TIMES OF WAR AND PEACE
THE ECONOMICS OF CONTINUING CONFLICT AND PRODUCTION: THEORY AND EMPIRICS

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ABSTRACT: *This paper presents a two-sector economy. In a **contested sector** two agents struggle to appropriate the maximum possible fraction of a contestable output. In an **uncontested sector**, they can exploit the production of some goods which are secure form appropriation. Agents split their resource endowment between 'butter', 'guns' and 'ice-cream'. The latter denote productive activities secure from appropriation. The productivity in the uncontested sector can countervail the incentives to conflict. IN a second section the basic model is extended to consider the impact of a larger time horizon on the intensity of conflict. Eventually, in a third section, following the theoretical insights the empirical analysis focuses on the relationship between civil wars in African countries and different sectors of the economy. In particular, a panel probit specification shows that the incidence of a civil war decreases in the size of manufacturing sector.*

KEYWORDS: Conflict, Productive and Unproductive Activities, Butter, Guns and Ice-cream, Appropriation, entrepreneurship, Warlords, Civil War.

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1. INTRODUCTION

This paper is intended to be a contribution to the theoretical economic analysis of conflict. A conflict can be described as *« a destructive interaction which involves strategic interdependent decisions in the presence of coercion and anarchy »*.In many general equilibrium models following Hirshleifer (1988/1991),[1] a contestable output falls into a common pool available for seizure and appropriation. The chosen levels of resources invested exclusively in productive or unproductive activities determine the social outcome of a conflict. Hirshleifer's seminal work and following contributions analyse a simplified economy where all productive activities are under the threat of violent appropriation. However, in reality, agents involved in a conflict have some income and wealth secure from appropriation. Hence, there must be a relationship between the choice of resources to be allocated to conflict and the choice of resources to be allocated in a secure production. In an extremely simplified economy, we can consider two sectors. In a first sector, each agent holds secure property rights over the production of some goods. Such secure property rights assure the holder of a secure level of production and income stream. In a second sector, agents struggle in order to appropriate the maximum possible fraction of a contestable output. In the continuation of this work, I shall label the first sector as *uncontested sector* and the latter as *contested sector*.

Several reasons can be advanced to distinguish between uncontested and contested sectors. First, there could be institutional factors protecting contracts and property rights. In fact, there could be sectors where enforcement of property rights can

[1] In more recent years several studies extended Hirshleifer basic model. See among others: Grossman (1991), Grossman and Kim (1995), Skaperdas (1992), Neary (1997a), Anderton et al. (1999), Noh (1999), Garfinkel (2004), Dixit (2004), Caruso (2006/2007), Hausken (2004/2006), Munster (2007), Spolaore (2007). The literature on the economics of conflict has been recently surveyed in Garfinkel and Skaperdas (2007).

be more effective than others. However, the protection of property rights can exist without a government with a monopoly of violence. Even stateless societies have developed informal institutions able to enforce property rights assignments. These informal structures were related to some specific factors as kin-ties, cheap and available information, reputation and social capital. These institutions in many cases are able to cope with the problem of management of common resources avoiding the "tragedy of commons", as noted in Collier and Gunning (1999). In brief, a first fruitful source to distinguish contested and uncontested sectors, can be referred to the separation between governance and government. Such a distinction has been recently emphasized in Dixit (2009).

Secondly, there could be geographical factors shielding some sectors from destructive conflicts and violent appropriation. On one hand, there could geographical obstacles making the struggle for appropriation less feasible. Instead, there are some fractions of territory more attractive than others because of their resources endowments and productive structures. This is verifiable when different warlords (or states and rebel groups) fight over the appropriation and the control of a territory. On one hand they fight and expend resources in an identified fraction of territory to appropriate a contested resource. On the other hand, they can be involved in productive activities on the fraction of territory whose government is completely secure. Finally, there are economic reasons shaping the preferences set of actors involved and spontaneously identifying a boundary between contested and uncontested sectors. Some activities can become relatively more attractive than others so that unproductive efforts can be devoted to them. Whenever the expected returns from appropriation and bloody rent-seeking are assumed to be greater than those attainable through investments in ordinary

entrepreneurial businesses, a rational agent may divert its efforts and resources to them. Therefore, in such a scenario, some entrepreneurial activities can be interpreted as non-attractive from rational agents. Paradoxically, being less profitable and non-attractive some activities are more secure from appropriation.

