



BIROn - Birkbeck Institutional Research Online

Gonzalez, T. (2006) Conflict, popular support and asymmetric fighting technologies. Working Paper. Birkbeck, University of London, London, UK.

Downloaded from: <https://eprints.bbk.ac.uk/id/eprint/26937/>

Usage Guidelines:

Please refer to usage guidelines at <https://eprints.bbk.ac.uk/policies.html>
contact lib-eprints@bbk.ac.uk.

or alternatively

ISSN 1745-8587



School of Economics, Mathematics and Statistics

BWPEF 0603

Conflict, Popular Support and Asymmetric Fighting Technologies

Tomás González

January 2006

Conflict, Popular Support and Asymmetric Fighting Technologies*

Tomás González[†]
Birkbeck College, University of London
tgonzalez@econ.bbk.ac.uk

January 2006

Abstract

This paper presents a model of conflict that combines popular support and asymmetric fighting technologies in a civil war setting. Starting with different endowments, two parties must decide on the amount of resources to divert from production to fighting. The conditions for conflict to arise are derived and civil war is shown to be subject to efficiency and distributive costs. Two other equilibria can occur, the first involving only one side choosing to arm, and the other a peace equilibrium where both groups choose zero fighting effort. The model is consistent with various historical accounts of the different roads to war and with recent empirical evidence on the determinants of conflict. Although the model focuses on civil wars, it can easily be extended to other situations that involve conflict such as rent seeking, political campaigning or litigation.

I. Introduction

Production and predation are different means by which individuals seek to obtain resources. Appropriation, be it in the form of crime, litigation, lobbying, strikes or any rent-seeking activity, dominates many aspects of economic life.

In fact, whether individual or collective, almost any decision that involves the allocation of resources is made against the backdrop of this consideration. Failure to anticipate predation from an opponent can be disastrous in terms of lost income, but so can be the failure to realize that appropriation can be as rewarding as production.

* *JEL* Classification Numbers: D72, D74.

[†]I would like to thank Jack Hirshleifer, Ron Smith, Ken Hori, Paul Schwinzer and Piergiorgio Alessandri for helpful comments.

So the question is not whether to devote resources to appropriative activities that could otherwise be used productively, but where to strike the right balance. As Hirshleifer (1988, p.202) explicitly put it “the decision variable on each side is not the discrete transition between war and peace but the proportions in which efforts are divided between the two ways of seeking advantage”. For a government this decision can take the form of determining how much to spend on military and defense activities, for a political campaign establishing what fraction of its budget to use in negative advertising, and for firms deciding how much to invest in trying to capture rents and special rights from regulators and lawmakers.

Civil wars are specific manifestations of this problem. They typically involve a government that must decide on the amount of resources it will commit to protection from potential insurgents who, in turn, must decide whether to engage in productive endeavors or predatory activities. This line of analysis has been widely used in the literature to explain both the occurrence and implications of wars¹. By using a rational choice framework where agents maximize expected income, these models typically show that conflict produces Pareto-inefficient outcomes and that war can have large distributive consequences².

Portraying insurgents as solely motivated by income has been the prevalent modelling choice in economics. It may be true that rebellion is the product of real objective grievances felt by certain groups of the population; or it could be that grievances are not real but rather perceived to be real, and exist only in the minds of those claiming to represent the oppressed; or yet, it could also be that insurgents, knowing them to be false, use grievances to hide their true intentions of economic gain. The point is that it makes no difference: rebels can be portrayed as income maximizers because it is their ability to finance themselves, not their motives, that allows them to survive and fight.

This fact has lead many authors to treat them as large-scale organized crime. Brito and Intrilligator (1992) model insurgents as providers of protection for drug-traffickers, while Grossman (1995 and 1999) treats revolutions as a struggle between kleptocrats seeking to increase their share in income, and Collier (2000b) presents rebellion as a distinctive form of organized crime that predates on natural resources.

There is also empirical evidence pointing in the same direction. Collier and Hoeffler (2001) analyze the occurrence of civil wars by looking at a sample of 161 countries over the period 1960–99. By using objective measures of greed and grievance to examine the risk of conflict, they find that it is economic opportunity, not injustice, that determines the probability of war.

¹See for example Grossman (1991), Hirshleifer (1988) and Skaperdas (1992). For a general review see Sambanis (2002).

²Hirshleifer (1995), Neary (1997) and Skaperdas (1997) are examples of models addressing this second issue.

Does this mean that grievances play no role in civil wars? Although the results seem to rule out an explanation based on *real* grievances, they are still consistent with one based on *perceived* grievances. But as Collier (2000a, p.4) summarizes, “the sense of grievance may be based upon some objective grounds for complaint, or maybe conjured up by massaging prejudices. However, while this distinction is morally interesting to observers—is the cause just?—it is of no practical importance”. This paper argues otherwise. Grievances do play a role, albeit for a different reason. If the public discourse adopted by a rebel organization convinces people of the righteousness of their claims, it gives them access to resources that otherwise would only have been accessible by force and thus increases the financial viability of rebellion. As the Vietminh manual on guerrilla warfare aptly put it:

Without the ‘popular antennae’ we would be without information; without the protection of the people we could neither keep our secrets nor execute quick movement; without the people the guerrillas could neither attack the enemy nor replenish their forces and, in consequence, they could not accomplish their mission with ardor and speed . . .

The population helps us to fight the enemy by giving us information suggesting ruses and plans, helping us to overcome difficulties due to lack of arms, and providing us with guides. It also supplies liaison agents, hides and protects us, assists our actions near posts, feeds us and looks after our wounded . . . cooperating with guerrillas, it has participated in sabotage acts, in diversionary actions, in encircling the enemy, and in applying the scorched earth policy . . . on several occasions, and in cooperation with guerrillas, it has taken part in combat.³

So the critical point is not whether grievances are real or perceived, but rather the ability of insurgents to convince people about the justness of their claims, and to transform that acceptance into effective support. This, in turn, has important implications for modelling because the choice of grievances becomes endogenous: rebels will champion the causes that allow them to extract the greatest possible support.

Besides grievances, there is another choice that affects the viability of rebellion: fighting technology. Insurgents must decide on how to employ their fighting forces in order to capture the largest possible amount of resources. And here, like in the case of grievances, it implies choosing from a broad range of options—most of which involve an *asymmetric* choice of warfare. Smaller sides, especially when subject to large differences in size or power, will choose markedly different fighting technologies. Generally they

³Cited in O’Neil (1990, p. 72). Originally cited by Otto Heilbrunn from *Bulletine Militaire* (June–August 1955) under the title “Guerrilla selon l’école Communistes.”

rely on hit-and-run attacks aimed at eroding the will and confidence of the opponent, and emphasize the use of speed, adaptability and surprise. As Mao points out in his analysis of guerrilla warfare:

“Guerrilla strategy must be based primarily on alertness, mobility and attack. It must be adjusted to enemy situation, the terrain, the existing lines of communication, the relative strengths, the weather, and the situation of the people.

In guerrilla warfare select the tactic of seeming to come from the east and attacking from the west; avoid the solid, attack the hollow; attack; withdraw; deliver a lightning blow, seek a lightning decision. When guerrillas engage a stronger enemy, they withdraw when he advances; harass him when he stops; strike him when he is weary; pursue him when he withdraws. In guerrilla strategy, the enemy’s rear, flanks, and other vulnerable spots are his vital points, and there he must be harassed, attacked, dispersed, exhausted and annihilated”⁴.

Asymmetries in fighting technology and popular support are thus essential features of conflict; and yet they have received little attention in the literature. This paper incorporates both in a model where government and insurgents must decide on the optimal size of their fighting forces. They make these decisions facing a production-predation trade-off, where diverting resources from production to appropriative activities reduces the side’s own income, but increases the amount that can be captured from the opponent.

