C.I.R.P.É.E

Centre Interuniversitaire sur le Risque, les Politiques Économiques et l'Emploi

Cahier de recherche/Working Paper **09-47**

Warlords, Famine and Food Aid: Who Fights, Who Starves?

Max Blouin
Stéphane Pallage

Novembre/November 2009

Pallage: (corresponding author) CIRPEE and Dept. of Economics, Université du Québec à Montréal, PO Box 8888 (Downtown Station), Montréal, QC, Canada H3C 3P8; tel.: (514) 987-3000 (8370)
pallage.stephane@uqam.ca
Blouin: CIRPÉE and Dept. of Economics, Université du Québec à Montréal

We thank Joost de Laat, Claude Fluet and Elena Panova for comments on earlier drafts. This research was financed by grants from SSHRC (Canada) and FQRSC (Quebec).

Abstract:
We examine the effects of famine relief efforts (food aid) in regions undergoing civil war. In our model, warlords seize a fraction of all aid and use it to feed soldiers. They hire their troops within a population of farmers heterogeneous in skills. We determine the equilibrium distribution of labor in this environment and study how the existence and allocation strategies of a benevolent food aid agency affect this equilibrium. Our model allows us to precisely predict who will fight and who will work in every circumstance.

Keywords: Food aid, civil war, warlords, famine

JEL Classification: O10, F35, D74

1 Introduction

Humanitarian aid agencies might be better prepared to deal with famines if they knew in advance which sectors of a population would be most affected. Part of the answer, we find, has to do with how the agencies themselves do things.

The arrival of food aid into a region tends to benefit more than just the hungry. Aid agencies hire local personnel, buy local goods, pay bribes, make deals, and are robbed. Much of this appropriation is organized by or trickles up to a regional potentate or warlord. Regions may already be at war with one another, but the onset of famine brings a new dimension of conflict: regions compete for food aid. And the best way to attract food aid is to have hungry people.

Therefore we would expect warlords to manipulate the food needs of the population within their control in an effort to enrich themselves or finance their operations — essentially, to use hunger as a weapon.

This paper presents a formal, game theoretic model which illustrates how warlords may include the availability of food aid in their strategic decision-making. We take as our starting point a country divided into two regions, each controlled by a warlord. Individuals within an area have different agricultural productivities, or at any rate different access to food. Many do not have enough to survive on their own. Warlords are engaged in appropriative conflict with each other: each warlord hires soldiers in order to fight over a prize. Soldiers earn enough not to starve. As warlords are the only employers in a region, their hiring practices largely determine who in the region will need food aid, and how much each person will need. In our model they take this fully into consideration when recruiting.

This view of things seems to tally with observations which people in the field have made over the years. Cuny[1] and Hill (1999) say, "Combatants always receive priority for food — those with guns rarely starve. (...) People who produce food are the ones most likely to starve." Weiss and Collins (2000) summarize the links between aid, agencies, and warlords as follows:

> Combatants steal or extort relief assets (...) In addition to humanitarian goods, combatants may receive cash for providing protection to relief workers or relief warehouses and for allowing access to certain roads, airfields, or ports. Combatants may also intentionally create

[1]Frederick C. Cuny was a civil engineer and disaster relief specialist. He did field work in such places as Nigeria, Sudan, Somalia and Sri Lanka, while they were undergoing civil conflict. He disappeared in Chechnya in 1995.

> noncombatant displacement and acute impoverishment in order to lure relief agencies and their assets to a conflict environment, as was the case with Liberian warlords. Relief agencies have often implicitly or explicitly cut deals and accepted that a portion of their relief assets will be diverted to combatants — a kind of “tax” or “cost of doing business” in war zones. (pp. 133-134)

In Africa, the power structure seems to change constantly. More and more governments lose their hold on their countries, which break up unofficially into smaller territories ruled by ambitious potentates. One journalist (Polgreen, 2006) speaks of

> (...) the drawn-out ending of one era — the slow demise of nationalist Big Man politics — and the beginning of another, in which warlords presiding over small, nonideological insurgencies played havoc across much of the region, enriching themselves and laying waste to their homelands.

1.1 Related Literature

Who takes part of conflict? Who fights? are questions that have been asked by researchers in many fields. The literature can be divided in two broad parts according to the way it approaches answers to these questions. First, an important literature tries to establish the circumstances that favor an individual’s participation in conflict. We should of course distinguish voluntary participation from conscription, although one could argue that conscription is easier to sustain if it somehow meets the will of conscripts. Where participation is voluntary, many motivations have been proposed. From frustration, economic, ethnic or other, to ideology (which, by most definitions, has a component of reality denial), the literature has covered a large spectrum of possible circumstances (see, e.g. Horowitz, 1985; Muller and Seligson, 1987). As Humphreys and Weinstein (2008) demonstrate, no single one, however, can speak for all conflicts.

While this literature tends to focus on the motivations for conflict, another views the cause of conflict in opportunities (Goodwin and Skocpol, 1989; Lohmann, 1993; Collier and Hoeffler, 2004; Fearon and Laitin, 2003). In this equally important literature, little place is left for spontaneous outspurs of violence or reality denials and ideologically driven actions. Here, individuals act rationally. They ponder their choices. Even though ideology can be rationalized (see, e.g. Bénabou, 2008), conflict is analyzed through the lenses of researchers in this strand of thought as the collective result of individually rational agents comparing all opportunities.

In the latter approach to circumscribe the triggering elements of individuals' participation in conflict, a series of theoretical articles have established substantial ground. Herschel Grossman (1991), for example, views insurrections as a business like any other. In his models, armies and milicias are made of individuals allocating economic time to soldiering. When choosing whether to take part of fight, these individuals weigh the pros and cons of their enrolment, and in particular, they understand the opportunity cost of their action. In such a theory of conflict, ideologies play little role. Soldiers are pure mercenaries. In Azam (2006), participants internalize the cost the conflict might have on them if they do not participate: the opportunity cost of not participating includes possible victimization of civilians by warlords. The latter of course anticipate this and make sure the cost is credible, by encouraging looting and violence against civilians, including their own. In Gates (2002), recruits enter a self enforcing contract with the landlord or the rebel leader. Their relationship is one of a principal and multiple agents and everyone's action is individually rational. Gates (2002) brings interesting light at the sustainability of militia groups. Recently, Esteban and Ray (2008) propose a theory of ethnic conflicts in which individuals participate because they benefit from the fight.

