalize," and that "there is no reason to presume that in general the relative return to appropriative competition either increases or decreases with the size of the resource endowment."

The basic contest model does suggest two second-order ways that low income might plausibly cause higher equilibrium levels of civil conflict. To see the first, note that the argument above implies that if you give the same amount of counterinsurgency funding to a poor and rich state, the poor state should get a much bigger "bang for the buck" because it would be able to hire (or support) much more labor. Much anecdotal and case-based evidence suggests, by contrast, that richer countries are more efficient at using counterinsurgency funds, either because of higher levels of human capital, training and organizational coherence, or because the strategic and tactical problems are more easily solved in an economically more developed setting (see below), or both.

Second, it could be that individuals and businesses are less able to hide their income from insurgents in poor than in rich countries. The standard "appropriative technology" of insurgency consists of visits to households or businesses to collect revolutionary taxes, often in kind. This may yield a higher share of total product in a society of small-holding peasants than in a world of mega-corporations and mobile, high-income-from-high-human-capital workers. If so, the effective tax rate insurgents can impose would be higher in poor countries. It is easily shown in the contest model that higher tax rates lead to higher equilibrium levels of conflict.[10]

The standard contest model is a highly "reduced form" approach to analyzing conflict. It hides the specifics of the interactions between combatants inside the "black box" of the contest success function. With minor changes, the model could be redescribed as a model of interstate conflict, conflict between animals for territory, between firms for market share,

[10]Along similar lines, external funding from neighboring states and superpowers has been an important source for insurgencies since 1945, acting in a way similar to raising t or lowering c_R in the contest model. Another possible explanation for the concentration of civil wars in poorer countries since 1945 is that civil war has been a form of interstate war by proxy, and that the relative absence of civil war among richer countries is a by product of the factors that have favored interstate peace among richer countries in this period.

between candidates for votes, or between lobbyists for policy. In all such cases, results follow from embedded assumptions about the shape of the contest success function, and in particular the assumption of diminishing returns to effort and an assumption about the specifics of the cross-partial derivative of $p(\cdot,\cdot)$.[11]

The range of application of the contest model is a virtue in that it highlights the strategic similarities of a broad range of political and economic situations. But it can also be a vice if the contest success function obscures important distinctions between types of conflict and violence. In the case at hand, we should not accept without argument that the returns to rebellion are diminishing, which makes possible a stable, interior equilibrium with a low level of insurgency in the contest model above. Many discussions of rebellion assume to the contrary that there are increasing returns, for example, a tipping point beyond which the government will fall. At a minimum we need a developed argument for why the returns to insurgency would be diminishing, and in the contest model approach this will at best be given "off stage."

Below I offer a model that opens up the contest success function, distinguishing between the violent interaction between government and rebel fighters, and the interaction between surviving rebels and peasants over revenue. To justify some important assumptions that go into this model, however, I need first to discuss how the strategic logic of insurgency differs from several other kinds of conflict that have been modelled using contest success functions.

[11]The usual assumption is that $p_{12} > 0$ for $\alpha > m\beta$ and $p_{12} < 0$ for $\alpha < m\beta$. This gives rise to best reply functions that increase and then decrease, and which intersect at an (α, β) such that $\alpha = m\beta$ when $p(\cdot,\cdot)$ is symmetric. (Here and below, f_i denotes the derivative of the function f with respect to argument i, and f_{ij} is the derivative of f taken first with respect to argument i and then with respect to argument j.)

3 Crime, mafias, insurgencies, and conventional warfare

In ordinary property crime, maintaining anonymity is the criminal's core strategy for avoiding arrest. Criminals seek to burgle unseen, to hold up banks wearing masks, or to mug quickly and then disappear into a large, anonymous urban population. They operate as individuals or in very small groups. The central motif of almost all crime drama is the finding and proving of "who done it?"

The strategy of anonymity means that *repeat business* is not an option for ordinary criminals. They cannot repeatedly mug the same people, or return repeatedly to the same store or bank, without being identified and arrested. Mafias are an attempt to solve this problem. Mafia members must make themselves known to the individuals and business owners from whom they extort regular payments. Their strategy for avoiding arrest is then to threaten violent reprisal if their victims denounce them to the police, and in particular if they testify in court. To make such threats credible, a mafia requires, in the first place, an organization. If one member is arrested due to testimony by a victim, there must be other members willing and able to punish the victim.

And given that there must be multiple members, there is a huge premium on loyalty within the organization. Since members know about and participate in the organization's violence and violent threats, *each member poses a denunciation risk to everyone other member*. Thus the sacred oaths, long initiation periods, ethnic and family ties, draconian punishments for suspected informers, and witness protection programs as an anti-racketeering strategy. Whereas increasing the total number of ordinary criminals may increase the expected returns to any given criminal (since police efforts are more diffused), adding mafiosi may decrease the expected returns to existing members because the network connections make for negative externalities regarding infiltration and betrayal.

Because mafiosi necessarily make themselves known to their targets, the problem for police is not primarily in identifying who the mafiosi are, but rather in acquiring solid evidence of criminal activity. They may face problems in locating a mafioso for arrest, but at least in urban environments this is generally not so difficult. One implication is that if the state does not care that much about evidence or due process and its agents are relatively unbribable, mafias cannot survive. Such a state will just kill or throw suspected racketeers in jail. Mafias did not flourish in Eastern Europe and much of the former Soviet Union until after the demise of communist regimes. Mafias require either a political environment with the rule of law and due process, or a state whose agents can be bribed to look the other way (or a combination of the two).

Insurgencies differ from mafias in espousing political goals. They seek either to become the formally recognized government in a region, to replace the current government in the country or to force a change in its policies.[12] Their situation also differs from mafias in that even rule-of-law countries tend to have few scruples about attacking and detaining rebels without full due process. Combined with the fact that insurgencies start out and often remain small and militarily weak relative to government forces, this means that they have to be able to hide from government troops and intelligence. Rural settings with close access to mountains or jungles are thus strongly favored.

But rough terrain is rarely sufficient to allow the survival of a guerrilla band, since the guerrillas must interact with people at least some of the time. They typically draw food and funds in the form of revolutionary taxes on households and businesses, engaging in "repeat business" with the same villages and people.[13] They require locals' information about

[12]There are cases, such as the RUF in Sierra Leone, where it is not clear whether the insurgent leaders are sincere about their political objections, but they nonetheless espouse them.