Within this framework the required conditions for conflict to emerge and the resulting equilibrium structure are analyzed. Consistent with the literature, conflict is shown to produce an inefficient outcome. In contrast, however, the model shows that distributive consequences of conflict depend only on both parties’ choice of fighting technology and that their effects are not restricted to differences *between*-groups.

The next section introduces the model and the main results, and section 3 characterizes equilibria and presents some comparative statics. Conclusions are given in the final section, together with a summary of the main results.

II. The Model

Civil war can be seen as the result of the strategic interaction between the government and rebels seeking to capture and redistribute income. The road to war can be described as follows. Initially there is a country inhabited only by peasants whose effort is entirely dedicated to production. Among them,

⁴Mao Tse-tung (1962, p. 47).

there are two individuals —the leaders— who are willing to organize an armed group to capture income if the appropriate conditions arise. The two groups will try to control the largest possible amount of output by combining a specific fighting technology and a political discourse aimed at obtaining popular support.

Given their choices, both groups must simultaneously decide on the optimal sizes of fighting forces. If both choose to have an armed force, conflict may arise and the economy fall into civil war. Two other equilibria are possible, one involving only one side choosing to arm, and the other an equilibrium where both groups choose zero fighting effort.

Note that model thus focuses on the acquisition of fighting effort and not in the war phase, so costs represent the loss of resources due to mobilization and not the destruction of war. Note also that throughout the paper income will be considered a proxy for *political power*, implying that the group that is able to capture the largest amount of output will become the government and the other the *rebels*.

The building blocks of the game are *production* and *combat* technologies. The first specifies the way output —the game’s prize— is generated and the second the way it is captured. We start with production.

Production

The game takes place in an economy with a population of size n composed of government’s army soldiers g , peasants e and rebels r . Initially everyone is a peasant.

Production takes the form $y = ae$ where a is a productivity parameter representing technology and e is the number of peasants (each providing one unit of effort of the same quality). Peasants’ effort increases production at a constant rate.

In order to capture the trade-off between production and predation, we can use the fact that $e = n - r - g$ in order to write production as

$$y(r, g) = a(n - r - g). \quad (1)$$

Represented like this, production is negatively affected by recruitment as every new combatant reduces aggregate output by the same constant amount of a units. The maximum level of production is reached when $r = g = 0$ since $e = n$. Three things are implied by this production technology. First, $r + g < n$ in order to ensure there is a prize to fight for (i.e. $y > 0$); second, the negative effects of recruitment are symmetric ($\frac{\partial y}{\partial r} = \frac{\partial y}{\partial g} = -a$); and third, larger a ’s represent wealthier economies where peasants are more productive and, thus, larger prizes are available for capture (i.e. a higher value for any fraction of captured y).

In this context aggregate costs of conflict can be measured in terms of forgone production (i.e. $y(0,0) - y(r,g)$). However, even if $r = 0$, costs can be positive if $g > 0$; that is, when the *threat* of conflict forces the government to arm itself in order to *deter* rebels. Finally note that (1) is not subject to production complementarities in the sense that peasants have no influence in other peasants' productivity.

Fighting

Rebels combine the use of political resources and violence in their struggle against the government. Given their importance in the model, we will discuss both in some detail. In the case of political resources, it means selecting a public discourse that specifies (i) the *grievances* they wish to correct and (ii) the *goals* they seek to accomplish. O'Neil's (1990) analysis suggests insurgents' grievances come from three main sources.

The first is the *political community* or State. When insurgents reject the idea of being part of the political community of their countries, they usually adopt the *secessionist* goal of withdrawing from it in order to form a new independent one. Such is the case of the Liberation Tigers of Tamil Eelam (LTTE) in Sri Lanka or the Basque Homeland and Liberty (ETA) in Spain.

The *political system*, which represents the general rules, values and mechanisms for making and executing binding decisions, is a second source. There are many types of political systems a society can adopt, including pluralistic, totalitarian, autocratic, oligarchical, etc. When insurgents choose to rebel against it, they generally adopt *egalitarian* goals of distributive justice (e.g. Shining Path in Peru); *pluralist* goals of individual freedom and liberty (e.g. the National Resistance Movement in Uganda); or *traditionalist* goals based on ancestral ties and religion (e.g. Hizballah in Lebanon).

Even if they decide to agree with the political system and community, insurgents may choose the *authorities* or the *policies* they pursue. In the first case they target individuals by accusing them of corruption, oppression or incompetence, as in the coups of 1963 in South Vietnam that overthrew Ngo Dinh Diem, or the attempt that failed to overthrow Hugo Chávez in Venezuela in 2002. In the second case they adopt goals that are either *reformist*, like the National Liberation Army (ELN) and the nationalization of energy policy in Colombia; or *preservationist*, like the Ulster Defence Association's (UDA) opposition to Northern Ireland's Good Friday Agreement.

How effective a particular discourse is in gaining popular support depends on various factors. The *economic* and *social structure* can help insurgents gather support if in a society divided by issues like ethnicity, religion or economic wellbeing, one group enjoys a disproportionate amount of power. The opposite can also happen if the government undermines support for worse-off minorities by reviving group rivalries, or if rebels recruit from different groups and those rivalries undermine their internal organization. But

even if they recruit from a single group, specific group attitudes towards discipline and authority can constrain the organizational requirements of the insurgent movement.

Political factors play a similar role. Attitudes towards issues like trust, participation or the use of force will determine to a large extent whether people want to get involved with the insurgents. For example, the lack of understanding of the political process, or a belief that it is impossible to alter it, can lead to a low desire to participate that hinders support for the rebels. On the other hand, absence of channels to participate in the face of a genuine desire to do so can provide a fertile ground for recruitment and support. So even in the presence of real grievances, the backing of the population will be conditioned by the interplay of the political system and political culture.

The above discussion can be generalized by specifying the set of all possible political discourses $\mathbf{X} = \{x_1, \dots, x_m\}$. From this set rebels will choose x_r^* such that:

$$\Lambda_r(x_r^*) \geq \Lambda_r(x_i) \quad \forall x_i \in \mathbf{X},$$

where $\Lambda_r : \mathbf{X} \rightarrow \mathbb{R}^+$ maps political discourses to popular support. Given the nature of popular support we don't specify its functional form, but we assume that \mathbf{X} and $\Lambda_r(\cdot)$ are observed by both players. Note that popular support is therefore *determinate* in the sense that rebels can choose any x_i but cannot endogenously alter its effectiveness. So as long as there is perfect information, insurgents will choose the discourse that leverages the greatest possible support. We also assume x_r^* does not say anything about the truthfulness of insurgents' claims: motivation is unobservable and thus has no effect on people's willingness to support a specific discourse.

The second decision rebels make is how to use their combatants. Fighting technologies can be broadly grouped in three categories. The first is *terrorism*, which essentially involves the use of small units to target non-combatants. Although its main purpose is to weaken the government by instilling fear and causing demoralization and disagreement, it can also have other objectives like "extracting particular concessions (e.g. payment of ransom or the release of prisoners), gaining publicity, demoralizing the population through the creation of widespread disorder, provoking repression by the government, enforcing obedience and cooperation from those inside and outside the movement, fulfilling the need to avenge losses inflicted upon the movement, and enhancing the political stature of specific factions within an insurgent movement."⁵

Guerrilla warfare and *conventional warfare* are the other two. The former targets government's armed forces by relying on larger units that engage

⁵O'Neil, p. 25.

in low-intensity confrontation, puts a premium on flexibility and speed, and depends to a large extent on concealment in the general population; the latter involves large-scale operations where insurgent units confront government forces directly, and usually uses conventional means of combat.