In this vein of research, another important question is why wars would erupt in the first place, in other words why warlords would choose conflict over settlement. Garfinkel and Skaperdas (2007) provide an excellent review of this literature. Conflict can be rationalized by information asymmetries: it may serve as a way for one party to (costly) signal its strength or equivalently to force another to reveal a private information and prevent its bluff (Brito and Intriligator, 1985). Wars can also arise in absence of informational problems. In spite of their cost, they can be worthwhile today if they provide one party with a permanent advantage over another (Garfinkel and Skaperdas, 2000) or because one party may prefer fighting for a pie that cannot be divided or for the lack of commitment possibilities in settlements (Fearon, 1995; Powell, 2006). Territories are often considered as indivisible in bargaining, although the indivisibility may be endogenous (Goddard, 2006).

In this paper, we present a general equilibrium model of a heterogeneous population at the brink of war and threatened by a famine. Two warlords prepare to wage war against each other. Their conflict is purely appropriative and cannot be resolved through bargaining because of their inability to commit to a settlement. In this environment, we identify the equilibrium distribution of soldiers and farmers and show the particular and non-trivial role humanitarian aid agencies can play in shaping the equilibrium distribution of agents across occupations. Importantly, we are able to predict who within the civilian population will fight, who will produce goods, who will starve, and among the latter who may be saved by humanitarian aid.

Clearly, this paper is also directly related to the literature on humanitarian aid. As is now well understood, all attempts at providing some form of protection against shocks are tainted in some way by the so-called Samaritan's dilemma (Buchanan, 1975; Pedersen, 2001). The benevolent aid provider unwillingly generates a demand for aid. Potential recipients tend to create the conditions that will grant them access to aid. Blouin and Pallage (2009) have shown that humanitarian aid agencies are by nature particularly vulnerable to this form of moral hazard. Although the Samaritan's dilemma, in the context of humanitarian aid, is significantly more difficult to solve than in typical aid relationships, the authors propose a self-enforcing contract that does address the problem. In a different paper, Blouin and Pallage (2008) show that humanitarian aid agencies are not deprived of means to influence conflicts on the ground: they can use warlords' greed to influence warfare by designing conditional aid delivery schedules. In the present paper, we put the spotlight on the micro-foundations of an equilibrium involving two belligerants, their respective population and an aid agency. As in Blouin and Pallage (2008, 2009), the role of the aid agency is far from neutral.

2 The Model

There are 2 areas (but our results can be generalized to N areas). Areas receive aid, they wage war on one another, but otherwise they are closed economies. They do not trade with each other or with the outside world. There is no migration from one area to the other. Each area has one warlord and a population of measure 1. A single humanitarian aid agency provides aid to both areas.

We shall assume that the areas are identical. This is not essential for our results, but does facilitate exposition a great deal.

Food is the only good in the economy. Individuals may harvest it, receive it as aid, or receive it as wages for soldiering. Each individual needs to consume a minimum quantity c of food to survive. Warlords are not subject to this requirement.

Briefly, the main events modeled in this paper are the following. Warlords recruit soldiers within their areas, then engage in appropriative conflict against one another. Many non-combatants are threatened with famine, and the aid agency tries to save as many of these as possible. Warlords loot a fraction of all incoming aid. We will elaborate on these actions later.

Our main objective is to determine which individuals in each area will be recruited, which ones will receive aid, and which ones will be victims of famine. We do not include war deaths in our model, only deaths from starvation. We do this in order better to focus on the subject at hand, the distribution of food resources during civil war.

2.1 The population

Each individual will become either a soldier or a farmer. If the warlord in his area offers him a wage which he finds suitable, he becomes a soldier. Otherwise he becomes a farmer. Farming here is used as a proxy for whatever way people acquire food under normal circumstances, i.e. without the intervention of a warlord or an aid agency. It can be any non-military occupation. Thus we need not necessarily think of these economies as agrarian.

People's productivities as farmers differ. Within each area an index i ranks individuals according to their farming productivity, from 0 (least productive) to 1 (most productive). In this sense we will say that the population is uniformly distributed on the interval $[0, 1]$. A *harvest function* $h(i)$ measures the actual amount of food an individual with index i can produce on his own as a farmer. This is an increasing function, with

$$h(0) < c < h(1) \quad . \tag{1}$$

That is, the least productive cannot produce enough to survive, while the most productive can. See Figure 1, which is drawn for a single area and a linear harvest function. We denote i^* the index number of the individual who can just produce enough to survive. Thus individuals in the interval $[0, i^*)$ cannot survive on their own; those in the interval $[i^*, 1]$ can. We call the former "poor" and the latter "rich." These are of course only relative terms.

For a poor individual, there are only two ways to escape starvation. The first is to be recruited as a soldier by the area's warlord. In that case, the individual does *not* produce $h(i)$; he must receive a wage of c or more to survive. The other is to be a farmer, produce $h(i)$ on his own, and receive $c - h(i)$ as aid.

In contrast to farming, soldiering is an occupation where all individuals are equally productive, provided they receive enough food (as wages) to survive. Specifically, we will say that any soldier who receives less than c is completely useless militarily; but all soldiers who receive c or more are equally effective.

Thus our main assumption regarding people is that they differ widely in their ability to produce food for themselves, but do not differ in their ability

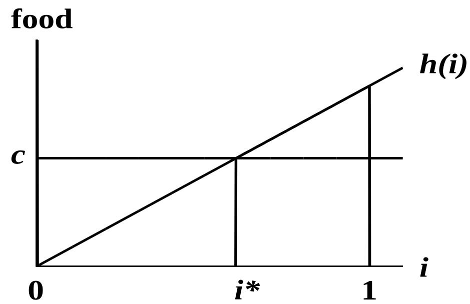

FIGURE 1. Individuals within an area are uniformly distributed over the interval $[0, 1]$. Their ability to provide for themselves is given by the harvest function $h(i)$.

to fight. After all, with a modern firearm in his hands, almost anyone can be a soldier; this is demonstrated by the all-too-common practice, in Africa and elsewhere, of recruiting children as militia.

2.2 Timing and objectives

The game unfolds in three stages, as follows:

1. warlords recruit soldiers; all those not recruited become farmers;
2. soldiers fight; farmers harvest;
3. the aid agency delivers food aid to people who need it; a fraction of this aid is seized by warlords.

2.2.1 Recruiting

In the first stage of the game, warlords recruit soldiers from the population and pay them wages. These wages can vary from one soldier to another. As previously mentioned, every soldier must be paid at least c, otherwise he will be ineffective. But there is also the individual's opportunity cost to consider: in order to induce an individual to become a soldier, a warlord must pay that individual at least what he could obtain by remaining a farmer, his harvest amount $h(i)$. The warlord will pay just enough to meet these two conditions; consequently a soldier's wage will be the survival amount or the harvest amount, whichever is more:

$$w(i) = \max\{c, h(i)\} \quad . \tag{2}$$

In equilibrium any individual of type i will accept to become a soldier if he is offered $w(i)$.[2] That being the case, we do not need to model individuals' behavior any further; we will focus on the decisions of warlords and the aid agency.