[13]External funding from neighboring states, the U.S. and U.S.S.R. during the Cold War, or from ethnic diasporas are also quite significant for many insurgencies. See Weinstein (2005) and Hovil and Werker (2005)

government troop movements, and their own movements and activities are partly observed by local noncombatants. This means that a successful insurgency must address the same core problem that mafias face – the risk of denunciation to authorities. And like mafias, insurgents almost invariably threaten and carry out violent punishments against those who denounce (or are said to have denounced), in order to deter others (Kalyvas 1999; Kalyvas 2003). They may also provide more positive inducements to lessen the risk of denunciation, such as ideological training programs, control and discipline of individual rebels who injure civilians, and defense against marauding government troops. But the government's willingness to use force against civilians to acquire information about the rebels tends to quickly draw any rebel group into a competition of threats and violence with respect to noncombatant locals.[14]

As with mafias and in contrast to ordinary crime, adding new members to a small insurgent band raises denunciation and detection risks for the whole organization. More rebel units are more likely to be seen by locals or to try to "tax" individuals who are willing to run the risk of reporting to the government. Because rebels are linked to each other and because in their early stages guerrilla movements depend on being able to hide, the capture of one rebel can favor the capture of more.[15] In addition, monitoring and screening become more difficult as the size of the rebel organization expands. It is reasonable to suppose that the ideological commitment of additional rebels is diminishing (the more intensely committed types are already in the organization), which means that expansion increases the risks of informers, defections, and bad types who raise detection risks by overly abusing

for studies of the implications of external funding for insurgent strategy and tactics, and Byman et al. (2001) for a study of external funding of insurgent groups after the Cold War.

[14]On this process, see for example Leites and Wolf (1970), Stoll (1993), and Kalyvas (2003). See Weinstein (2006) for a more general analysis of the determinants of different modes of rebel organization.

[15]More evidence in favor of this characterization is provided by the cell structures that rebel organizations often use to lessen the network externalities of detection and infiltration.

noncombatants.[16]

In sum, network connections and the need to hide imply that individual rebels may be made *less safe* rather than more safe when the rebel organization increases in size (other things equal).[17] By contrast, ordinary criminals and soldiers in a conventional army are made more safe when more criminals or soldiers are added (holding police or the other military constant). In the case of criminals, police efforts are more diffused. In the case of a conventional military, a bigger army is more likely to win, and at a lower cost in lives.

The model of insurgency in the next section uses the assumption that adding rebels increases the share of the total rebel group that is captured or killed for a given government force size. As noted above, in both Mao's theory and a number of internal conflicts in the last 50 years, small guerrilla movements have grown so large that they were able to reconfigure themselves as conventional military forces able to fight set-piece battles against state armies. A more sophisticated model might incorporate this possibility.

4 A model of insurgency

Again we consider a game with two strategic players, a government G and a rebel leadership R. They compete over control of tax revenues from a continuum of individuals (normalized

[16]Rebel organizations may devote considerable resources to ideological training of recruits (e.g., NPA in the Philippines, Museveni's NRA in Uganda) or use lower tech methods such as requiring recruits to kill soldiers or even members of their own family (to make it very difficult for them to return to their former life).

[17]Here is a very simple illustration of how network connections will tend to make the probability of capture increasing in the size of the organization. Consider a country or region or village with n people, r of whom are active rebels. The government interrogates one person at random, and interrogation reveals if the person is an active rebel for sure. If there are no network connections between rebels at all, then ex ante a rebel's probability of capture is $1/n$. If, due to network connections, capture of any one rebel implies capture of the rest, then ex ante a rebel's probability of capture is r/n, which is increasing in r. A richer version of this set up has the government interrogating s people at random, and an expected share of other rebels captured if the government gets good information from interrogation. Again, individual risk of capture will be increasing in r.

to size 1), each of whom produces pre-tax income $y > 0$ if working in the private sector. Let $\alpha \in [0, 1]$ be the size of the rebel force, and $\beta \geq 0$ be the size of government forces. When there are α rebels and β government soldiers, total tax revenues are $ty(1 - \alpha - \beta)$, where $t \in [0, 1]$ is a fixed tax rate.

The sequence of actions and events in the game are as follows.

1. R and G simultaneously choose to conscript α and β rebels and soldiers, at marginal costs $c_R y$ and $c_G y$, respectively.

2. A fraction of the rebels, $p(\alpha, m\beta)$, are captured or killed by government forces.

3. The remaining rebel force, now of size $\alpha(1 - p(\alpha, m\beta))$, collects revolutionary taxes from a share of the population that is neither a solider nor in the rebel group. Assume that one rebel collects from $\delta > 1$ peasants, so that R's total revenues are the smaller of $ty(1 - \alpha - \beta)$ and $ty\delta\alpha(1 - p(\alpha, m\beta))$.

4. The government collects tax revenues from peasants who are not "controlled" (here, taxed), by rebels. Thus G's total revenues are the larger of zero and $ty(1 - \alpha - \beta - \delta\alpha(1 - p(\alpha, m\beta))$.

Two differences from the standard contest model formulation should be stressed. First, notice that the model separates the interaction between insurgents and counterinsurgents from the interaction between insurgents and locals that produces revenues. Accordingly, $p(\alpha, m\beta)$ is no longer a contest success function. It might instead be called a "capture" or "capture and kill" function, since it relates the size of rebel and government forces to the share of rebels captured or killed.

I assume that $p(\alpha, m\beta)$ is increasing in *both* its arguments. This is uncontroversial for β, since this just means that more government forces capture or kill a larger share of a given rebel force. The assumption that the share captured or killed increases with the size of the *rebel* force follows on the argument given above, that denunciation and detection are critical for rebel losses, and are harder to prevent as force size grows, other things equal.

A second feature worth noting is the assumption that the rebels' tax collection technology has constant returns to scale up to the point at which the whole region is controlled by the rebels. One can imagine arguments for why there would be increasing returns (e.g., government is a natural monopoly), or decreasing returns (e.g., eventually there must crowding, as occurs in this model), or perhaps increasing then decreasing returns. I don't see a decisive consideration one way or the other. Clearly, though, one way to "get" decreasing returns to rebellion would be to simply assume that the rebel's collection technology has quickly decreasing returns to scale, whereas the government's does not.

Let $k(\alpha, m\beta) = \alpha p(\alpha, m\beta)$ be the number (measure) of rebels captured or killed when the initial force sizes are α and β. Rebel and government utility functions are thus

$$u_R(\alpha, \beta) = ty \min\{1 - \alpha - \beta, \delta(\alpha - k(\alpha, m\beta))\} - c_R y \alpha \quad (1)$$

$$u_G(\alpha, \beta) = ty \max\{0, 1 - \alpha - \beta - \delta(\alpha - k(\alpha, m\beta))\} - c_G y \beta. \quad (2)$$

For the comparative statics results discussed below, I make three additional assumptions about the rate of change of the number killed or captured as force sizes vary; these assumptions parallel those made in typical contest-model formulations. They are:

1. $k_{11} > 0$ when $\beta > 0$: The number captured increases at an increasing rate as R adds rebels, for given (positive) government force size. By the arguments about network connections and the strategy of hiding given in section 3, this is plausible, at least over the range where guerrilla tactics of hiding and hit-and-run attacks are necessary for

the rebels. For instance, the assumption implies that adding more mafiosi increases the number prosecuted at an increasing rate.