A simple fitting example could be drawn from reality of many African developing countries which experience the sadly famous 'resource curse'. In many cases, governments and different warlords compete over the appropriation of rents flourishing from exports of natural resources. This leads to social unrest and violent competition. In fact, it is now fully acknowledged that emergence of civil wars is positively related with the exploitation of rents flourishing in some sectors (see among others Collier and Hoeffler 1998, Le Billon 2001a, De Soysa 2002, Fearon and Laitin 2003). In particular, as shown in Buhaug and Gates (2002) localization of civil wars is positively related with the presence of natural resources. In particular, the authors studied the location of all battles thereby identifying the geographic extent of 265 civil conflicts over the period 1946-2000 and finding a robust positive association between the occurrence of violent conflicts and natural resources location.

The distinction between contested and uncontested sectors opens questions about the design of economic policies able to cope with both the persistence of bloody conflicts and the emergence of welfare-enhancing institutions. Ross (2003/2007) compares the cases of Nigeria and Indonesia in this way, though his work lacks strong theoretical underpinnings. Among other factors, the author maintains that in Indonesia the governments have been committed to support agricultural and manufacturing sectors. Instead Nigerian governments[2] focused upon exploitation of Oil sector thus

[2] See also the account given by Omeje (2004).

undermining entrepreneurial activities in small manufacturing sector and agriculture. Yet, Nigeria is plagued by an endless war in the oil-rich Niger Delta. Instead, Indonesia avoided the crowding-out of productive sectors as manufacturing and agriculture.

The reliance upon some contested sectors is the case of other African developing countries descended to civil wars as – among others – Chad, Liberia, Uganda and Angola. (see respectively Johnston 2004, Deininger 2003, Le Billon 2001b, Malaquias 2001). To simply illustrate the point, table 1 reports sectoral contributions to gross domestic product (GDP) for Angola, Chad, and Nigeria. which are resource-dependent economies and are commonly included among countries affected by the *resource curse*. All of them are dependent upon oil, whereas Angola is also dependent upon diamonds. All of them experienced violent internal conflicts. In 2002, Angola's long-running internal conflict between the ruling party the MPLA and UNITA ended (on Angola's war economy see among others Ferreira, 2006). Chad, which is listed among the poorest countries in the world, experienced a civil war onsets, in 1994. Therefore, for sake of the argument, Though by no means a perfect proxy, consider the mining (Oil) sector as a first candidate to be the contested sector, and the manufacturing sector to be the uncontested sector.

TABLE 1 - CONTRIBUTIONS TO GDP IN SELECTED COUNTRIES - VALUES EXPRESSED IN % -

	Year	Agriculture	Manufacturing	Mining
Angola	***1995***	7.4	4.05	59.9
	2006	8	3.7	58.8
Nigeria	***1995***	32.34	10.2	40.2
	2006	33.11	3.52	39.5
Chad	***1995***	36.8	11.9	0.6
	2006	21.3	6.7	46.2

Source: Unctad

These examples drawn form reality led easily to a further assumption. Namely it is reasonable to assume that there is a productive asymmetry between contested and uncontested sectors. In fact, contested production within the mining sector could be assumed to exhibit constant returns to scale whereas small-scale manufacturing firms and rural units could exhibit decreasing returns to scale. When distinguishing between contested and uncontested sectors, therefore, it is also reasonable to assume a productive asymmetry between them.

Hence, in the continuation of this work, I shall present a simplified economy characterized by two sectors labelled respectively as *contested* and *uncontested*. Two rational agents split their own positive resource endowment between two kinds of productive activities and unproductive activities. Beyond the classical 'butter' and 'guns' I shall label the productive investments in the uncontested sector 'ice cream'. Moreover, there is a productive asymmetry between the two sectors. That is, there is an uncontested sector characterized by decreasing returns to scale (DRS) and a contested sector characterized by constant returns to scale (CRS). For instance, the economies presented in Table 1 are characterized by dominance of contested butter, namely the Oil (or mining) sector, whereas a small manufacturing sector is defined as the 'ice-cream'.