We wish to make two additional points about recruiting. First, we model soldiering as a voluntary occupation: there is no conscription. In reality conscription may very well occur; but in that case it is still more difficult to conscript someone against his will (someone whose prospects as a civilian are high) than someone who has relatively little to lose by joining the militia. Even this is sufficient to justify our approach.

The second point is that the wage set out in equation (2) does not take into account any risks incurred by soldiers. In other words, it is not necessary to pay soldiers *more* than their harvest amount $h(i)$ on the grounds that they face a risk of death. The reason is that in most modern civil wars, civilians are as much in danger as soldiers [see Azam (2002) and sources therein].

2.2.2 War

In the second stage, warlords fight over a prize of value W. This can be territory, power, or a resource; it may include the warlords' own wealth, so long as this is subject to appropriation during war.

Each warlord receives a share of this prize proportional to his share of soldiers deployed. Thus warlord 1 receives

$$\left[\frac{s_1}{s_1 + s_2}\right] W \tag{3}$$

as a direct result of war, where s_1 and s_2 are the sizes of the armies recruited in areas 1 and 2, respectively. Warlord 2 receives the remainder of the prize. The expression in brackets is a standard contest success function [see for example Tullock (1980), Hirshleifer (1988)]. If $s_1 = s_2 = 0$, this fraction is assumed to be $1/2$. Expression (3) represents the traditional approach to appropriative conflict.

[2] His acceptance can be secured by offering slightly more than this, but the difference can be negligibly small.

2.2.3 Aid

In the final stage, a humanitarian aid agency intervenes. Its aim is to save as many people as possible from starvation. Food aid is given only to poor farmers, i.e. not to soldiers and not to farmers with types $i > i^*$, since these groups already have enough to survive. A poor farmer who receives aid gets only what he needs in order to survive, which is $c - h(i)$. The agency is hampered in its efforts by the fact that a fraction θ of all aid entering an area is seized by that area's warlord.[3] The agency knows this will happen, so if it wants an amount x to reach potential famine victims in area j, it must send in $x/(1-\theta)$. The agency has a fixed food budget B which it cannot exceed; nor is it mandated to provide anyone with more than what they need to survive.

The fact that food aid comes after the hostilities is consistent with the choices often made by humanitarian agencies in the field, i.e. to withdraw momentarily from war-torn areas and wait for more peaceful times to do their job. Several aid agencies chose to withdraw from bloodshed in Sudan's Darfur, e.g. the Norwegian Refugee Council in November 2006 (IRIN, 2006) and Oxfam, Mercy Corps and Save the Children Spain in April 2007 (Byers, 2007). Similar withdrawals took place in Somalia in 1999 (IRIN, 1999).

2.3 Warlords' payoffs

In making his recruitment decision, a warlord has his eye on the proceeds of war, given by expression (3), on the wages he must pay his soldiers, and on the amount of aid which his area can receive, a fraction θ of which falls into his hands. That is, warlord 1 tries to maximize

$$\pi_1 = \left[\frac{s_1}{s_1 + s_2}\right] W - P_1 + \theta A_1 \quad , \tag{4}$$

where P_1 is the payroll for his army, and A_1 is the total amount of food aid sent into area 1. Warlord 2 has a similar equation for π_2. We will refer to last term in the equation as the *aid term*.

Warlords make their recruitment decisions simultaneously. The agency has a chance to observe their choices before intervening. We look for the subgame-perfect equilibrium of this game. In such an equilibrium, the agency acts with full knowledge of the warlords' actions; moreover, each warlord acts taking the

[3]Here θ is exogenous. It could certainly be endogenized, and settle at a level where the warlord's efforts to increase it balance out the agency's efforts to keep it low. We feel this would add a level of complexity without really generating new results. See Azam (2002) for a discussion of how warlords allocate effort between warfare and looting.

other warlord's actions as given (i.e. correctly anticipating them) and knowing how the agency will react.

The main tradeoff faced by a warlord is that recruiting poor individuals into his army may improve matters for him on the battlefield (at relatively low cost), but at the same time leave fewer people prone to starvation, thereby resulting in less aid entering his area. In addressing this issue, he must pay attention not only to how many soldiers he recruits, but also to the types of individuals he recruits. We will see that warlords' hiring patterns depend crucially on the agency's budget B.

3 Analysis of Equilibrium

Given our assumption of identical areas, all equilibria are symmetric (this is straightforward to show, but a formal proof is omitted).

Also, all equilibria necessarily involve *some* recruitment on both sides. If neither warlord chooses to spend anything on recruitment, i.e. if $s_1 = s_2 = 0$, then each one ends up with half of the prize. But here neither warlord is taking full advantage of the situation. Since warlord 2 is not putting up a fight, warlord 1 could take the entire prize by raising even the smallest of militias: this would be a clear gain. Therefore $s_1 = s_2 = 0$ cannot be an equilibrium.

We will assume that neither warlord ever wants to recruit the entire poor population in his area. This can be done by placing a suitable restriction on W. The purpose of this assumption is to ensure a role for food aid in the model.

3.1 Benchmark: the situation without aid

First of all, for purposes of comparison with subsequent results, let us consider the situation in the absence of any food aid. There is no agency, or, equivalently, the food aid budget is $B = 0$.

Under these circumstances, a warlord will hire the cheapest soldiers he can find: he will recruit only poor people, i.e. people with types $i < i^*$. Each of these costs him c, a sort of minimum wage for him. The exact number of soldiers hired is found by standard optimization techniques. Warlord 1 chooses s_1, anticipating that the other warlord chooses s_2. He solves

$$\max_{s_1} \ \pi_1 = \left[\frac{s_1}{s_1 + s_2} \right] W - s_1 c \quad ; \tag{5}$$

warlord 2 chooses s_2 simultaneously, taking s_1 as given. Taking first-order conditions, i.e. setting derivatives equal to zero, yields the solution:

$$s_1 = s_2 = \frac{W}{4c} \quad \equiv \bar{s} \quad . \tag{6}$$

All poor people not recruited die of starvation; the number of such deaths in each area is $i^* - \bar{s}$. The payroll in each area is $\bar{s}c$, equal to a quarter of the value of the prize.