2. $k_{22} < 0$ when $\alpha > 0$: The number captured increases at a decreasing rate as G increases the number of police/soldiers, for a given number of rebels. More soldiers or police are more likely to get good information about rebel unit whereabouts, or are more likely to encounter them at random, but the "returns" are diminishing.

3. $k_{12} > 0$: The effect of increasing government forces on the number captured is higher when the number of rebels is larger. Or likewise, the effect of increasing the number of active rebels on the number captured increases as there are more soldiers/police. (For instance, more FBI focused on the mafia means that adding more mafia becomes more dangerous for the mafia as a whole.)[18]

Analysis. Figure 2 displays the rebel leadership's and government's best reply functions for the type of case of interest here – that is, when the government has counterinsurgency capabilities sufficient to prevent its overrun by the rebel group. $\alpha(\beta)$ is the rebel leadership's optimal force size if there are β counterinsurgency personnel, and $\beta(\alpha)$ is the government's optimal force size if there are α rebels. Nash equilibrium levels are at the intersection (α^*, β^*). For readability the graph's x and y limits are "clipped" at .1 rather than 1. The rebel's best reply $\alpha(\beta)$ continues on in the same way as β increases to 1, although at a β close to one $\alpha(\beta)$ changes course and heads to intersect the y axis at $\beta = 1$, due to an effect of the constraint in the utility function. By contrast, the government's best reply $\beta(\alpha)$ discontinuously jumps down to and remains at zero for rebel force sizes greater than a threshold value $\bar{\alpha}$.[19]

[Figure 2 about here]

[18] All three properties are true of the capture model suggested in footnote 17.

[19] In this example, at $\bar{\alpha} \approx .56$. The example is generated using the capture function $p(\alpha, m\beta) = m\alpha\beta/(m\alpha\beta + 1)$ and parameters $t = .2$, $m = 1800$, $d = 35$, $c_R = 1$, $c_g = .3$.

A good way to grasp the logic of model is to work through the logic of the best reply functions. Beginning with the government, if the rebel movement is small enough (size less than $\underline{\alpha}$), then the group is so difficult for government forces to find and penetrate and the amount of tax revenue it appropriates is so small that counterinsurgency is not worth the cost – the government's best reply is zero effort. This cannot occur in equilibrium because the rebel group's best reply to zero government effort would be to mobilize a significantly larger force ($\hat{\alpha} = 1/(1 + \delta)$) that would allow it to tax and control the whole population.

As rebel forces surpass $\underline{\alpha}$ the returns to government counterinsurgency increase making larger government forces increasingly worthwhile. A larger rebel force taxes more territory and faces greater penetration and capture risks, which makes a greater counterinsurgent response desirable for the government. Eventually, however, if the rebel force is large enough (above $\bar{\alpha}$), counterinsurgency is again not worth the cost for the government. The reason is that if the rebels have forces greater than $\hat{\alpha}$, they have more than enough to control the whole tax base. So for the government to take back any tax base, it has to fight enough to reduce the rebel forces below $\hat{\alpha}$ after captures and kills. When α is large enough this can be so costly for the government that it is better off just "giving up," as it were, and ceding control to the rebels. Once again, this situation cannot occur in equilibrium because the rebel leadership does not want to "overhire" forces if it faces no opposition (the rebels are in effect the government in this counterfactual in any event).

Now consider the rebel leadership's best replies to different levels of government effort. There are two cases, corresponding to whether the constraint in the utility function binds. The constraint binds if, after captures and kills, the rebel movement still has enough personnel to control the country's entire tax base. In this case, which corresponds to the part of $\alpha(\beta)$ that is increasing in β, the rebels want to set their force size so that they will have just enough to control the whole country after the fighting. This can obtain only when government forces are sufficiently small. By contrast, if government forces are large enough, the constraint in the rebel's utility function does not bind and the solution is interior, which means that the rebel group chooses the force size such that the marginal cost of another rebel equals the marginal gain in tax revenue. The larger the government presence, the smaller the marginal gain from adding another rebel due to capture and compromise risks, and thus the smaller the optimal rebel force size.

Proposition 1 asserts that if the game has a pure strategy equilibrium it is unique, and is either "interior" with positive government and rebel force levels, or a corner solution in which the "government" makes no effort and the rebels take over. (Proofs of propositions are in the Appendix.)

Proposition 1: If the game has a pure strategy equilibrium it is unique, and is either interior, satisfying the first order conditions

$$k_1(\alpha, m\beta) = 1 - c_R/\delta t \tag{3}$$

$$k_2(\alpha, m\beta) = \frac{t + c_G}{m\delta t}, \tag{4}$$

or the constraint in (1) and (2) binds and the equilibrium is $\alpha^* = 1/(1+\delta)$, $\beta^* = 0$. In words, a pure strategy Nash equilibrium involves either positive force levels on both sides or the rebels "take over," controlling the whole country which is ceded by the government. A necessary and sufficient condition for the latter is that $k_2(\hat{\alpha}, 0) \leq (t + c_G)/m\delta t$.

For certain parameter values, the game can have a unique mixed strategy equilibrium, which occurs "in between" the equilibria described in Proposition 1. The equilibrium with $\beta^* = 0$ occurs when government counterinsurgency is highly inefficient (that is, has very low marginal return in terms of numbers captured or killed), whereas the pure strategy equilibrium with positive force levels on both sides requires that the government be sufficiently capable. In between, it can happen that the government wants to raise forces $\beta(\hat{\alpha})$ if $\alpha = \hat{\alpha}$, but the rebel's best reply to $\beta(\hat{\alpha})$ is a force size such that the government's best reply would be to give up, setting $\beta = 0$, to which $\hat{\alpha}$ would again be a best reply by the rebels. The mixed strategy Nash equilibrium involves R choosing $\bar{\alpha}$ while G mixes appropriately on $\{0, \beta(\bar{\alpha})\}$. In this case, either the rebels take over with no opposition or there is a big conflict.[20]

The mixed strategy equilibrium has little or no substantive relevance, however. It disappears, for example, in a Stackleberg version of the game that takes the government as the incumbent who can set police and counterinsurgent force levels prior to possible entry by a rebel group.[21] Moreover, both the mixed strategy equilibrium and the equilibrium in which the government cedes control of the country to the rebels ($\beta^* = 0$) can occur only in a part of the parameter space where the core assumptions about the capture function $p(\alpha, m\beta)$ are not so reasonable. If the government is so weak or inept that rebel takeover is a strong possibility, then the assumption that adding rebel forces raises the probability of capture for each individual rebel is suspect. The assumption was offered as appropriate for conflicts that are at or are stuck in Mao's first two stages of guerrilla war. In these, the government remains dominant in terms of men and materiel; its difficulty is primarily in identifying and locating rebels, rather than in marshalling the forces to defeat them if found. In what follows I focus on the comparative statics of the "interior" equilibrium that arguably corresponds to the case of persistent, fairly low-level insurgency.[22]

[20]The earlier, conference version of this paper gives the details for the mixed strategy equilibrium for the case of $p(\alpha, m\beta) = m\alpha\beta/(m\alpha\beta + 1)$. $\bar{\alpha}$ is defined as the α such that the constraint in (2) binds with equality at $(\bar{\alpha}, \beta(\bar{\alpha}))$, where $\beta(\cdot)$ solves G's first-order condition (4).