In such a context, the final allocation of resources between 'butter', 'guns' and 'ice cream' will depend upon exploitation of force. To the best of my knowledge, within a growing literature on conflict theory there are very few papers analysing two sectors with three activities as two kinds of productive activities (secure production, contested production) and unproductive activities. Garfinkel and Skaperdas (2007) introduced the

argument in a section of their survey on economics of conflict. In a two-agent world, the authors assumed that agents can produce butter, guns and an inferior substitute for butter, called 'margarine'. The latter is assumed to be secure from appropriation by the rival. In the presence of perfectly enforced property rights over the production of butter, both agents would not have any incentive to produce margarine. Then, their model allows for two types of equilibria. In the first equilibrium agents only produce 'margarine' thus implying no allocation of resources to both 'butter' and 'guns'. In a second kind of equilibrium, both parties produce positive quantities of guns and butter but no margarine. Different equilibria emerge in the presence of particular combination of a degree of decisiveness of the conflict and a productivity parameter. Whenever the degree of productivity for margarine is relatively high with respect to the decisiveness of violent conflict, agents are likely to invest only in the secure production of margarine.

More attention has been paid to economies characterized by two kinds of unproductive activities (defence and offence) and productive activities. This is the case of Grossman and Kim (1995), Rider (1999) and Panagariya and Shibata (2000) among others. The latter, models an arms rivalry between two small countries facing a constant probability of war. Countries produce arms and a consumption good that can be traded internationally whilst a defence good interpreted as a public good is non-traded. The main result is that a subsidy flowing from one country to another can boost consumption and then increase total welfare. Rider (1999) develops a model with two goods and three activities (production, predation and defence) to show the impossibility of pure and uncontested exchange. In such a framework each agent is assumed to produce only one good.

This paper is simply designed. In a first section, a basic model is presented. In a second section, the impact of a longer time horizon is studied. In a third section, an empirical application focused on African civil wars is presented. In the last section, results are summarized and some conclusions are presented.

2. A BASIC MODEL OF CONFLICT AND PRODUCTION

The world is made of two risk-neutral agents indexed by $i = 1,2$. They interact simultaneously. Both agents have a positive resources endowment denoted by $R_i \in (0,\infty), i = 1,2$. It can be divided into 'guns', 'butter' and 'ice-cream'. By 'guns' I indicate any positive investments in unproductive activities of fighting. By 'butter' I indicate any positive investment in productive activities in the contested sector, whilst by 'ice-cream' I indicate any positive investments in productive activities in the uncontested sector. The interaction between the two agents generates an equilibrium allocation of resources endowment to 'guns', 'butter' and 'ice-cream'. To summarise formally it is possible to write the resources constraint as:

(1) $R_i = y_i + x_i + G_i, i = 1,2$

where G_i denotes the level of 'guns', and y and x denote 'ice-cream' and 'butter' respectively. They are all assumed to be positive: $G_i \in (0,\infty)\ y_i \in (0,\infty), x_i \in (0,\infty), i = 1,2$. In the contested sector, the contested joint product – indicated by CY - can be described as a simple linear additive function:

(2) $CY = x_1 + x_2 = TR - G_1 - y_1 - G_2 - y_2$

where $TR = R_1 + R_2$ and $TR \in [1,\infty)$. This aggregate production function is characterized by constant returns to scale and constant elasticity of substitution. The outcome of the

struggle is determined by means of an ordinary Contest Success Function[3] (henceforth CSF for brevity) in its ratio form:

(3) $p_i(G_1, G_2) = G_i / (G_1 + G_2), i = 1,2$

The functional form adopted for CSF is a special case of the general ratio form of CSF $b_i G_i^m / (b_1 G_1^m + b_2 G_2^m),\ m > 0, b_i > 0, i = 1,2$ which is extensively adopted in literature. In our context, firstly agents are identical in fighting abilities $(b_1 = b_2 = 1)$. Moreover, the parameter m is set to unity, $m = 1$. This is a crucial assumption. In fact, the parameter m which is commonly referred as 'decisiveness parameter' or 'mass effect parameter' does capture to which degree fighting efforts are translated into probability of success. That is, whenever $m < 1$, it could be said that the CSF does exhibit decreasing returns in the techonology of conflict. Whenever $m > 1$. Thus with $m = 1$ it exhibits increasing returns to fighting. it could be said the CSF exhibits constant returns to fighting. Such assumption appears to be particularly fitting in our context.