3.2 Effect of food aid

The benchmark equilibrium is an interior solution: each warlord could hire more or fewer soldiers if he wished, but it is not optimal for him to do so. We now ask how the introduction of food aid can modify this behavior. We begin the analysis by making a simple point, in the form of a proposition.

Proposition 1. *A warlord's army never exceeds size $\bar{s}$ in equilibrium.*

We omit a formal proof, since the result is quite intuitive. In the benchmark equilibrium, each warlord basically maximizes the first two terms on the right-hand side of (4) when he chooses $\bar{s}$, since the third term (the aid term) is not included. What happens if we now include aid terms? Since $\bar{s}$ already maximizes the first two terms, the warlord will choose a level other than $\bar{s}$ only if doing so increases the aid term. How can this happen? Recruiting *more* soldiers cannot result in more aid entering an area, since it is non-combatants who receive aid. But recruiting *fewer* soldiers *may* attract more aid to the area, since those not recruited become potential aid recipients. Therefore we may consider $\bar{s}$ as an upper bound on each area's recruitment in equilibrium.

3.3 Agency strategy

If the agency cannot save everyone from starvation, it will save as many as it can. The way to do this is *not* to help the neediest first. If the agency concentrates its efforts on farmers with types (index numbers) close to 0, it will not be able to save a large number of people, because then each person it assists needs to be given a lot of food in order to survive. In other words, if the agency feeds the neediest first, a little bit of food aid goes only a short way towards relieving famine.

The agency wants a little bit to go a long way. It will, therefore, give its top priority to farmers who do need assistance, but who need comparatively little of it. This means those farmers with types less than but close to i^*.

This principle is illustrated by Figure 2. In the left panel, individuals with types from a to i^* receive aid. Each receives the difference between minimum survival consumption c and his own production $h(i)$. The red (dark if copy is black and white) area therefore represents the total amount of aid received by individuals in the area. In the right panel, the *same* amount of aid is received by a different set of individuals, those with types ranging from 0 to b. These are the neediest people in the area. Clearly, more lives are saved in the left panel than in the right, and so we retain that strategy as the optimal one for the agency.

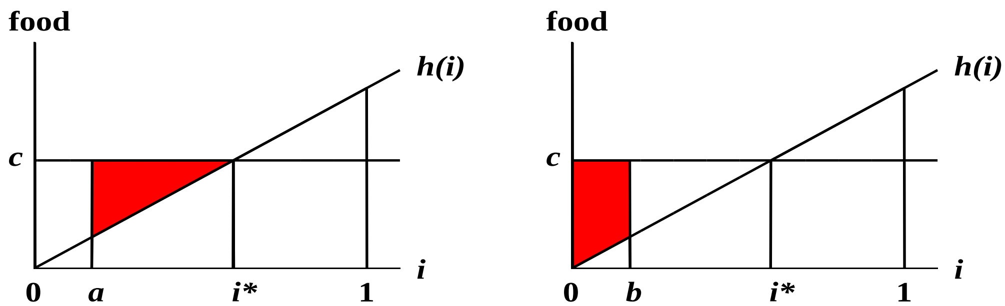

FIGURE 2. The same amount of aid given to two different parts of the population. More lives are saved in the left panel than in the right.

Specifically, the agency will feed every farmer (in each area) whose type lies above a certain threshold a and below i^*. Where this threshold lies depends on how warlords recruit and on the agency's budget.

The above reasoning is consistent with alternative interpretations of the function $h(i)$, which can stand for other things besides food productivity. In general, $h(i)$ stands for the ease with which food can be obtained. For instance it could be a function negatively related to one's distance from food access centers (FACs) such as cities. Hence someone with a high $h(i)$ would be someone living close to an FAC, while someone with a low $h(i)$ would be someone living in a more remote area. Indeed, famines tend to happen in rural areas, not cities (Cuny, p.7).

This is compounded by the fact that it costs an aid agency more to get food to its target, the farther the target is from a city or port of entry. And the longer the delivery route, the more opportunities arise for a warlord to appropriate a share of the aid, at roadblocks for example. Besides, warlords often control the transportation infrastructures themselves, renting trucks and selling fuel to aid agencies at exorbitant prices. So the farther away an individual is from a city, the more needs to be expended in order to save him. Naturally, under these circumstances, aid agencies will often concentrate on areas closest to cities first, and gradually expand their operations outward. This is perfectly consistent with the agency's strategy given above.

3.4 Equilibrium with small budget

If the agency's budget is relatively small, then there will not be enough aid to save everyone in both areas, even if each warlord hires $\bar{s}$ soldiers. knowing this, each warlord will try to attract as much of the agency's budget to his own area.

Consider what happens if each warlord recruits those individuals in his area with types immediately below i^* — the richest of the poor, so to speak. This is shown in Figure 3. The label R stands for "recruited" and the yellow (lightly shaded if copy is black and white) areas represent the amount of food paid out as wages by warlords. When the time comes to distribute aid, the agency sees the same situation in both areas, and so allocates the aid evenly between the two. In doing so, it adheres to the principle described above, namely to feed the most productive poor farmers first. The label A stands for "aided" and the red area represents the amount of aid received by farmers. This leaves part of the population, labeled F in the figure, in a state of famine.

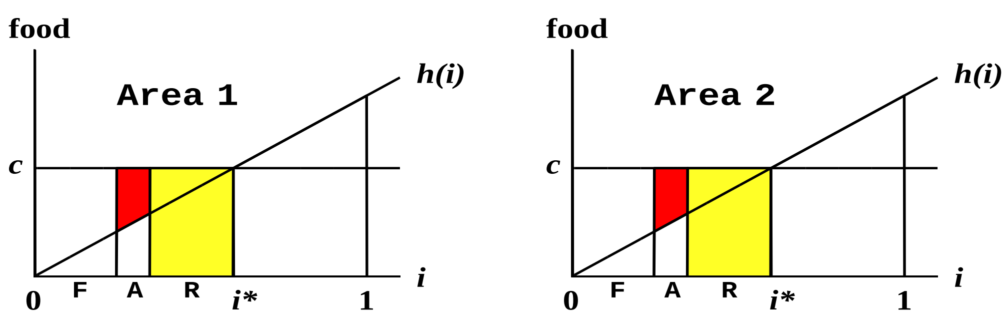

FIGURE 3. Disequilibrium. Here each warlord could do better by recruiting lower types.

This situation cannot be an equilibrium. Warlords did not act in a forward-looking manner when recruiting. If warlord 1 anticipates that warlord 2 will recruit individuals close to i^* (the richest of the poor) he would do better to recruit the very poorest soldiers in his area, as shown in Figure 4. The aid agency, seeing that the resources at its disposal can save more people in Area 1 than in Area 2, will send more aid to Area 1. The total amount of aid received is the same as in Figure 3.