[21]It can be shown that in the Stackleberg version, the government commits to a higher force level than in the simultaneous move case, leading to a lower equilibrium level of rebellion. Comparative statics are the same as in the simultaneous move case.

[22]The model in the earlier version of this paper considered the case of conflict over a region of a country beyond which the rebel group simply could not expand. In this case the $\beta^* = 0$ equilibrium has a natural

Proposition 2. An interior Nash equilibrium (α^*, β^*) has the following comparative statics:

- Government and rebel force levels, and thus the amount of conflict, do not vary at all with per capita income, y.
- Greater government efficiency or effectiveness in counterinsurgency, m, implies fewer rebels and fewer soldiers in equilibrium.
- Higher government costs for conscripting (or recruiting) and provisioning soldiers, c_G, imply fewer soldiers and more rebels in equilibrium.
- Higher costs of recruiting, training, and supplying rebels, c_R, imply fewer rebels and fewer soldiers in equilibrium.
- Higher tax yield t for rebels and government implies more soldiers in equilibrium, but may associate with a greater, smaller, or equally sized rebel movement.
- Greater efficiency in the rebel organizations ability to collect revolutionary taxes, δ, implies more soldiers in equilibrium, but may associate with a larger, smaller, or equally sized rebel movement.[23]

These effects can mainly be anticipated from Figure 2, keeping in mind that an exogenous variable that makes insurgency more attractive for rebels tends to shift $\alpha(\beta)$ up (or right), while a variable that makes counterinsurgency more attractive for the government tends to shift $\beta(\alpha)$ up (or left). So, for example, increasing the government's conscription

interpretation as a situation where the government allows rebel control of the region because the tax base is too small and counterinsurgency too difficult to make governing it worthwhile. The British and French treated some peripheral zones in some of their colonies this way, as did some Latin American countries until fairly recently.

[23]For the case of $p(\alpha, m\beta) = m\alpha\beta/(m\alpha\beta + 1)$, the equilibrium size of the rebel movement does not vary at all with changes in δ or t (in the interior equilibrium).

costs reduces government effort for any level of rebel activity, leading to less counterinsurgency and more rebellion. The effects are different for an increase the rebel group's costs of conscription or recruitment. For this change the model predicts less rebellion and less counterinsurgency. Government reduces its effort when the rebellion shrinks because it becomes more difficult to find and attack a better hidden opponent on which is harder to get good intelligence.

Increasing the tax rate that both sides can extract, or increasing the rebel group's efficiency at collecting revolutionary taxes, shifts both curves outward leading to an increase in government effort but no clear change for the rebels (who are more tempted by rebellion but face stronger government opposition).

The model as it stand assumes that the rebels and the government collect at the same tax rate from individuals in society. Rebel and government taxation "technologies" are often quite different, however. Rebels raise funds from house-to-house visits, contraband operations, or foreign patrons, whereas governments can use commodity taxation, sales taxes, or income taxes in more developed economies. If we modify the model so that the rebel group's tax extraction rate is $t_R > 0$ and the government's is $t_G > 0$, then it is easy to show that increasing t_R shifts the rebel group's best reply function upwards, making for an increase in equilibrium levels of both government and rebel forces. By contrast, increasing t_G while holding t_R fixed shifts $\beta(\alpha)$ upwards, increasing equilibrium counterinsurgency while reducing rebellion. If, as argued below, t_G tends to be smaller and t_R larger in poor than in rich countries, we would observe higher levels of civil conflict in poor countries even their governments made less (or a similar amount of) police and counterinsurgent effort.

Per capita income makes no difference for civil conflict in the model for the same reason as before: a larger tax base is a positive incentive to fighting, but this is offset by the negative incentive that comes from greater costs for conscripting or otherwise staffing a force. In contrast, increasing the government's efficiency at counterinsurgency (m in the model) unambiguously reduces the equilibrium level of conflict. If, as argued below, richer countries are more efficient at counterinsurgency due to features of the natural and social terrain in richer countries, this could help explain the association between income and civil peace.

5 Recruitment, risk attitudes, and income

The model of the last section assumed that government and rebels conscript and provision their fighters at a fixed marginal cost. Conscription is typical for government forces involved in a civil conflict, and there are examples of rebel forces conscripting fighters as well. Child soldiers, who are frequently abducted or otherwise forced to join, are often used by rebel groups and sometimes in government forces.

Nonetheless, conscription is more problematic for rebels than for the government because, at least in the early stages, the rebel leadership does not control an administrative apparatus that can openly monitor a territory for deserters. Further, because hiding is so critical for the survival of guerrilla bands, the risks involved in conscripting fighters against their will can be unmanageable. Disgruntled conscripts would be inclined to defect to the government side, bringing information with them.[24]

So, especially in their small or early stages, guerrilla groups may depend on volunteers far more than conscripts. And volunteers need to be compensated, whether by the prospect of victory and subsequent reward, by the satisfaction of fighting for justice, or by the living

[24]Thus, rebel groups that do try "conscription" tend to abduct children, who often do not know how to return home if they were to escape, and who are more easily scared or convinced to stay with the rebel group (Blattman 2007). In a few cases, such as the LTTE in Sri Lanka, the rebel group develops such strong control of a region that conscription is made possible by the ability to threaten the conscript's family with retribution if he or she should defect.

that being a rebel provides. Regardless of the first two, joining an insurgency has to provide *some* material living to rebels since it is a long-term endeavor. Certainly potential rebels will take into account the comparison between the living provided by insurgency and the living provided by the regular economy, even if they also factor in considerations of justice and prospects for changing the government.

The game described above can be modified so that individuals choose whether to join the rebels in their fight. To keep with the spirit of a pure political economy model, I will consider potential rebels who care only about maximizing expected utility from income. They do not have idealistic motivations.[25]

Suppose that the rebel leadership R offers a wage w, which can be enjoyed only if the rebel is not captured or killed. Thus, individuals join the rebellion if their expected utility for the lottery on w and being killed or captured is at least as high as their utility for the disposable income $y(1-t)$ they can earn in the regular economy. Let $u(x)$ be a concave, strictly increasing utility function for income, with $u(0) = 0$ set as the value for being killed or captured. For simplicity and broadly consistent with the facts, I will continue to assume that government soldiers are conscripted and provisioned at marginal cost $c_G y$.