At the same time, the functional form of CSF adopted is also crucial with regard to the positivity assumption for guns. In fact, the ratio form of the CSF implies that if one of the two contestants does not allocate any resource to 'guns', the other party does appropriate all the contested output, namely $p_i(G_i, 0) = 1, \forall G_i \in (0, \infty)$. Then, either party would be likely to defect and invest any small positive magnitude in order to raise its fraction of the aggregate output from 50% to 100%, in order to appropriate all the joint contested output[4] defined by (2). Thus, if one agent chooses not to invest in 'guns', it

[3]Selective seminal contributions on CSF are by Tullock (1980), O'Keeffe et al. (1984), Rosen (1986), Dixit (1987) and Hirshleifer (1989). See then Skaperdas (1996) and Clark and Riis (1998) for a basic axiomatization. See also Amegashie (2006) and Peng (2006).

[4] Hirshleifer (1989, p. 105) also notes that the contested 'prize' must be larger than zero. *"Then , assuming only that* $V > 0$ [where V is the value of the prize], *under the Cournot assumption either player would be motivated to defect, since even the smallest finite commitment of resources makes the defector's relative success jump from 50% to 100%."*.

will receive a zero payoff, while player 2 will receive the payoff full and *viceversa*. If 'peace' can be defined as the condition in which $G_1 = G_2 = 0$, peace can never occur as an equilibrium under the ratio form of CSF. This is confirmed in Neary (1997b) which states "*as long as a player cannot physically exclude her consumption expenditure from being part of the overall prize, this expenditure is at risk of loss to the other players, and the player is, however unwillingly, a part of the game*"[5] That is, given the ratio form adopted for CSF, the positivity assumption for guns does capture the coerced participation in the conflict. Equation (3) is differentiable and follows the conditions below:

$$(3.1) \quad \begin{cases} p_1 + p_2 = 1 \\ p_i = .5 \text{ at } G_1 = G_2 \\ \partial p_i / \partial G_i > 0 \quad \partial p_i / \partial G_j < 0 \\ \partial^2 p_i / \partial G_i < 0 \quad \partial^2 p_i / \partial G_j > 0 \end{cases}$$

and then the outcome in the contested sector is given by:

$$(4) \qquad S_i = p_i(G_1, G_2)\theta CY$$

Where $\theta \in (0,1)$ denotes a physical destruction parameter. It can be interpreted as an ex-ante perception of destructiveness of conflict. That is, a conflict is twice costly. On one hand the amount resources allocated to 'guns' do constitute a deadweight loss for society because the same amount of resources could be allocated to more productive activities. On the other hand, in the case of actual violent conflicts there is a fraction of resources physically destroyed. In other words, the loss is not only what can be physically destroyed; it is also what agents could have produced in the way of useful goods and services. Given the analytical complexity, I shall assume for sake of

[5] Neary (1997b) p. 378

simplicity that it is equal for both agents. As θ increases, the conflict is perceived less and less destructive. Given conditions (3.1) the fraction of contestable output accruing to agent i is increasing in its own level of guns whereas it is decreasing in the opponent's level of guns.

The uncontested sector is modelled as a traditional sector exhibiting decreasing returns to scale. Therefore, the production function is a standard intensive production function which exhibits decreasing returns to scale:

(5) $Y_1(y_1) = y_1^a; Y_2(y_2) = y_2^b$

where y_i denotes the level of resources devoted to the uncontested production by agent i and $a \in (0,1)$ and $b \in (0,1)$ are the parameters capturing the degree of returns of scale for agent 1 and agent 2 respectively. It is trivial to say that $Y(0) = 0$, $Y(\infty) = \infty$, $\partial Y / \partial y > 0$, $\partial^2 Y / \partial^2 y_i < 0$, that

$\partial Y_1 / \partial a > 0 \Leftrightarrow y_1 > 1, \partial Y_2 / \partial b > 0 \Leftrightarrow y_2 > 1$.