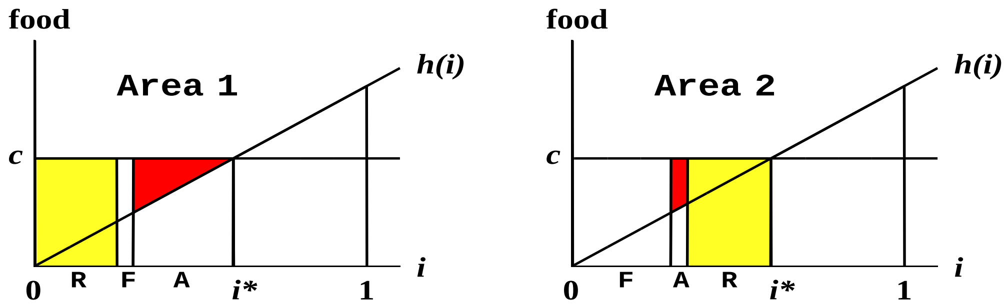

FIGURE 4. Disequilibrium. Here warlord 1 is recruiting optimally but warlord 2 is not.

This is not an equilibrium either, since warlord 2's behavior in this case is still non-optimal. The true equilibrium is depicted in Figure 5. Both warlords recruit the poorest individuals in their respective areas, i.e. the ones who would be the least productive as farmers. In this case neither warlord can improve his situation given the other's behavior.

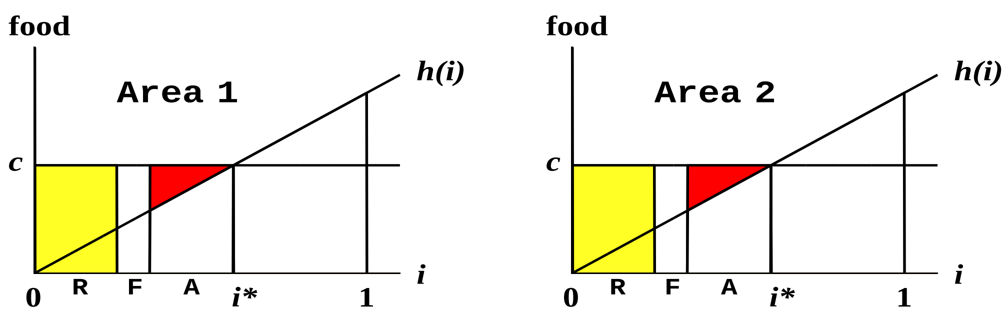

FIGURE 5. Equilibrium with small aid budget. Both warlords, because they are competing for aid, recruit the poorest individuals as soldiers.

In Figure 5 the agency is able to save more lives in total than in either of the two previous figures, using the same amount of aid. In our model this happens not because the warlords have any concern for the welfare of their populations, but because each is trying to lure the limited amount of aid to his own area. Each warlord tries to create within his area the conditions which the aid agency favors for effective intervention.

As for the *size* of each warlord's army, this has a lot to do with what we mean by a small budget for the agency. We showed in Proposition 1 that in equilibrium warlords do not raise armies larger than $\bar{s}$. We say that the agency's budget is "small" when each warlord recruits $\bar{s}$ soldiers, hires the "right" ones (in the sense of Figure 5), and *still* the agency does not have enough to save all remaining poor individuals.

As we mentioned when explaining Proposition 1, equilibrium army sizes will only be less than $\bar{s}$ if recruiting fewer people can result in more aid. But if the agency is already expending its entire budget when armies are of size $\bar{s}$, then nothing can be done to attract more aid. Therefore armies *will* be of size $\bar{s}$ in equilibrium. The warlord's tradeoff between army size and aid only manifests itself with larger agency budgets.

Example 1. *Suppose that minimum survival consumption is* $c = 1$ *and that the harvest function is the linear function* $h(i) = 2i$. *This yields* $i^* = 1/2$ *as the breakpoint between rich and poor. Let the value of the prize be* $W = 1$ *and let* $\theta = 1/3$ *be the fraction of all incoming aid that is looted.*

Straightforward calculations show $\bar{s} = 1/4$ *as the benchmark equilibrium. When the agency's budget is small, therefore, each warlord recruits an army of size* $1/4$, *composed of the lowest-type individuals in his area, which is to say types* 0 *to* $1/4$.

How small is "small"? In each area, types $1/4$ *to* $1/2$ *are left in want of assistance. The total aid required to save them, given by triangular areas such as in the preceding figures, is* $1/16$ *for each area, so* $2/16$ *for both areas together. Therefore an aid package of* $3/16$, *or* 0.1875, *is needed to save all potential famine victims, since a third of it will be looted. Any budget* B *between* 0 *and* 0.1875, *then, results in the equilibrium configuration of Figure 5.*

3.5 Equilibrium with large budget

Now we imagine a food aid budget B that is substantially larger. In this case, since there is plenty of food at the agency's disposal, warlords no longer feel the need to compete with each other for it. That is, each warlord feels confident that whichever poor individuals he does not recruit will receive aid. So the amount of aid that reaches his area depends on his actions alone, not on those of the other warlord.

Since the agency has not spent its entire budget, each warlord could attract more aid to his area by recruiting fewer low types. The tradeoff between soldiers and aid, which was absent when the budget was small, is now present.

Perhaps the best way to represent this tradeoff is to calculate the real cost of hiring an individual. This is the sum of the *labor cost* involved (the wage the individual must be paid) and the *opportunity cost* of hiring him (the amount of aid which could have been looted had he *not* been hired). That is to say,

$$\text{cost} \quad = \quad \text{wage} \quad + \quad \text{potential looted aid} \quad . \tag{7}$$

The wage, as mentioned before, is c or $h(i)$, whichever is more. As for aid, an individual whose type is lower than i^* will need to receive an amount $c - h(i)$ to survive. The agency, anticipating that a fraction θ of whatever it sends will be stolen, sends him

$$\frac{c - h(i)}{1 - \theta} \quad . \tag{8}$$

A fraction θ of this last amount is stolen, and the rest, $c - h(i)$, reaches the farmer. An individual whose type is greater than i^* receives no aid. Equation (7) becomes

$$\text{cost}(i) \quad = \quad \begin{cases} c + \left(\frac{\theta}{1-\theta}\right)[c - h(i)] & \text{if} \quad i < i^* \quad ; \\ h(i) & \text{if} \quad i \geq i^* \quad . \end{cases} \tag{9}$$

According to equation (9), the cost of recruiting an individual is lowest at i^* (where it is equal to c) and gets progressively larger as one moves away from i^* in either direction. This makes sense. The individual whose type is i^* can be paid the minimum wage c and does not receive any aid if left unrecruited: he is therefore the cheapest to hire. The next cheapest are those to his immediate left and right. Types slightly below i^* are also paid c and receive a small amount of aid if not hired; types slightly above i^* must be paid a little bit more than c but receive no aid if not hired.