Expected utility for joining the rebels is thus $u(w)(1 - p(\alpha, m\beta))$, while the utility for not joining is $u(y(1-t))$. Given government force size β, if R wants a force size of α, it needs to offer a wage of

$$w = u^{-1}\left(\frac{u(y(1-t))}{1 - p(\alpha, m\beta)}\right).$$

The wage is increasing in α because the risk of capture increases with α for the reasons discussed above.

[25]These could easily be incorporated at the expense of more notation, and I doubt the implications would be surprising (that is, more idealism will imply more rebels and more counterinsurgency).

The rebel group leadership's utility function then becomes

$$u_R(\alpha, \beta) \quad = \quad u(ty \min\{1 - \alpha - \beta, \delta\alpha(1 - p(\alpha, m\beta))\} - w\alpha). \tag{5}$$

In terms of equilibrium logic, switching from conscription to recruitment does not change anything important. The only difference is that now the rebel group's marginal costs for adding rebels are increasing rather than constant. The effect will be similar to shifting $\alpha(\beta)$ left in Figure 2, implying fewer rebels and a smaller counterinsurgency in equilibrium.[26]

However, incorporating recruitment does allow us to analyze an initially plausible counter to the observation made above that while poor people have less to lose by rebelling, they also have less to gain (so why would there be any net effect?) Perhaps the marginal utility of additional income is smaller for wealthier people, making them less willing to risk the very bad outcomes of capture or death as a rebel. By contrast, for poorer people the possible gains from becoming a rebel are much more meaningful.

Another version of this argument is the claim that poverty itself makes for grievance and in consequence a greater willingness to take up arms. This is equivalent, I believe, to the proposition that poorer people are more risk acceptant. The idea is that they are willing to run higher risks of capture and death for the same proportional increase in income.

Consider the specific risk averse utility function $u(x) = x^\rho$, $\rho \in (0, 1)$. This implies

$$w = \left(\frac{(y(1-t))^\rho}{1 - p(\alpha, m\beta)} \right)^{1/\rho} = \frac{y(1-t)}{(1 - p(\alpha, m\beta))^{1/\rho}}.$$

Yet again, R's marginal cost for adding rebels is linear in y, and thus R's net revenues

[26] Analytic solutions are harder to obtain now; even with $u(x) = x$ and $p(\alpha, m\beta) = m\alpha\beta/(m\alpha\beta + 1)$, R's first-order condition requires solving a cubic equation. Note also that if we allow income to vary in the population, this creates another source of increasing costs for rebel recruitment, since they will draw first from the poor and have to offer increasing amounts to persuade additional recruits to join up.

are as well. R's marginal trade-offs concerning α are not affected by increasing y, and so the equilibrium force size for both rebels and government will again be independent of per capita income, despite our allowing for any degree of risk aversion. The only evident change from introducing risk aversion is that the rebel organization has to pay recruits more to compensate them for the risk of being captured. This will shift $\alpha(\beta)$ to the left in Figure 2, lowering both α^* and β^*.

The reason that the levels of rebellion and counterinsurgency are independent of income here is that the utility function $u(x) = x^\rho$ exhibits *constant relative risk aversion*. If a person's preferences satisfy this property, then her level of income y does not affect how she chooses between getting y for sure and a gamble that gives $\tau_1 y$ with some probability, and $\tau_2 y$ with the complementary probability, where $\tau_1 > 1 > \tau_2 \geq 0$.[27]

If we think that *increasing* relative risk aversion (IRRA) is empirically common and significant – that higher wealth makes one markedly less willing to take a gamble such as, say, a p chance of a 10% increase in wealth and a $1-p$ chance of a 40% decline – then we have a possible explanation for why poor countries are much more civil war prone. When Arrow (1971) advanced the idea of relative risk aversion, he proposed that IRRA was empirically plausible, but subsequent investigations have produced mixed support at best.[28] Ogaki and Zhang (2001) point out that for households with incomes and wealth close to the subsistence level, relative risk aversion must be *decreasing* in income since falling below the subsistence level is so bad; they find empirical support for decreasing relative risk aversion in consumption data from India, and cite other studies with similar results. Behavioral economists argue on the basis of lab experiments and observation that "people do not display a consistent coefficient of relative risk aversion, so it is a waste of time to try to measure it" (Rabin and

[27]More generally, constant relative risk aversion means that $-xu''(x)/u'(x)$ is constant.

[28]See for example Meyer and Meyer (2005).

Thaler 2001, 225). The idea is that risk attitudes depend on contextual features of specific gambles, such as how they are framed.

So it seems unlikely that a general human propensity for IRRA could explain the empirical relationship between low levels of economic development and civil war, given that evidence for significant IRRA in other domains such as financial assets and consumption is weak. Alternatively, it could be that some general contextual feature of the specific decision to become a rebel makes for (effectively) greater risk acceptance about rebellion in poor countries. I cannot think of what this ad hoc feature would be, however.

Is there some more compelling way to account for the strong empirical association between low per capita income and the propensity for civil war? Income is plausibly linked to two other variables in the model besides y, in ways that might help explain the regularity.

First, as seen above, more efficient counterinsurgency (larger m) implies fewer rebels and fewer soldiers in equilibrium. In the context of the model, government forces are more efficient when they capture or kill more rebels for given force sizes. Efficiency in this sense will be determined by factors such as the physical and social terrain, by government and rebel organizational capabilities, and by doctrine.

Richer countries are more urbanized and more uniformly covered by road and communication networks. These factors favor counterinsurgency and government control by making it harder for a nascent guerrilla band to hide. Small, highly secretive terrorist cells can operate in cities, but the movements and operations of larger rebel bands will be visible to many urban dwellers, and the opportunities for anonymous denunciation plentiful. In rural villages, where everyone knows everything about everybody, it is much easier to credibly threaten reprisal for denunciation or to hold small groups collectively responsible. Road networks reduce the amount of land that is good for hidden rebel camps and allow government forces to concentrate more quickly in response to attacks.[29] In the last 60 years, richer countries have tended to have richer neighbors and better political relations with their neighbors, which may have reduced the options for foreign sanctuaries and support for guerrilla groups in wealthier countries.

Richer countries may also tend to have more efficient counterinsurgency due to better training, discipline, and possibly doctrine. Counterinsurgency is an extremely difficult political and military task. The main problems are acquiring the intelligence to distinguish reliably between active rebels and noncombatants, preventing military units from killing indiscriminately and so increasing support for the rebels, and preventing corruption in which military units loot and pillage from helpless populations. These problems may be more easily solved by a well-paid, well-trained, literate military with a strong chain of command and a strong sense of professionalism – all features that are plausibly correlated with per capita income.[30] This is not to say that the problems are easily solved even then, as the experience of the US in Iraq and Vietnam, the USSR in Afghanistan, and the British in Northern Ireland testify. However, the comparison to counterinsurgency as practiced in Angola, Sudan, Liberia, Guatemala, El Salvador, or Peru – where government units regularly massacred, bombed or strafed whole villages suspected of collaborating with rebels – is instructive.