The effectiveness of a fighting technology is largely driven by the physical environment. Topography can be to the rebels' advantage if harsh *terrain* hampers the advance of government forces, or if it provides remote and inaccessible places to hide the bases required for recovery and organizing operations (e.g. Afghanistan's mountains and caves); but it can also be to their disadvantage if large open spaces predominate, where surveillance and control are easier (e.g. Western Sahara's desert). *Size* and *proximity* also play a role since larger areas can be harder to isolate and control, while small distances between insurgent operation areas facilitate logistics, coordination and control.

Infrastructure has similar characteristics, in the sense that it can be advantageous to any of the sides. Poor communication systems and bad roads, rail networks or river and sea transportation systems favor insurgents by holding back government forces; while the opposite compensates the government's strategic need to have static units in specific areas and gives it the necessary mobility to confront hit-and-run attacks.

Finally there is an issue that affects both combat effectiveness and popular support: *leadership*. On the one hand, leaders can directly attract support and keep combatants motivated if they are charismatic and persuasive (e.g. Fidel Castro in Cuba or Jonas Savimbi in Angola), or if they are skilled in selecting a political discourse (e.g. marxism and liberation theology in Latin America). On the other, leaders are responsible for organizational issues that determine political and military success (e.g. communications, training, transportation, financing, etc.) and for maintaining unity, which is essential to focus efforts, prevent internal disagreements and enhance coordination and morale.

As in the case of political resources, we can formalize these ideas by defining the set of *available* fighting technologies $\mathbf{H} = \{h_1, \dots, h_k\}$, where h_i is a specific combination of weapons, targets and tactics. Rebels will choose the fighting technology h_r^* such that:

$$\Phi_r(h_r^*) \geq \Phi_r(h_i) \quad \forall h_i \in \mathbf{H},$$

where $\Phi_r : \mathbf{H} \rightarrow \mathbb{R}^+$ maps specific fighting technologies to *combat effectiveness* (i.e. the amount of resources that can be captured by force). As in the case of discourses, we do not specify its functional form and assume that $\Phi_r(\cdot)$ and \mathbf{H} are observed by both parties. Therefore fighting technology is also *determinate* as perfectly informed rebels will choose the most effective technology available, but are unable to alter its effectiveness endogenously.

So far we have focused on the rebels, but government proceeds in a similar way. Its leader will choose the political discourse x_g^* such that $\Lambda_g(x_g^*) \geq \Lambda_g(x_i)$ for all $x_i \in \mathbf{X}$, and the fighting technology $h_g^* \in \mathbf{H}$ that maximizes $\Phi_g(h_i)$. Note that the functions mapping political discourses to popular support and fighting technologies to combat effectiveness are different for both groups, reflecting differences in the intrinsic characteristics of their leaders.

In this setting, conflict technology should possess two characteristics. First, the outcome has to depend on the relative strengths of the combatants' political and armed fighting technologies. Little popular support or an ineffective fighting technology does not necessarily imply a bad outcome if the opponent also has weak technologies. Second, it has to be consistent with war initiation. When $r = 0$ rebels must be able to capture a positive fraction of income in order to get the necessary funds to recruit combatants.

If we let $\gamma = \Lambda(x_g^*)$ and $\rho = \Lambda(x_r^*)$, and normalize the effectiveness of fighting technology, a modified version of the ratio-form CSF that satisfies the two requirements is:

$$p_r(r, g) = \frac{\rho + r}{(\rho + r) + (\gamma + \phi g)} \quad \text{and} \quad p_g(g, r) = \frac{\gamma + \phi g}{(\rho + r) + (\gamma + \phi g)}, \quad (2)$$

where p_r and p_g are the fractions of income captured by rebels and government, g and r are the sizes of their fighting forces, and $\phi = \frac{\Phi(h_g^*)}{\Phi(h_r^*)}$ the relative fighting effectiveness. Writing them like this implies income can be captured either by political means (the fractions $\rho/(\cdot)$ and $\gamma/(\cdot)$) or by force (the fractions $r/(\cdot)$ and $g/(\cdot)$)⁶.

Income shares given by (2) are increasing in the combatant's own effort and decreasing in the opponent's, account for all available output ($p_r = 1 - p_g$), and depend only on the efforts of the players participating in conflict⁷. They are also twice continuously differentiable and subject to decreasing returns in own effort, a fact that reflects the inability of an extra soldier to make a difference in a large army.

Under these circumstances a party that does not fight will still capture a positive fraction of income, but no fraction of income is guaranteed to any party, even if it has a very large fighting force. So in a situation of total peace the distribution of income is given by $p_r = \frac{\rho}{\rho + \gamma}$ and $p_g = 1 - p_r$.

⁶To avoid confusion, *conflict* technology denotes the combination of politics and weapons used to capture output as specified in (2), while *fighting* technology refers to a particular h_i .

⁷In general this CSF has all the properties of contest success functions given in Skaperdas (1996).

Rebels' Behaviour

The rebels face the problem of maximizing their expected income $y_r(r, g)$, which is constrained by the production-predation restriction and by conflict technology. Since combat effectiveness and popular support are assumed to be common knowledge, their problem becomes:

$$\max_r y_r(r, g) = \frac{a(n - r - g)(\rho + r)}{(\rho + r) + (\gamma + \phi g)},$$

which can be given the standard interpretation of maximizing the capture of produced output. The first order condition for the problem is:

$$\frac{\partial y_r}{\partial r} = \frac{-a(r^2 + (g - n)(\gamma + g\phi) + (2r + \rho)(\gamma + \rho + g\phi))}{(r + \gamma + \rho + g\phi)^2} = 0.$$

Given that a, ρ, γ and ϕ must be positive⁸, g and r must be nonnegative and $n > r + g$, we can solve for r to obtain the rebels' income-maximizing force for every size of the government's army:

$$F_r(g) = \sqrt{(n + \gamma + \rho + g(\phi - 1))(\gamma + g\phi)} - (\gamma + \rho + g\phi). \quad (3)$$

A closer look at (3) reveals the underlying mechanism behind the rebels' optimal response. The first order condition can be written as $\frac{\partial y}{\partial r} p_r(r, g) + \frac{\partial p_r}{\partial r} y(r, g) = 0$, where the first term represents the reduction in output from having one less peasant (*marginal cost*), and the second the additional income an extra combatant can capture (*marginal benefit*). Marginal cost (*MC*) is always negative and decreasing because every new recruit reduces output and raises p_r at a decreasing rate, making the fraction of rebels' income lost to new recruits ($-a p_r$) a decreasing function of r .

On the other hand, marginal benefit (*MB*) is always positive and decreasing because each new recruit increases p_r , and in doing so raises the amount of income rebels can capture by $y g \frac{1}{\rho + r + \gamma + \phi g}$. It is also subject to decreasing returns both because of the decreasing returns to capture and because larger forces imply smaller output.

What is the optimal response to an increase in the government's forces? The answer can be seen in figure 1⁹. Initially, when the government's army is g_0 , the optimal rebel size is given by r_0 , where $MC = MB$. An increase in the government's force to g_1 will lower output and p_r for any level of r , causing a fall in the amount of income every individual combatant is able to

⁸Moreover, $\phi \geq 1$ as will be shown in section III.

⁹Note that the *MC* curve is plotted in absolute value and hence represents the magnitude and not the sign of lost output.

capture (shifting MB to the left), and a fall in the amount by which each new recruit reduces y_r (shifting MC down). If only the change in capture is allowed to take place, the optimal response will be to increase marginal benefit by lowering r to r' (*capture effect*). But when the the reduction in output is also considered, the optimal response is to increase armed size to r_1 (*harm effect*).