The optimal strategy for each warlord is of course to hire the cheapest soldiers in his area, but "cheapest" according to the accounting of equation (9). The resulting equilibrium is depicted in Figure 6.

We see that in equilibrium the richest of the poor and the poorest of the rich are recruited: the greater availability of food aid transforms soldiering from a lower-class to a middle-class occupation.

Of course, removing higher type farmers from food production has potentially important implications on the quantity of food available in the economy.

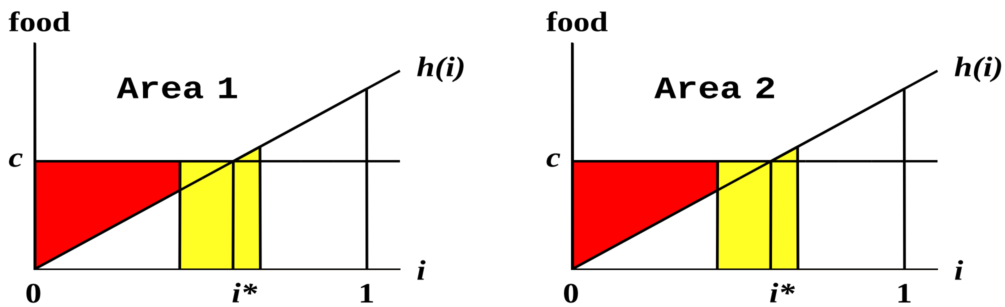

FIGURE 6. Equilibrium with large aid budget. Both warlords, because they are not competing for aid, leave the lowest types starving so as to attract as much aid as possible.

The existence of large aid budgets therefore disrupts the optimal allocation of labor in the recipient regions. This is another manifestation of the Samaritan's dilemma in humanitarian aid (Blouin and Pallage, 2009).

As for the size of each army, it is smaller than $\bar{s}$. Compared with the small-budget situation, the present situation is one in which soldiers have the same benefit in battle but cost more on average. So at the same time that warlords replace low-type soldiers with higher-type ones, they also reduce the total number of them.

The appendix explains how to determine the precise range of types recruited.

Example 2. *Let parameter values be as in Example 1. That is, let* $c = 1$, $h(i) = 2i$, $W = 1$ *and* $\theta = 1/3$.

Using the method shown in the appendix, we find that each warlord hires types 0.3545 *to* 0.5727*, an army of size* 0.2182*.*

How large is "large"? In each area types 0 *to* 0.3545 *require assistance to varying degrees. The amount required to save all these individuals is* 0.2288 *for each area, so* 0.4577 *for both areas. An amount* 0.6865 *has to be sent, since a third of it will be looted. Therefore a budget* B *of* 0.6865 *or more qualifies as a "large" budget.*

3.6 Equilibrium with medium budget

There is a gap between the largest "small" budget and the smallest "large" budget, as evidenced by Examples 1 and 2. What happens when the budget is in this gap?

The resulting equilibrium will share characteristics of the first two scenarios. An equilibrium with starvation is necessarily of the kind pictured in Figure 5, i.e. with small budget. An equilibrium in which the agency does not use its whole budget is necessarily of the kind seen in Figure 6, i.e. with large budget. An equilibrium with medium budget, therefore, is one in which the agency saves everyone, but has no money left over.

As mentioned, the agency will save every poor farmer whose type lies above a certain threshold a, whose value is determined by the warlords' recruitment and by the agency's own budget.

What is the cost, in equilibrium, of hiring individuals with types $i < a$? Their wage is c, since they are necessarily poor. And since their type is too low for the agency to send them aid, the opportunity cost of hiring them is zero. As for individuals with types above a, the cost of hiring them is the same as in the large-budget scenario. In summary, then, the cost of hiring a soldier of type i is

$$\text{cost}(i) \quad = \quad \begin{cases} c & \text{if } i < a \quad ; \\ c + (\frac{\theta}{1-\theta})[c - h(i)] & \text{if } i \in [a, i^*) \quad ; \\ h(i) & \text{if } i \geq i^* \quad . \end{cases} \tag{10}$$

The cheapest soldiers to hire are those with types below a, followed by those with types close to i^*. In equilibrium both warlords hire these, resulting in the hiring pattern seen in Figure 7.

As the figure shows, warlords recruit from two completely disjoint classes of people. They hire types close to i^* for the same reason as in the large-budget case: because these types are not very good aid-attractors and therefore more valuable as soldiers. And they hire the lowest types in their areas for the same reason as in the small-budget case: because the agency's budget is still not large enough for them to abandon their competition for aid; they leave enough high types unrecruited in order to attract the agency's resources. This competition diminishes, however, as the aid budget becomes larger. When the budget is large enough, it disappears completely.

For the same reason as in the large-budget scenario, army size for each area is strictly less than $\bar{s}$. The appendix discusses how the exact ranges of recruited types are determined.

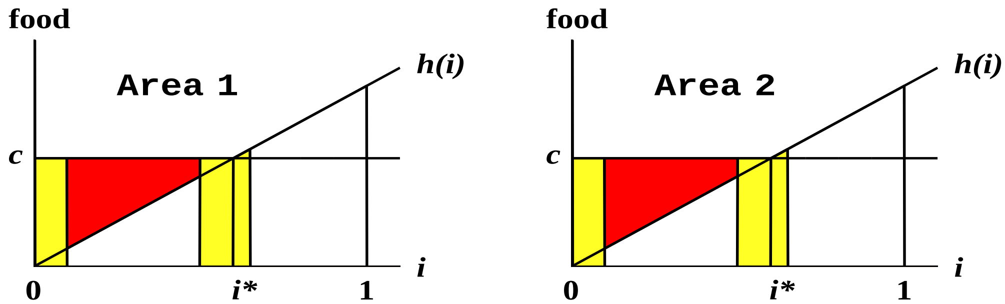

FIGURE 7. Equilibrium with medium aid budget. The agency spends its entire budget (with nothing left over), and no one dies from famine.