A second variable in the model that might vary systematically with income is t, the

[29]Fearon and Laitin (2003) find that the percentage of mountainous terrain in a country is positively related to civil war risk, although this is not one of the most robust predictors. Empirically, road density and urbanization are related to lower civil war risk, but these are so closely correlated with per capita income that the effects are hard to distinguish. Kocher (2004) argues that the income-civil war relationship is mainly due to urbanization disfavoring rebellion. A suggestive set of examples comes from South America in the 1970s, where intellectuals (especially in Argentina) tried to develop urban-based insurgencies. They were in all cases quickly penetrated and destroyed by state militaries and secret services. On Argentina, see Gillespie (1982). That said, there are a few cases of successful urban insurgency, such as in Northern Ireland and now Iraq.

[30]Felter (2005) uses extensive incident-level data from the Philippine military's wars in Mindanao and Luzon to show that local units with highly trained leadership cadres are the most effective at killing or capturing rebels while avoiding civilian deaths.

share of income that rebels and government can extract from locals. Suppose we enrich the model by distinguishing between the rebel's effective tax rate t_R, and the rate the government can get, call it t_G. As noted above these will often be different, since the government can tax cash crop production of the region by having the state marketing board pay farmers less than the world price (Bates 1981), or by controlling extractive industries in the region such as oil or mining. In richer countries where income is directly taxed, the government has the advantage of an extensive, employer-based monitoring system. Also, income in a richer country may be less subject to extortion by rebels because it is hypothetical money kept in banks and cyberspace, and because a large corporation's decentralized structure makes it harder to threaten than a small business owner. In a richer economy with more income from human capital, individuals are more able to move in response to local extortion threats and the dangers of living in a conflict zone, making the effective tax rate for rebels lower. By contrast, farmers' income comes from immovable capital.

These examples suggest that economic modernization would tend to reduce t_R, the share of national income that a rebel group can extract through the standard taxation technologies of insurgency. In the model, this leads to fewer rebels and less police/counterinsurgent effort by the government.

6 What prevents a peaceful settlement?

The insurgency equilibrium outcome in the model is inefficient; both rebels and governments could do better if they could contract with each other. In this simple and stylized model, inefficiency has only two sources: the diversion of labor from production to fighting, and the diversion of labor from production to tax collection by the rebel group, which is in effect assumed to be less efficient than the government's tax collection system.

Several minor modifications could introduce a larger and more realistic set of inefficiencies. First, I assumed that individuals are taxed either by the rebel group or by the government, but not both. Often this is not the case. For example, peasants in rebel-controlled areas may grow crops for market that are taxed by government marketing agencies. If so, then they will be overtaxed by a logic like that in Shleifer and Vishny (1993) and Olson (1993), and consequently will produce less than is optimal. Second, I assumed that the government is perfectly discriminate in its application of force (no one but rebels are captured or killed), and I neglected that, over time, rebel and government violence destroy physical and human capital, discourage investment and production, and encourage refugee flows. In a richer (though less tractable) model, it would be natural to have the violence between soldiers and rebels producing "collateral damage" to people and assets in the regular economy.

In the model at hand, an efficient outcome would be an agreement by R and G to conscript or recruit no rebels and no soldiers, and for G to distribute a portion of the total tax revenues ty to R that would leave both R and G at least as well off as they are in the insurgency equilibrium. Of course, this outcome cannot be achieved in the one-shot game analyzed here because neither side could credibly commit to the deal. The rebel leadership would want to take advantage of the government's weak military and police presence to grab control of territory, and the government would have no incentive to transfer funds to the rebel leaders if they had no force behind them.

In the real world, government-rebel interactions need not be "one shot." Could R and G use the fact of continuing interaction to construct a more efficient arrangement? If we make the model the stage game of a repeated game with discounting, then by the usual arguments the repeated game will have efficient equilibria if the players are patient enough. For example, peace might be supported by having the government anticipate that failure to make transfers to the rebel leadership would lead to war, while the rebel leadership anticipates that arming and grabbing territory would be met by significant counterinsurgency.

But assuming a repeated-game structure assumes too much. If either side can hope to use force to eliminate or permanently disadvantage the other, then the mechanism that makes efficiency possible in a repeated game (conditional retaliation) can be undermined, essentially returning the situation to a "one shot" Prisoner's Dilemma-type problem.[31] Consider, for example, the following dynamic version of the model analyzed above. The game is repeated in successive periods, but suppose that if one side chooses zero forces and a public peace deal while the other chooses a positive level of forces, the side choosing zero is permanently eliminated while the other takes control of the whole country from that period forward. Then there is no way to support the efficient outcome described above using implicit threats of retaliation.

Thus, the rebel group fears accepting a peace deal because once its leadership becomes publicly visible (and findable) and once it disarms, it may be wiped out or permanently disadvantaged if the state reneges. This is arguably why rebel groups almost always demand political power rather than just policy changes or financial transfers to a region; they expect that only by gaining political power (or a perhaps a share of it) can they be assured of the policy changes or transfers they desire. Policy commitments are not credible unless the rebel group can somehow retain an adequate ability to return to war from peace.

Apart from attempting to crush the other side, the main way that combatants (and mediators) in civil wars attempt to resolve such commitment problems is by trying to construct political institutions that would share power between the former combatants. In wars over secession or regional autonomy, power-sharing proposals often envision regional political

[31]For models of inefficient civil and interstate conflict that rely on this mechanism, see Fearon (1994, 1995, 2004), and for a more general analysis, Powell (2004). The same mechanism is also at work in Acemoglu and Robinson's (2006) models of democracy and autocracy.

institutions that would be run in part or whole by the former rebels.[32] Providing a political institutional base for the former rebels increases their ability to "police" the deal. It may also, however, increase the former rebels' ability to demand even more from the government, making for another commitment problem that could prevent a deal in the first place.

In wars over control of a central government power-sharing proposals seek to divide political offices and/or control of the military among the former combatants. Judging by the relative frequency with which such arrangements have been discussed but the rarity with which they are successfully implemented, it appears to be extremely difficult in practice to strike a balance that assures each side that it is not too exposed to the danger of reneging by the other (Fearon 2007; Walter 2002).