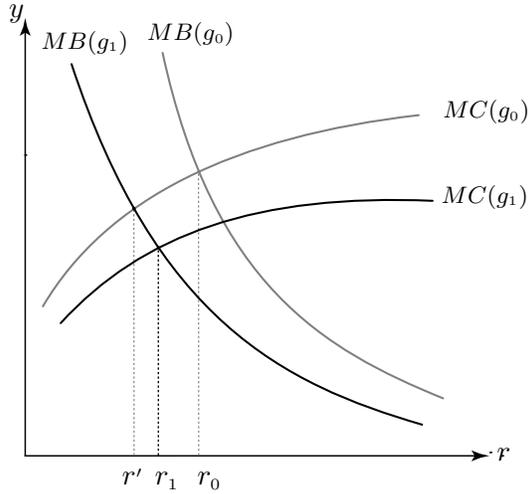


Figure 1: Rebels' optimal response to increases in g

The final outcome will depend on which of the two effects dominates. If the capture effect dominates (as in the figure: $|r' - r_0| > |r_1 - r'|$), the optimal response is to reduce the rebel force. But if the harm effect dominates, the optimal response is to increase r . Which of the two prevails will depend on the size of the government's army: for small values of g the harm effect is likely to dominate because of the large returns to capture of a small army; for a large g the opposite is likely to be true with the capture effect being stronger. This nonlinearity is what lies behind the slope of $F_r(g)$ in figure 2.

Government's Behaviour

The government also maximizes its expected income $y_g(g, r)$. It faces the same constraints as the rebels in production and fighting, and it too observes popular support and combat effectiveness. Hence its problem is given by:

$$\max_g y_g(g, r) = \frac{a(n - r - g)(\gamma + \phi g)}{(\rho + r) + (\gamma + \phi g)},$$

which yields the first order condition:

$$\frac{\partial y_g}{\partial g} = \frac{a \left(\phi(n-r)(r+\rho) - 2g\phi(r+\gamma+\rho + \frac{g\phi}{2}) - \gamma(r+\gamma+\rho) \right)}{(r+\gamma+\rho+\phi g)^2} = 0.$$

Again, given that a , ρ , γ and ϕ must be positive, g and r must be nonnegative and $n > r + g$, we can obtain:

$$F_g(r) = \frac{\sqrt{(r+\rho)(r+\gamma+\rho+(n-r)\phi)} - (r+\gamma+\rho)}{\phi}, \quad (4)$$

where $F_g(r)$ is the government's army that maximizes income for every size of the rebel force. A closer look at (4) shows that when taking recruitment decisions the government must also strike a balance between the cost of lost output and the benefit of additional income. In fact, given the similarity of the cases, an analysis in terms of MC and MB can also be made of the government's optimal response to increases in r .

Equilibrium

The outcome of this game can be represented in a triangle with sides of size n for the government's and rebels' fighting forces (figure 2). Since (3) and (4) are the combatants' best responses to the other combatant's actions, the Nash equilibrium is given by g^* and r^* , the values of g and r that make $F_r(g) = F_g(r)$. After some simplification solutions in \mathbb{R}^{2+} can be shown to be:

$$r^* = \frac{\gamma + n\phi - \rho(2\sqrt{\phi} + \phi)}{2(\sqrt{\phi} + \phi)}; \quad (5)$$

$$g^* = \frac{(n+\rho)\phi - \gamma(1+2\sqrt{\phi})}{2\phi(1+\sqrt{\phi})}. \quad (6)$$

Note that since the game space is an isosceles right triangle, the vertical (or horizontal) distance of any point to the hypotenuse will be equal to $n - r - g$, the number of peasants. This means that any two points lying on a line parallel to the hypotenuse will imply the same level of production, whilst a point in a line closer to the origin implies a higher level of output. In other words, there are an infinite number of isoproduct lines with the hypotenuse being $y = 0$ and the origin $y_{\max} = y(0, 0)$.

We can use (5) and (6) to see the effect of changes in the parameters on the equilibrium force sizes. In the case of ρ :

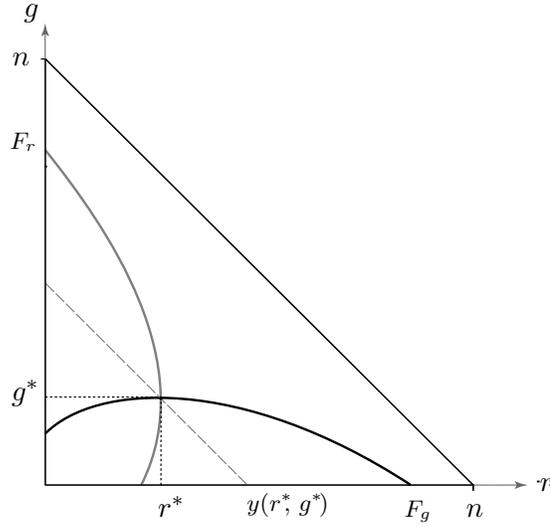


Figure 2: Conflict equilibrium

$$\frac{\partial r^*}{\partial \rho} = -\frac{2 + \sqrt{\phi}}{2(1 + \sqrt{\phi})} < 0 \quad \text{and} \quad \frac{\partial g^*}{\partial \rho} = \frac{1}{2(1 + \sqrt{\phi})} > 0.$$

An explanation of these signs can be given using the marginal analysis introduced in the previous section. When ρ increases rebels are able to capture a larger amount of output for every level of r . This shifts MB to the left as each individual combatant is now able capture a smaller fraction of output, and MC upwards since the larger p_r implies a larger fraction of output is lost for each new recruit. Because the two effects go in the same direction $F_r(g)$ will shift to the left, reducing r .

For the government the implications are the opposite. A bigger support for the rebels reduces p_g for all levels of g , shifting MB to the left and MC downwards. But since increases in ρ always increase rebels' income, MC will fall by a larger amount than MB and thus $F_g(r)$ will move up. In other words, the government will confront the larger support for the rebels by increasing its fighting force in order to prevent its output-share from falling.

Increases in γ are analogous, but here it is the government the one that reduces its armed force because of the negative capture and harm effects, and the rebels the ones that increase recruitment. As before reaction functions will shift, but $F_g(r)$ downwards and $F_r(g)$ to the right:

$$\frac{\partial r^*}{\partial \gamma} = \frac{1}{2(\sqrt{\phi} + \phi)} > 0 \quad \text{and} \quad \frac{\partial g^*}{\partial \gamma} = -\frac{1 + 2\sqrt{\phi}}{2\phi(1 + \sqrt{\phi})} < 0.$$

Changes in n increase both army sizes. A larger n implies a larger output, so the fraction of it captured by each combatant will rise and shift MB to the right for both sides. But since n has no effect on the fraction of output lost by each new recruit (i.e. recruitment comes from the new population), individual costs will remain unaltered and MC will not move. An increase in population will have only a positive capture effect, and will thus shift both reaction functions outwards:

$$\frac{\partial r^*}{\partial n} = \frac{\sqrt{\phi}}{2(1 + \sqrt{\phi})} > 0 \quad \text{and} \quad \frac{\partial g^*}{\partial n} = \frac{1}{2(1 + \sqrt{\phi})} > 0.$$

Note that although population size affects recruitment, (5) and (6) are not influenced by the productivity parameter a . That is, a larger output will not affect recruitment as long as it is caused by higher productivity and not by population growth. The reason can be seen in the first order conditions: an increase in a raises the fraction of output lost for every new recruit by the same proportion it increases the fraction every combatant can capture. The result is an upward shift in MC and a right shift of MB that leave optimal army sizes unaffected¹⁰.