Example 3. *Let us use the same parameters as in the previous examples:* $c = 1$*,* $h(i) = 2i$*,* $W = 1$ *and* $\theta = 1/3$*.*

Equilibrium depends critically on the budget B*. We let this budget vary from* 0.1875 *(the largest "small" budget) and* 0.6865 *(the smallest "large" budget). For each budget level, we use the method explained in the appendix to find the equilibrium range of types recruited by the warlords. Results are reported in Table 1. Each row reports the budget* B*, three types* a*,* x *and* y*, and army size* s_1 *(which is equal to* s_2 *in equilibrium). Each warlord recruits types* 0 *to* a *and* x *to* y*; the aid agency provides aid to types* a *to* x*.*

Figure 8 summarizes the results of Examples 1, 2 and 3. The largest small budget is labeled B^*, and the smallest large budget is B^{**}. For any given budget, types recruited are those below the a curve plus those between the x and y curves.

4 Conclusion

We present a simple theory of participation in wars, civil or other. We show how famines and humanitarian agencies interact with warlords' choices of which soldiers to recruit in a civilian population. We assume that civilians are not drafted. They are hired by warlords and have to be paid a wage at least equal to their best alternative option in civil life. We show that warlords choose their recruits based on their direct cost and on their likelihood to attract food aid. As a result, depending on the budget available to the aid agency, warlords may select their troops within a group of more or less productive farmers.

B	a	x	y	s_1
0.1875	0.25	0.5	0.5	0.25
0.2	0.2418	0.4953	0.5024	0.2488
0.25	0.2104	0.4773	0.5113	0.2445
0.3	0.1813	0.4605	0.5197	0.2405
0.35	0.1540	0.4447	0.5276	0.2369
0.4	0.1281	0.4297	0.5351	0.2336
0.45	0.1036	0.4154	0.5423	0.2305
0.5	0.0801	0.4016	0.5492	0.2276
0.55	0.0575	0.3884	0.5558	0.2249
0.6	0.0358	0.3756	0.5622	0.2223
0.65	0.0149	0.3633	0.5684	0.2199
0.6865	0	0.3545	0.5727	0.2182

TABLE 1. Results for Example 3: equilibrium with medium aid budget, for various budget levels B. Each warlord hires types 0 to a and x to y.

We show, as a consequence, that the humanitarian aid agency's budget has a potentially important effect on the production of food in the region. If the aid budget is large, warlords will recruit soldiers within the group of more productive farmers, even though the latter cost him more to hire. This has a negative impact on the amount of food produced.

Our paper has two important implications. It provides a new building block to the micro-foundations of an individual's participation in conflict, and possible anticipation and manipulation of those decisions by warlords. It also provides a tool for aid agencies to forecast how their budget and actions may effect the intensity of conflict and the faces of those who will starve and those who will fight.

References

Azam, J.-P. (2002). "Looting and conflict between ethno-regional groups: lessons for state formation in Africa." *Journal of Conflict Resolution* 46(1), 131-153.

Azam, J.-P. (2006). "On thugs and heroes: why warlords victimize their own

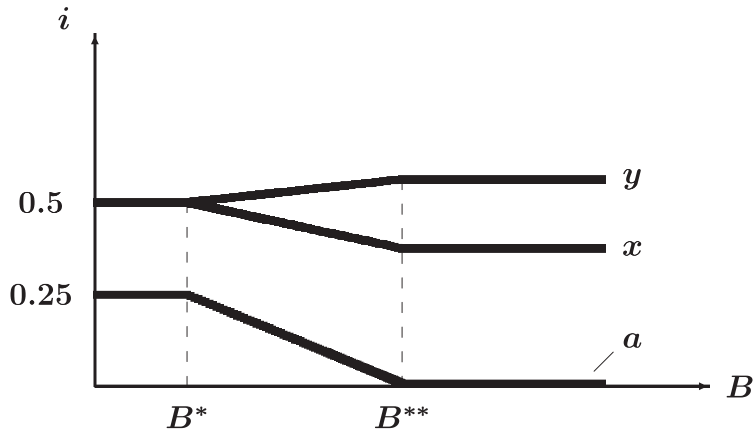

FIGURE 8. Summary of results for Examples 1, 2 and 3. For a given budget level, warlords hire all types below the a curve and between the x and y curves. B^* is the largest small budget and B^{**} is the smallest large budget.

civilians," *Economics of Governance* 7 (1), 53-73.

Blouin, M. and Pallage, S. (2008). "Humanitarian relief and civil conflict." *Journal of Conflict Resolution* 52(4), 548-565.

Blouin, M. and Pallage, S. (2009). "Addressing the food aid curse." *Economics Letters* 104(1), 49-51.

Bénabou, R. (2008). "Ideology," NBER Working Papers 13907, National Bureau of Economic Research, Inc.

Brito, D. and Intriligator, M. (1985). "Conflict, war and redistribution," *American Political Science Review* 79, 943-957.

Buchanan, J. (1975). "The Samaritan's dilemma." In: Phelps, E. (Ed.), *Altruism, Morality and Economic Theory.* Russel Sage Foundation, New York.

Byers, D. (2007). "Fearful aid agencies pull out of Darfur." *London Times*, April 23.

Collier, P. and Hoeffler, A. (2004). "Greed and grievance in civil war," *Oxford Economic Papers* 56(4), 563-595.

Cuny, F.C. and Hill, R.B. (1999). *Famine, Conflict and Response.* West Hartford, CT: Kumarian Press.

Esteban, J. and Ray, D. (2008). "On the Salience of Ethnic Conflict." *American Economic Review* 98(5), 2185-2202.

Fearon, J. D. (1995). "Rationalist explanations for war," *International Organization* 49, 379-414.

Fearon, J. D. and Laitin, D. (2003). "Ethnicity, insurgency and civil war," *American Political Science Review* 97(1), 75-90.

Garfinkel, M. R. and Skaperdas, S. (2007). "Economics of conflict: an overview," in T. Sandler and K. Hartley (eds.), *Handbook of Defense Economics* Vol. II, 649-709.

Gates, S. (2002). "Recruitment and allegiance: the microfoundations of rebellion," *Journal of Conflict Resolution* 46(1), 111-130.

Goddard, S. (2006). "Uncommon ground: territorial conflict and the politics of legitimacy," *International Organization*, 60(1), 35-68.

Goodwin, J. and Skocpol, T. (1989). "Explaining revolutions in the contemporary Third World." *Politics and Society* 17(December), 489-509.

Grossman, H.I. (1991). "A general equilibrium model of insurrections," *American Economic Review* 81(4), 912-921.

Hirshleifer, J. (1988). "The analytics of continuing conflict." *Synthese* 76(2), 201-233.