A spheres-of-influence agreement in which the rebels control less than what they could given the government's effort would seem to be the type of bargain most feasibly policed by an implicit understanding that violation would lead to more open and inefficient conflict. And in fact, "sitzkrieg" is a typical condition for rural guerrilla conflicts. Here, the rebels keep their arms and stay largely hidden, but restrain themselves from taking as much control as they could given the scale of government counterinsurgency in the short run. The government, on the other hand, does not conscript and employ the counterinsurgent force that would be short-run optimal given the size of the rebel force, understanding that if it did the rebels would scale up and the conflict would escalate to the (α^*, β^*) equilibrium level. For example, the Burmese government cut a series of deals with hill tribe rebel groups in the early 1990s in which the rebels kept their arms and the two parties divided up revenues from the opium business.[33] Where feasible, such deals are still second best.

[32] Some examples include the treatment of the Moro National Liberation Front in the Philippines, GAM in Aceh, Indonesia, the IRA in Northern Ireland, and arguably the PLO in the West Bank and Gaza.

[33] See also Keen (1998) on Liberia and Sierra Leone.

Another hypothetically plausible type of explanation for inefficient fighting in a dynamic version of the model examined here would argue that one or both sides possess private information about their capabilities or resolve to fight, leading to the use of fighting as a costly but credible signal of capabilities or resolve. For example, the government might be unsure about the replacement rate of rebel fighters, which might be affected by rebel organizational capabilities and regional popular support for the rebel aims, both of which could be hard to observe directly. Such "war of attrition" explanations are frequently given in the media and sometimes by combatants themselves. They become less persuasive over time, however, especially for a five- or ten- or even twenty-year fight that looks very much the same from year to year (Fearon 2004).

A final type of obstacle to a stable peace deal concerns the government fear that if it cuts a deal with one rebel group, it may soon face other insurgent groups, or splinter groups, making similar demands and employing guerrilla tactics to control territory. R may not have the capability to prevent new "entrants" from using the same technology of rebellion, which could be just as profitable after a peace deal between R and G. The logic is that of the chain store paradox. The government prefers inefficient conflict in case A in order to deter inefficient conflict in cases B, C, D, and so on.[34]

This mechanism would be expected to make for greater government intransigence in countries with a larger number of potentially secessionist minority groups. Walter (2005) empirically examines the relationship between the number of ethnic groups in a country and the government's propensity to grant a measure of regional autonomy, and finds that this is lower in more diverse countries. The logic also suggests that peace deals will be more difficult

[34] In the classic chain store paradox models, the equilibrium outcome is efficient because no entrant challenges and thus fighting is off the equilibrium path. To get inefficient fighting "on the path," we would need to allow for heterogeneous types of entrants, some of which are willing to fight if they have zero regional control even if they face resistance, and whose preferences are not publicly observable. The explanation then becomes a private information story.

to reach in conflicts where there is no dominant rebel organization capable of suppressing or controlling challengers.[35]

7 Conclusion

The most common form of civil war in the post-World War II period has been a relatively small, stalemated guerrilla war confined to a rural periphery of a poor, post-colonial state. This is violence of a quite different sort from the French Revolution, the great model for theorizing about internal conflict. In the French Revolution paradigm, masses demonstrate in a capitol city, which leads to violent encounters with the coercive arms of the old regime. Such conflicts still occur, as in Iran and perhaps Nicaragua in 1978, or China (Tiananmen) and Romania in 1989. But this pattern is far more the exception than the rule. Nor is the model of the U.S. Civil War – essentially an interstate war fought by standing armies – at all common in this period.

I have argued that guerrilla warfare has distinct features and a distinct logic that, when incorporated in a model of the problem, help to explain its longevity and stability. In the French Revolution scenario, if the government is likely to collapse at a certain level of opposition, then there are "increasing returns" to adding more people to the opposition's protests. As a technology for attempting to change the government, revolution is an all-or-nothing affair, a matter of tipping points, focal points, and successful or unsuccessful mass coordination.

By contrast, in the guerrilla war technology a relatively small number of poorly armed rebels survive by hiding successfully from government forces, which, if they knew where the rebels were, could fairly easily destroy them. Rough terrain can help hide the rebel groups,

[35]Peace negotiations for both Burundi and Somalia have been held up repeatedly by the appearance of new opposition groups demanding payoffs, just as an agreement is about to be signed.

but preventing informers and denunciation to authorities is also essential. The problem of denunciation and detection, I have argued, implies that adding more rebels can increase the risks for existing fighters, and thus produce "decreasing returns" for the rebel movement (given a level of government resistance). This in turn leads to the possibility of a stable but violent equilibrium in which neither government nor rebels find it worthwhile to expand their efforts. Expansion would make the rebels too subject to detection and counterattack. A greater effort by the government would not yield enough new captures to make it worth the additional cost.

Higher per capita income means that there is in principle more stuff to appropriate if you are a member of a rebel band, and more stuff worth defending if you are on the government side. However, as argued above, the value of *not* fighting is also higher in a richer country, which raises the marginal costs of recruitment or conscription. These two considerations tend to offset each other, even when we consider risk aversion (and assuming that poorer people are not relatively more risk acceptant).

More plausible explanations for the empirical association between higher incomes and lower civil-war risk pose an indirect link, via the association of high income with (a) natural and social terrains inimical to guerrilla hiding, (b) possibly state military capability to conduct more efficient counterinsurgency, and (c) inability to appropriate as large a share of income through house-to-house visits by guerrillas, due in part to the mobility of human capital (as opposed to land).

At a theoretical level, the main innovation of the paper is the opening up of the traditional "contest success function" used to study an enormous variety of types of human and animal conflict. A natural next step would be to go further in this direction, developing a more explicit model of the information contest between rebels and government in this case of guerrilla war. In other words, can we "open up" the capture function used here, so providing plausible microfoundations for the assumption that adding rebels increases the risks of capture for all?

8 Appendix

Proof of Proposition 1. Suppose that (α^*, β^*) is a Nash equilibrium and that the constraint binds in (1) and (2) so that $1 - \alpha^* - \beta^* \leq \delta(\alpha^* - k(\alpha^*, m\beta^*))$. Then G's payoff is $-c_G\beta^*$, which implies that $\beta^* = 0$ since otherwise G could do better by reducing β^*. $\beta^* = 0$ implies that R's problem is to choose α to maximize $t \min\{1 - \alpha, \delta\alpha\} - c_R\alpha$, which yields $\alpha^* = 1/(1+\alpha)$. And given this α^*, G's utility function becomes $t \max\{0, -\beta + \delta k(\hat{\alpha}, \beta)\} - c_G\beta$. $\beta^* = 0$ is a best reply to $\hat{\alpha}$ if and only if this function slopes down in β at $\beta = 0$, which follows from $k_{22} < 0$ when the condition given in the Proposition holds.

If (α^*, β^*) solves the first-order conditions and the constraint does not bind, then this is necessarily a Nash equilibrium, as the assumptions that $k_{11} > 0$ and $k_{22} < 0$ imply that the second-order conditions for maxima are satisfied. In addition, $k_{11} < 0$ implies that there is a unique $\alpha(\beta) > 0$ that solves (1) with equality when $k_1(0, \beta) \geq 1 - c_R/\delta t$, and $\alpha(\beta) = 0$ when this inequality does not hold. Likewise, $k_{22} > 0$ implies that there is a unique $\beta(\alpha)$ that satisfies (2) when the constraint does not bind. Thus if there is an interior Nash equilibrium it is unique.