Finally, the effect of changes in ϕ on equilibrium fighting forces is given by:

$$\frac{\partial r^*}{\partial \phi} = \frac{(n + \rho)\phi - \gamma(1 + 2\sqrt{\phi})}{4(1 + \sqrt{\phi})^2\phi^{\frac{3}{2}}} \quad \text{and} \quad \frac{\partial g^*}{\partial \phi} = \frac{\gamma(2 + 5\sqrt{\phi} + 4\phi) - (n + \rho)\phi^{\frac{3}{2}}}{4\phi^2(1 + \sqrt{\phi})^2}.$$

Starting from a situation where the effectiveness of the two sides is the same, an increase in ϕ means government's soldiers become more effective at capturing output. Given that $\frac{d}{d\phi}(\frac{\partial p_g}{\partial g})$ is positive when $g\phi$ is small and negative when it is large, an increase in ϕ raises the effectiveness of the first soldiers but lowers it for a big army. In other words, the returns from adopting a better fighting technology are large but fall rapidly.

This is reflected in figure 3 by the movements in MB and MC . For small values of ϕ , a raise in the government's fighting effectiveness increases marginal benefit to a greater extent than marginal cost and hence increases g (right panel). For large values, however, an increase in ϕ will reduce g because soldiers are already so effective that the extra income captured by the new technology is insufficient to compensate for the fraction lost in recruitment (left panel). The overall response is thus an initial upward movement of $F_g(r)$ when ϕ is small, and a gradual shift down if ϕ continues to raise.

¹⁰This does not mean that an increase in a has no influence at all on recruitment; it will not change army sizes, but it leads to larger values of equilibrium marginal captures.

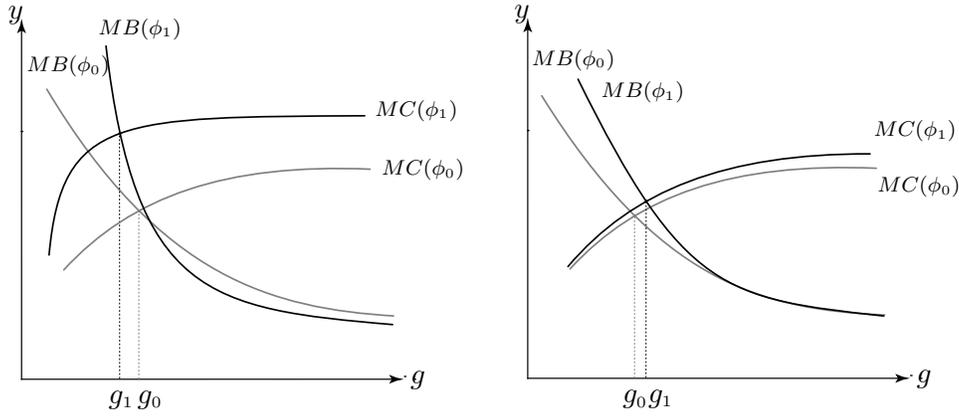


Figure 3: Government's optimal response to increases in ϕ

For the rebels the increase in ϕ means a reduction in their relative combat effectiveness. This has the opposite effects (i.e. MB and MC shift downwards), causing $F_r(g)$ to move to the right. For small values of ϕ (when g is likely to rise) MB will fall by a larger amount than MC and so the optimal response is to reduce r . When ϕ is large the opposite will take place and the optimal response will be to increase r .

Output, recruitment and shares

Using (5) and (6) we can determine the values of the rest of the variables needed to characterize equilibrium. In the case of production:

$$y^* = a(n - r^* - g^*) = \frac{a(\gamma + (n + \rho)\phi)}{2\phi}, \quad (7)$$

implying equilibrium output increases with productivity and population size and with γ and ρ , reflecting the fundamental trade off faced by the parties: on the one hand recruitment is discretionary, but cannot increase capture without reducing output; and on the other, population support does not hurt output, but the effectiveness of a political discourse cannot be increased endogenously.

Equation (7) has two additional implications. First, given $\frac{\partial y^*}{\partial \phi} < 0$, an increase in relative combat effectiveness increases the total amount of resources the economy dedicates to appropriative activities: the ratio (g^*/r^*) might fall, but $g^* + r^*$ will always rise. Second, it gives an upper bound to popular support: unless $\gamma < (n - \rho)\phi$, output under civil war could be larger than output of total peace $y(0, 0)$.

Equilibrium shares are obtained by substituting g^* and r^* in (2) which, after some simplification, yields:

$$p_r^* = \frac{1}{1 + \sqrt{\phi}} \quad \text{and} \quad p_g^* = \frac{\sqrt{\phi}}{1 + \sqrt{\phi}}, \quad (8)$$

implying that, regardless of productivity, population size or popular support, the side with a more effective fighting technology will capture a larger amount of output. The reason for this result lies in the optimizing behavior of both groups. Using the first order condition for rebels we have:

$$a p_r = \frac{y_g}{(r + \rho + \gamma + g \phi)} \quad \Rightarrow \quad \frac{\rho + r}{\gamma + g \phi} = \frac{e}{\rho + r + \gamma + g \phi}$$

and for the government:

$$a p_g = \frac{y_r}{(r + \rho + \gamma + g \phi)} \quad \Rightarrow \quad \frac{\gamma + g \phi}{\rho + r} = \phi \left[\frac{e}{\rho + r + \gamma + g \phi} \right],$$

indicating that when combatants are equally effective at fighting, total force sizes will be the same ($\rho + r = \gamma + g$) and income will be equally split. In other words, the party with smaller popular support compensates for its relative weakness by recruiting a larger fighting force.

When $\phi > 1$, however, $\gamma + g \phi > \rho + r$ and the government will have a larger share. Rebels do respond to the government's soldiers greater effectiveness by increasing r , but only to the point where $p_r < p_g$; recruiting more to prevent their share from falling would have a cost in terms of lowering y_r . Therefore (8) implies that, despite any initial distribution of resources, income will be split according only to fighting effectiveness, with the more effective side receiving the larger fraction.

This result differs from Hirshleifer (1991) where the party endowed with fewer resources improves its income share by committing relatively more effort to fighting. This is what he calls the *paradox of power* which, in its strong form, corresponds to the case when $\phi = 1$ above. Nonetheless he gives some numerical examples to illustrate the possibility that the paradox can be violated, but not because of differences in combat effectiveness, but rather because the importance of having a larger army can be very high¹¹. Skaperdas (1997) also finds that a larger productivity for appropriative activities increases a player's share in income, but his result is contingent on the strength of complementarities in production.

¹¹Hirshleifer uses a *CSF* function in which differences in fighting technology do not affect fighting effectiveness directly, but through a *mass effect* parameter that reflects the importance of having a large army.

Optimal sizes (5) and (6) can also be used to determine the viability of recruitment. To see this note that the optimization problems for both players can be given the standard interpretation of maximizing expected income. But since $n - r - g = e$, capturing income can also be interpreted as a competition for peasants, where parties get hold of the output produced by the peasants they are able to control. If each side pays wages from captured output, and if all output is used to pay salaries, in the case of the rebels we must have:

$$w_r r + w_e e_r - y p_r = 0,$$

where w_r and w_e are, respectively, the wages of rebels' combatants and peasants. Given that $e_r = e p_r$ represents the peasants under rebel control, the equality becomes $w_r r - (a - w_e) e_r = 0$, with $a - w_e$ being the amount of each peasant's production retained by the rebels.