Horowitz, D. (1985). *Ethnic Groups in Conflict.* Berkeley: University of California Press.

Humphreys, M. and Weinstein, J.M. (2008). "Who fights? The determinants of participation in civil war," *American Journal of Political Science* 52 (2), 436-455.

IRIN (1999). "Somalia: security concerns force aid agencies out of Merka." UN Office for the Coordination of Humanitarian Affairs, Report 4/30/99.

IRIN (2006). "Sudan: Norwegian aid agency shuts down Darfur operation." UN Office for the Coordination of Humanitarian Affairs, Report 11/10/06.

Lohmann, S. (1993). "Dynamics of informational cascades: the Monday demonstrations in Leipzig, East Germany, 1989-1991." *World Politics* 47(October), 42-101.

Muller, E. and Seligson, M. (1987). "Inequality and insurgency." *American Political Science Review* 81(June), 425-452.

Pedersen, K. R. (2001). "The Samaritan's dilemma and the effectiveness of development aid." *International Tax and Public Finance* 8 (5-6): 693-703.

Polgreen, L. (2006). "A Master Plan Drawn in Blood." *New York Times*, April 2.

Powell, R. (2006). "War as a commitment problem," *International Organization* 60, 169-203.

Tullock, G. (1980). "Efficient rent-seeking," in J.M. Buchanan, R.D. Tollison and G. Tullock (eds.), *Toward a Theory of the Rent-Seeking Society*. College Station: Texas A&M University Press.

Weiss, T.G. and Collins, C. (2000). *Humanitarian Challenges and Intervention.* 2nd ed. Boulder, CO: Westview Press.

Appendix

Equilibrium with large budget

Warlord 1's payoff is

$$\pi_1 = \left[\frac{s_1}{s_1 + s_2}\right] W - P_1 + \theta A_1 \quad . \tag{11}$$

Taking the derivative of π_1 with respect to s_1, we obtain

$$\frac{\partial \pi_1}{\partial s_1} = \left[\frac{s_2}{(s_1 + s_2)^2}\right] W - \frac{\partial P_1}{\partial s_1} + \theta \, \frac{\partial A_1}{\partial s_1} \quad . \tag{12}$$

The difficulty here is that P_1 and A_1 do not merely depend on how many soldiers are hired, but also on *which ones* are hired. This is true of their derivatives also. For this reason, we cannot use (12) in the usual way, i.e. by setting it equal to zero to find s_1. Rather, we use it to measure each individual's net marginal value as a soldier. If i is a farmer, this measures the net increase in π_1 that would result from hiring him. If i is already a soldier, it measures what would be lost by *not* hiring him. In equilibrium, all individuals with positive values are in the army, while those with negative values remain farmers. When the value is zero, it means the warlord is indifferent between hiring and not hiring him.

The first term on the right-hand side of (12) is the marginal benefit of the individual as a soldier, in terms of his help in acquiring the prize. It can be simplified by noting that in a symmetric equilibrium s_2 will be equal to s_1. The last two terms measure the cost of hiring the individual (wage and opportunity cost), already set out in equation (9). Thus we have

$$\frac{\partial \pi_1}{\partial s_1} \quad = \quad \left[\frac{W}{4s_1}\right] \quad - \quad \text{cost}(i) \quad , \tag{13}$$

which is graphed in Figure 9. The warlord hires all types from x to y. Note that $\partial \pi_1 / \partial s_1 = 0$ at both x and y. This is how the values of y and z can be found. First we let $s_1 = y - x$ in equation (13). Then we set the entire right-hand side of the equation equal to zero, first using $i = x$ (noting that in this case $i < i^*$), then again using $i = y$ (noting that this time $i > i^*$). This gives us a system of two equations in two unknowns, which is easily solved.

In equilibrium all types from 0 to x need food aid to survive. Since the warlord behavior described presupposes that the agency can save all of these individuals, the agency's budget must be sufficient to do this. This establishes a lower bound on our notion of a "large" budget.

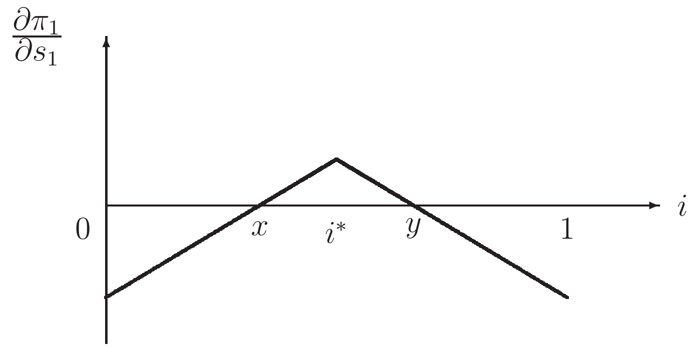

FIGURE 9. Net marginal value of soldiers when the agency's budget is large.

Equilibrium with medium budget

The medium-budget equilibrium is solved in a similar way. Equation (13) is used once again, but this time cost is given by equation (10) instead of (9). The result is graphed in Figure 10. The warlord hires all types from 0 to a and from x to y.

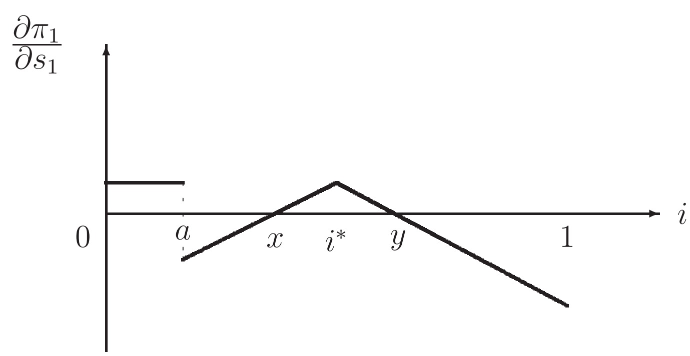

FIGURE 10. Net marginal value of soldiers in equilibrium when the agency's budget is medium.

The values of a, x and y are calculated as follows. First, let $s_1 = a + y - x$ in equation (13). Then, set the entire right-hand side of the equation equal to zero, first with $i = x$ then again with $i = y$ (since $\partial\pi_1/\partial s_1 = 0$ at those points). This gives us two equations in three unknowns: a, x and y. One more equation is needed. Everyone from a to x needs aid to survive. In the medium-budget scenario, the agency spends its entire budget and just manages to save everyone. Thus for the third equation we calculate the amount of aid which needs to be sent in order to save types a to x in both areas (taking looting into account) and set it equal to the agency's budget B.