These arguments establish that there cannot be more than one interior pure-strategy Nash equilibrium, and that the only pure-strategy Nash equilibrium possible such that the constraint binds is $(\hat{\alpha}, 0)$. It remains to show that $(\hat{\alpha}, 0)$ and an interior equilibrium point (α^*, β^*) cannot both be equilibria for the same parameter values. Suppose the contrary. If $(\hat{\alpha}, 0)$ is an equilibrium then $k_2(\hat{\alpha}, 0) \leq (t + c_G)/m\delta t$. $k_{12} > 0$ implies that this inequality also holds for any $\alpha < \hat{\alpha}$, so that it cannot be that $\alpha^* \leq \hat{\alpha}$.

Suppose now that $\alpha > \hat{\alpha}$. $k(\hat{\alpha}, 0) = 0$ and $k_{22} < 0$ imply that $k(\hat{\alpha}, m\beta^*) < m\beta^* k_2(\hat{\alpha}, 0)$.

Subtracting $\beta^*(t + c_G)/\delta t$ from both sides leads to

$$k(\hat{\alpha}, mb^*) - \beta^* \frac{t + c_G}{\delta t} < \beta^* \left(mk_2(\hat{\alpha}, 0) - \frac{t + c_G}{\delta t} \right) \leq 0,$$

where the last inequality follows from $k_2(\hat{\alpha}, 0) \leq (t + c_G)/m\delta t$. Multiplying through by δt and adding the negative quantity $t(1 - \alpha^* - \delta a^*)$ to both sides (negative because $\alpha^* > \hat{\alpha}$), we have

$$t(1 - \alpha^* - \delta\alpha^*) - \beta^* t + \delta t k(\hat{\alpha}, m\beta^*) - \beta^* c_G \leq t(1 - \alpha^* - \delta\alpha^*) < 0.$$

But this implies that the constraint in (2) binds for G, which means that $\beta^* > 0$ cannot be part of an equilibrium.

Proof of Proposition 2. Let $(\alpha(c_G), \beta(c_G))$ solve (3) and (4), and then implicitly differentiate both equations in c_G. This yields

$$\begin{aligned} \frac{dk_1}{dc_G} = k_{11}\alpha' + k_{12}\beta' &= 0 \\ \frac{dk_2}{dc_G} = k_{21}\alpha' + k_{22}\beta' &= 1/\delta t. \end{aligned}$$

From the first equation, $k_{11} > 0$ and $k_{12} > 0$ imply that α' and β' must have opposite signs. From the second, $k_{21} > 0$, $k_{22} < 0$, and $1/\delta t > 0$ rule out $\alpha' < 0$ and $\beta' > 0$, so it must be the case that $\alpha'(c_G) > 0$ and $\beta'(c_G) < 0$. Exactly the same type of argument yields the stated results for c_R, t, and δ.

Likewise, implicitly differentiating the first-order conditions at the equilibrium values in m yields

$$\frac{dk_1}{dm} = k_{11}\alpha' + k_{12}(\beta + m\beta') \quad = \quad 0$$

$$\frac{dk_2}{dm} = k_{21}\alpha' + k_{22}(\beta + m\beta') \quad = \quad 0.$$

From the first equation, $k_{11} > 0$ and $k_{12} > 0$ imply that if $\alpha' > 0$, it must be that $\beta + m\beta' < 0$. But then the second equation cannot hold, since $k_{21} > 0$ and $k_{22} < 0$. Thus $\alpha' < 0$, which means that for the second equation to hold we need $\beta + m\beta' < 0$, which implies $\beta' < 0$.

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Figure 1. Income and civil war risk

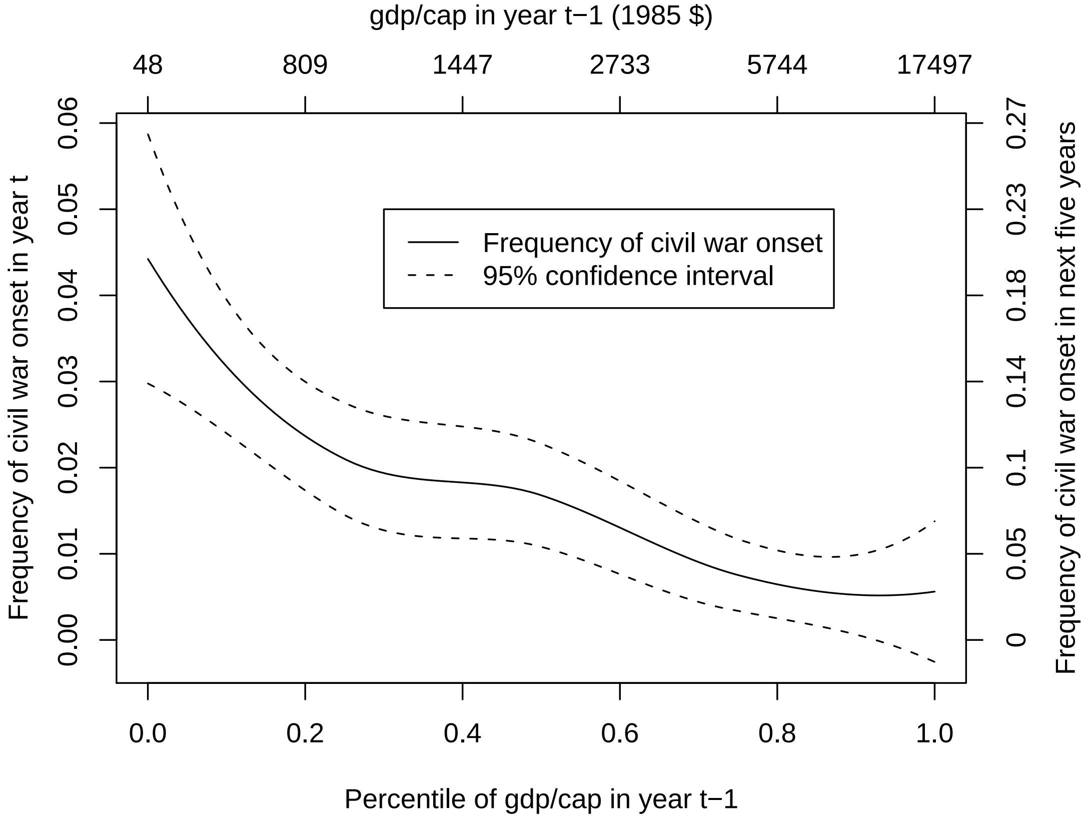

Figure 2. Best reply functions for government and rebels.