Feasibility in recruitment requires the constraint $w_r \geq \delta w_e$ to be satisfied, which says peasants will only become rebels if they can expect to earn at least δ times the wage of peasants. If we assume $\delta = 1$, we can combine the equality with the fact that w_e is the difference between a and the amount retained by the rebels, and write the constraint as¹²

$$\tau \geq \frac{r}{e_r + r} \quad \tau \in (0, \bar{\tau}],$$

which says that for recruitment to be possible, the tax rate $\tau = \frac{a - w_e}{a}$ imposed on peasants must be larger than the share of appropriative resources in the total amount they control. The maximum feasible tax rate is $\bar{\tau}$ such that $a(1 - \bar{\tau})$ is the smallest amount of income required for peasants to engage in production, and $\tau = 0$ does not raise the required resources to ensure participation.

Due to the symmetry of the cases, the government's participation constraint is defined likewise:

$$\tau \geq \frac{g}{e_g + g} \quad \tau \in (0, \bar{\tau}].$$

¹²Note that δ can be smaller or greater than 1, reflecting the importance of income with respect to other motivators in the decision to join the rebel group. Larger values of δ imply recruitment is more expensive and thus that a greater effort is needed from peasants to fund rebellion.

III. Characterization of Equilibria

The above analysis can be put together to determine the circumstances that lead to investment in fighting forces. Initially the economy has no combatants so $e = n$ and $y = y_{\max}$. Among the peasants, the two leaders choose x and h and decide the size of their fighting forces. Given that we have assumed output to be a proxy for political power, (8) implies that the side with the greater fighting effectiveness becomes the government so that $\phi \geq 1$.

Once choices are made, two conditions must be satisfied for conflict to take place: both players have to choose a positive fighting force and recruitment must be feasible. If we use the (ρ, γ) space to determine the levels of popular support consistent with war, the first condition is given by¹³:

$$\begin{aligned} r^* \geq 0 & \quad \Rightarrow \quad \gamma_{r^*} \geq (2\sqrt{\phi} + \phi)\rho - n\phi; \\ g^* \geq 0 & \quad \Rightarrow \quad \gamma_{g^*} \leq \frac{(n + \rho)\phi}{1 + 2\sqrt{\phi}}, \end{aligned}$$

while the second is determined by the equilibrium values of the participation constraints¹⁴:

$$\begin{aligned} PC_r : \quad \bar{\tau} \geq \frac{r^*}{e_r^* + r^*} & \quad \Rightarrow \quad \gamma_{PC_r} \leq \frac{((\rho - n)(\bar{\tau} + (\bar{\tau} - 1)\sqrt{\phi}) - 2\rho)\phi}{\bar{\tau} + (\bar{\tau} - 1)\sqrt{\phi}}; \\ PC_g : \quad \bar{\tau} \geq \frac{g^*}{e_g^* + g^*} & \quad \Rightarrow \quad \gamma_{PC_g} \geq \frac{(n + \rho)(\bar{\tau}(1 + \sqrt{\phi}) - 1)\phi}{\bar{\tau} - 1 + (\bar{\tau} - 2)\sqrt{\phi}}. \end{aligned}$$

The four inequalities are plotted in figure 4¹⁵. In the dark grey area the level of support for both sides is large enough to allow recruitment, but not so large as to make fighting suboptimal. It corresponds to interior solutions like the one depicted in figure 2. Starting from any point in this area, an increase in γ while holding ρ constant reduces g and forces rebels to increase r in order to prevent their output share from falling. But since $\frac{\partial y^*}{\partial \gamma} > 0$, the increase in r is smaller than the reduction in g , and output rises. Output shares remain constant and entirely determined by ϕ .

¹³The subindexes in γ represent the values of support for the government that satisfy each inequality (e.g. γ_{r^*} are the values of γ consistent with $r^* \geq 0$).

¹⁴Written like this, the PC constraints say that for recruitment to be possible the equilibrium share of appropriative resources for each player must be smaller than the maximum feasible tax rate. Also note that (7) implies $e^* = \frac{(\gamma + (n + \rho)\phi)}{2\phi}$.

¹⁵Note that $y^* = y(0, 0)$ along the dotted line, so this line represents the maximum admissible values for γ and ρ . Also note that the kinks in the PC constraints stem from the fact that outside the zero army lines force sizes are given by $F_r(0)$ and $F_g(0)$.

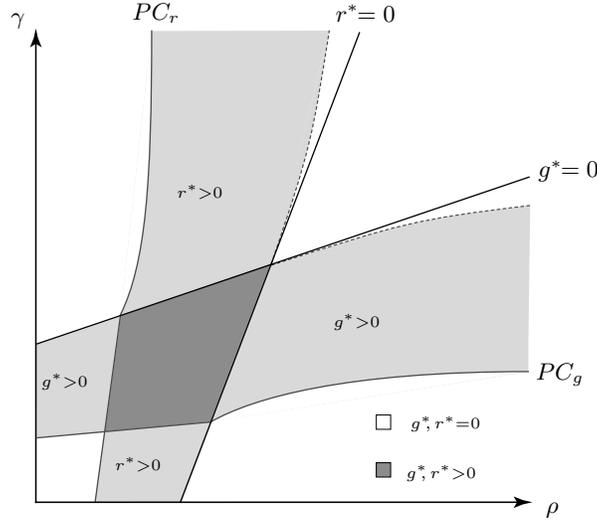


Figure 4: Characterization of Equilibria

The inequalities also define three other possible types of equilibria. Regions shaded in light-grey represent corner solutions where only one player chooses to fight (*armed peace*). In the two located between the $g^*=0$ line and PC_g , the government's army size is determined by $F_g(0)$, and equilibrium output and shares by $y(0, F_g(0))$ and $p_g(F_g(0), 0) = 1 - p_r(0, F_g(0))$.

Note that although both equilibria involve only the government choosing to arm, they are qualitatively different. In the first (left of PC_r) rebels would like to fight but, given ϕ , cannot obtain enough support to capture the necessary output. Rebellion is financially nonviable because the amount of income needed to recruit can only be obtained by taxing peasants above the maximum feasible tax rate. In the second r^* is zero for the opposite reasons. Despite being able to recruit, rebels have such a large support that they find optimal not to fight: having a fighting force would imply a reduction in income since marginal cost outweighs marginal benefit for any recruit.

The same analysis can be made for government. In the two light-gray areas between the $r^*=0$ line and PC_r , only the rebels choose to arm. Equilibrium output and shares are obtained from $F_r(0)$ and lack of financial viability occurs below PC_g .

Finally the three white regions represent corner solutions where both players choose zero fighting effort (*total peace*). Here output is y_{\max} and income shares are determined solely by popular support ($p_g^* = \frac{\gamma}{\gamma + \rho} = 1 - p_r^*$). Of the three, the area between PC_g and PC_r is characterized by peasant's indifference: fighting is optimal but impossible because support is so low that no party is able to capture enough income to recruit. That is, peace

arises from the financial invariability of war. In the other two one of the sides can fund fighting but finds it optimal not to do so, while for the other fighting is optimal but financial constraints impede it.

Note that all of the above discussion depends on the specific values of tax rates and relative combat effectiveness. Changes in $\bar{\tau}$ and ϕ will therefore affect the size and shape of the different regions. In the case of the tax rate, impact on the likelihood of war comes only from the participation constraints. That is

$$\frac{dPC_r}{d\bar{\tau}} = \frac{2\rho(1 + \sqrt{\phi})\phi}{(\bar{\tau} + (\bar{\tau} - 1)\sqrt{\phi})^2} > 0 \quad \text{and} \quad \frac{PC_g}{d\bar{\tau}} = -\frac{2(n + \rho)(1 + \sqrt{\phi})\phi^{\frac{3}{2}}}{(\bar{\tau} - 1 + (\bar{\tau} - 2)\sqrt{\phi})^2} < 0,$$

which indicate that, for a given level of support for the opponent, an increase in the maximum feasible tax rate makes recruitment possible for both sides with smaller own support (i.e. both participation constraints shift towards the origin). Note also that since $\tau = 1 - \frac{w_e}{a}$, an increase in $\bar{\tau}$ can come either from larger productivity or smaller wages.

The impact of changes in combat effectiveness is determined differently. If we focus on the area between the two zero army lines, the inequalities have the following properties¹⁶:

- (P1) $\frac{d\gamma_{r^*}}{d\rho}, \frac{d\gamma_{g^*}}{d\rho} > 0 \quad \forall \phi \geq 0;$
- (P2) $\frac{d\gamma_{r^*}}{d\rho} > \frac{d\gamma_{PC_r}}{d\rho}, \frac{d\gamma_{g^*}}{d\rho} < \frac{d\gamma_{PC_g}}{d\rho} \quad \text{for} \quad \bar{\tau} > 0;$
- (P3) $\gamma_{PC_r} = \gamma_{r^*} = -n\phi \quad \text{for} \quad \rho = 0;$
- (P4) $\gamma_{g^*} = \gamma_{PC_g} = 0 \quad \text{for} \quad \rho = -n.$

Therefore, in the case of the rebels, an increase in ϕ shifts $r^*=0$ and PC_r to the right, reflecting the fact that for a given level of government support ρ must be larger if the rebels are to have a positive army. For the government the effect is ambiguous. The $g^*=0$ line shifts up since $\frac{d\gamma_{g^*}}{d\phi} > 0$, but the impact on PC_g depends on the sign of $\frac{dPC_g}{d\phi}$. We can use this last derivative to determine the critical value of ϕ that makes $\frac{dPC_g}{d\phi} = 0$. Since $\bar{\tau}$ must be between zero and one, and since $\frac{d^2PC_g}{d\phi^2} < 0$ over that interval, it is given by:

¹⁶Although not necessary for determining the impact of movements in ϕ , these additional properties show the tax rate consistent with unconstrained recruitment:

$$\frac{d\gamma_{PC_g}}{d\rho}, \gamma_{PC_g} = 0 \quad \text{if} \quad \bar{\tau} = p_r^* \quad \text{and} \quad \lim_{\bar{\tau} \rightarrow p_g^*} \frac{d\gamma_{PC_r}}{d\rho} = \infty, \quad \lim_{\bar{\tau} \rightarrow p_g^*} \rho_{PC_r} = 0.$$

$$\phi_c = \frac{(\bar{\tau} - 1)^2 (1 + 2t^2 - (2\bar{\tau} - 1)\sqrt{1 + 4\bar{\tau}})}{2\bar{\tau}^2(\bar{\tau} - 2)^2},$$

which implies that only if $\phi < \phi_c$ can increases in ϕ lead to upward shifts in PC_g ¹⁷. Therefore an increase in ϕ will always shift the civil war area to the right and, provided it is large enough, will always bring peace (figure 5). The type of peace, however, depends on the values of $\bar{\tau}$ and ϕ . If $\phi < \phi_c$ an increase in ϕ shifts PC_g up as in the figure and the economy can end up in the total peace region (point P_1). The reason is that when ϕ is small an increase in ϕ leads to an increase in g and in the government's share but also to a reduction in output; so if peasants cannot be heavily taxed (i.e. small $\bar{\tau}$), the increase in capture may not be large enough to compensate the fall in output and could leave the government with insufficient resources to recruit. Otherwise the economy will move to the armed peace region with the government capturing enough income to pay for its army, and the rebels unable to recruit due to lower output and a relatively smaller fighting effectiveness (point P_2).

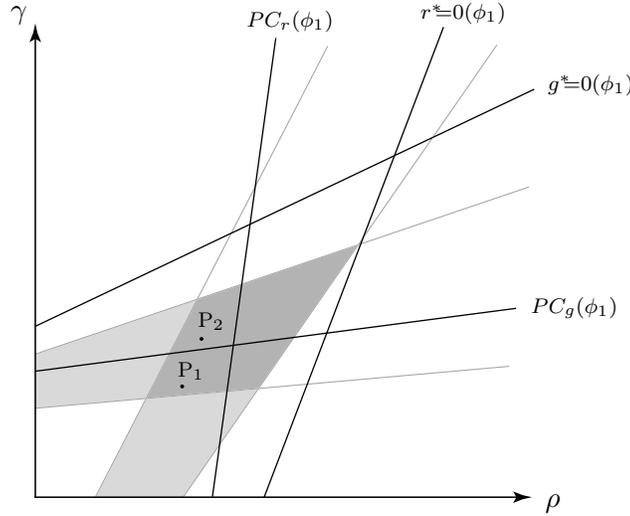


Figure 5: Equilibrium impact of an increase in ϕ

The road to war

The above analysis implies there can be many different roads to war. One of particular historical importance, and a source of influence for many in-

¹⁷Note that since ϕ_c depends only on $\bar{\tau}$ and $\phi \geq 1$, $\phi < \phi_c$ implies $\bar{\tau} \lesssim 0.36$.

surgencies, is Mao's protracted popular war. His approach, used in the anti-Japanese and anti-Koumintang wars, consists of three distinctive phases. The first is the *strategic defensive*, which occurs when the enemy is in the offensive and the insurgent's primary goal is survival. Their effort is focused on political activities such as propaganda, recruitment of local political leaders and the organization of demonstrations and other acts of protest. At this stage the use of force is kept to a minimum, consisting mainly of selective terrorism to gain support by demonstrating willingness and capability to fight and by trying to provoke disproportionate government repression.

The second is the *strategic stalemate*, characterized by the use of guerrilla warfare. Ideally the effort made in the first stage should allow insurgents to establish bases in remote areas and carry surprise attacks on government's forces. They will seek to form a parallel government in the areas they control, and try to drive government's forces in to a strategic defensive. The need for a full-time guerrilla force arises in this phase, specially in the later stages.

Phase three is the *strategic offensive* where guerrilla forces are transformed to conventional armies. On the military side the objective is to defeat government forces, while in the political side to take control of government. In the end, the large scale of military victories and the insurgent's political strength should lead to the collapse of the government and the triumph of rebellion.

In terms of the model, the strategic defensive corresponds to the armed peace area between the zero army lines where $g^* > 0$. Rebels do not have enough support to finance rebellion, so they keep military operations to a minimum ($r^* = 0$) and focus on political organization. If a more effective political discourse that increases ρ for a given γ becomes available, or if a more effective fighting technology can be found, they could capture enough income to move to phase two inside the civil war area.

Phase three will take place only if the new technology makes rebels more effective at fighting (i.e. $\Phi(h_r) > \Phi(h_g)$) so that they can seize power. If the change in ϕ is large enough, or if the effectiveness of the government's political discourse falls sufficiently relative to their opponents', rebels will drive the government to the strategic offensive and leave the civil war area¹⁸.

A different approach to the protracted popular war is the military-focus strategy. In contrast to Mao's this strategy makes no systematic attempt to win popular support, but instead directs efforts to military operations. Here popular support is expected to come either from military victory or from direct efforts after power has been taken. In the model, the military-focus strategy can be represented as a reduction in ϕ for a given ρ that pushes the economy into war by shifting the civil war area to the left. As before, final victory is seen to be attainable through combat effectiveness superiority if ϕ falls enough to give power to the rebels and leave the civil war area.

¹⁸See section one for a discussion of the factors that can affect γ , ρ and ϕ .

Note that one particularly important source of change in ϕ can be external intervention. This was the case, for example, in countries like Nicaragua, Angola and Afghanistan, where civil wars were seen by superpowers as a battlefield for the cold war.

Another strategy that has frequently been employed by insurgents is conspiracy. Essentially conspiracies are coups organized by small groups — military or civilian — to get hold of power. They rely on secrecy, organization and careful planning and are generally carried out in urban settings close to centers of government. As O’Neil (p. 32) points out, “[although] environmental factors, such as economic regression and maldistribution, political disorder, and corruption may be the underlying causes of the insurrection, the defection of military officers is the crucial variable”. Moreover, little or no attention is paid to popular support, and “the extent [to which] the views of the masses are taken into consideration, calculations center on public acceptance of the outcome”. In other words, conspirators know that the only way to power is by controlling those that control armed power. In this respect the strategy is similar to the military focus strategy, but it differs in the sense that the rebels seek to control the army by winning the loyalty of the incumbent officers instead of trying to replace them.

In the model conspiracies correspond to an attempt of seizing government by winning the support of the military to reverse $\Phi(h_g)/\Phi(h_r)$. Starting from a point in the armed peace region, if such a strategy becomes available, its success would depend on the magnitude of the change in ϕ and on the public’s acceptance of the coup. A conspiracy can succeed in overthrowing the government, but it can also send the economy into the civil war area if the toppled government manages to retain large amounts of support.

Finally two other possible outcomes should be mentioned. The first is a situation where rebellion is viable despite insurgents being highly unpopular. If ϕ is sufficiently low, an economy can be at war despite $\gamma \gg \rho$. But for this to happen insurgents must be able to capture large amounts of output by force in order to compensate for the lack of support. Natural resources provide such an opportunity as shown by the cases of diamonds in West Africa or cocaine in Colombia¹⁹.

Second, the opposite is also possible. For large enough values of ϕ , armed peace can occur even if $\gamma \ll \rho$; that is, a situation of *repressive peace* where government retains power by being effective at using force to overcome lack of support and repress the desire for political change. Throughout history many examples can be found of tyrannies and other authoritarian regimes that meet this description.

¹⁹Collier and Hoeffler (2001) find that the risk of civil war is substantially higher in economies dependent on natural resource exports.

Conclusion

This paper follows the literature that sees conflict as the product of optimizing decisions by agents trying to strike a balance between productive and appropriative activities. The approach adopted here, however, is one of a competition for peasants' output where parties fight using political and military means, and where asymmetries in fighting technology are reflected directly in the effectiveness of combatants. In this setting conflict can occur, but only if both parties are capable of obtaining—either by force or through the voluntary support of peasants—enough resources to recruit and maintain an armed group.

Although the model relies on specific functional forms and is built on a static, perfect-information framework, the results obtained are consistent with various historical accounts of the different roads to war and with empirical evidence on the consequences of conflict. Civil wars do generate large costs in terms of lost output, worsen income distribution and shift spending to military activities.

With the appropriate parameter values, the model can also explain situations like the continued existence of highly unpopular rebel groups, the failure of insurgents to topple tyrannical regimes or cases where peace prevails even in the absence of an army. In the end it is the interplay of popular support and fighting effectiveness that determines which type of equilibrium arises.

The results also have three important implications in terms of the mechanics of conflict. The first has to do with the debate surrounding the role of grievances in civil war. Even if injustice does increase popular support, and thus the financial viability of rebellion, it may not be sufficient to fund recruitment and push the economy to war; especially if the government has a very effective army, as in the case of authoritarian regimes. So maybe it is effective repression what explains the difficulty in establishing an empirical link between grievances and war.

The second is related to the fact that conflict is more prevalent in poor countries. Here implications are the opposite: holding everything else constant, a more productive economy should have a larger feasible tax rate and thus be more likely to experience war. Nevertheless tax rates, as defined in the model, are also dependent on the reservation wages of peasants and have to be consistent with specific levels of popular support and fighting effectiveness to generate war. So perhaps, if the results of this model are to be accepted, wealthier economies experience less conflict not because they are wealthy but because they have more effective armies, because their political institutions have greater legitimacy and because rebellion does not generate much real support.

The third has to do with the requirements for successful peace agreements. The analysis of changes in fighting effectiveness suggests that, at

a minimum, they should include *disarmament* (i.e. one of the groups must give up their weapons to increase the other's fighting effectiveness). But disarmament can only fulfill this role if it is large enough for one of the peace areas to be reached and if it guarantees weapons are rendered useless. Otherwise it may fail to stop conflict and, even if it does, leave the economy under the threat of rearmament. But note that by no means is disarmament a sufficient condition: other arrangements have to be in place for disarmament to be incentive-compatible, such as power-sharing pacts, third party intervention and plans for the reintegration of former combatants.

Finally note that although this analysis has focused on civil wars, it can easily be extended to litigation, lobbying, political campaigning and, in general, to any rent seeking activity that includes a battle for public support and that can be subject to asymmetries in fighting.

References

- BRITO, D. L., AND M. D. INTRILLIGATOR (1992): "Narco-traffic and Guerilla Warfare: A new Symbiosis," *Defense Economics*, 3, 263–274.
- COLLIER, P. (2000a): "Economic Causes of Civil Conflict and Their Implications for Policy," *World Bank, Policy Research Working Paper*.
- (2000b): "Rebellion as a Quasi-Criminal Activity," *Journal of Conflict Resolution*, 44, 839–853.
- COLLIER, P., AND A. HOEFFLER (2001): "Greed and Grievance in Civil War," *World Bank, Policy Research Working Paper*.
- DIXIT, A. (1987): "Strategic Behaviour in Contests," *American Economic Review*, 77, 891–898.
- FREEDMAN, L. (ed.) (1994): *War*. Oxford University Press, Oxford.
- GROSSMAN, H. (1991): "A General Equilibrium Model of Insurrections," *American Economic Review*, 81, 912–921.
- (1995): *Handbook of Defense Economics* chap. Insurrections, pp. 166–189. Elsevier Science B.V.
- (1999): "Kleptocracy and Revolutions," *Oxford Economic Papers*, 51, 267–283.
- HIRSHLEIFER, J. (1988): "The Analytics of Continuing Conflict," *Synthese*, 76, 201–233.
- (1991): "The Paradox of Power," *Economics and Politics*, 3, 177–200.

- (1995): *Handbook of Defense Economics*chap. Theorizing about Conflict, pp. 166–189. Elsevier Science B.V.
- NEARY, H. M. (1997): “Equilibrium Structure in an Economic Model of Conflict,” *Economic Inquiry*, 35, 480–494.
- O’NEIL, B. E. (1990): *Insurgency and Terrorism*. Brassey’s, Virginia.
- SAMBANIS, N. (2002): “A Review of Recent Advances and Future Directions in the Literature on Civil War,” *Defense and Peace Economics*, 13, 215–243.
- SHAPIRO, C. (1989): *Handbook of Industrial Organization*chap. Theories of Oligopoly Behavior, pp. 320–382. Elsevier Science B.V.
- SKAPERDAS, S. (1992): “Cooperation, Conflict, and Power in the Absence of Property Rights,” *American Economic Review*, 82, 720–739.
- (1996): “Contest Success Functions,” *Economic Theory*, 7, 291–306.
- (1997): “The Distribution of Income in the Presence of Appropriative Activities,” *Economica*, 64, 101–117.
- TSE-TUNG, M. (1962): *On Guerrilla Warfare*, vol. Samuel B.Griffith translator. Frederick A. Praeger, New York.