The level of production in the uncontested sector can be simply denoted through $UY = Y_1 + Y_2$. Therefore, the final income of each agent can be described as a function of contributions of both sectors as $W_i = f(Y_i, S_i)$. Eventually, each agent maximizes an objective function as:

(6) $W_i(Y_i, S_i) = Y_i + S_i, i = 1,2$

This kind of function can lead to ambiguous results. On one hand, an increase in the amount of 'guns' lowers the level of production. On the other hand, final wealth of each agent could be raised through positive investments in appropriative activities. Agents are assumed to be rational and to interact simultaneously à la Nash-Cournot. Therefore, treating the opponent's choice as given each agent i maximizes (6) with respect to G_i

and y_i. Under an ordinary process of maximization the Nash equilibrium choices of 'ice-cream' are:

(7.1) $y_1^* = (2a/\theta)^{1/(1-a)}$

(7.2) $y_2^* = (2b/\theta)^{1/(1-b)}$

The equilibrium level of 'ice-cream' is increasing in the degree of returns to scale, $\partial y_1^* / \partial a > 0, \partial y_2^* / \partial b > 0$. Trivial to say that $y_1^* = y_2^*$ for $a = b$. Note also that the level of 'ice-cream' is decreasing in the destruction parameter $\partial y_i^* / \partial \theta < 0, i = 1,2$. A smaller degree of destruction implies fewer resources allocated to production in the uncontested sector. The equilibrium level of 'guns' is given by:

(8) $G_1^* = G_2^* = G^* = (TR/4) - 2^{(2a-1)/(1-a)}(a/\theta)^{1/(1-a)} - 2^{(2b-1)/(1-b)}(b/\theta)^{1/(1-b)}$

A necessary and sufficient condition to have an equilibrium for the solutions shown in (7.1), (7.2) and (8) is $TR > (2a/\theta)^{1/(1-a)} + (2b/\theta)^{1/(1-b)}$, namely $TR > y_1^* + y_2^*$. Note that the level of guns is increasing in the destruction parameter, $\partial G^* / \partial \theta > 0$. Namely, the lower is the perceived potential destruction the higher is the investment in guns. Moreover it is clear that $\partial G^* / \partial a < 0, \partial G^* / \partial b < 0$. At the equilibrium the level of 'butter' is:

(9.1) $x_1^* = R_1 - y_1^* - G_1^* =$
$= ((3R_1 - R_2)/4) - 3 \times \left(2^{(2a-1)/(1-a)}(a/\theta)^{1/(1-a)}\right) + 2^{(2b-1)/(1-b)}(b/\theta)^{1/(1-b)}$

(9.2) $x_2^* = R_2 - y_2^* - G_2^* =$
$= ((3R_2 - R_1)/4) - 3 \times \left(2^{(2b-1)/(1-b)}(b/\theta)^{1/(1-b)}\right) + 2^{(2a-1)/(1-a)}(a/\theta)^{1/(1-a)}$

And it is possible to show that the level of butter of each agent is decreasing in its degree of returns to scale and increasing in rival's degree of return to scale. This holds in the presence of DRS in the uncontested sector. In fact, $\partial x_1^* / \partial a < 0$ and $\partial x_2^* / \partial a > 0$ if and only if $(1/\theta) > e^{1-(1/a)}/2a$. The latter condition holds given the DRS assumption

$a \in (0,1)$. The same applies with b, in fact $\partial x_2^* / \partial b < 0$ and $\partial x_1^* / \partial b > 0$ if and only if $(1/\theta) > e^{1-(1/b)}/2b$. This means that as the degree of returns to scale increases each agent will prefer to allocate resources to the uncontested sector. That is, as the secure and uncontested sector becomes more productive (albeit still in the range of the DRS) the level of contested 'butter' decreases.

The level of butter of agent i is increasing in its own initial endowment and decreasing in the endowment of the opponent, namely $\partial x_i^* / \partial R_i > 0, \partial x_i^* / \partial R_j < 0, i = 1,2, i \neq j$. Final incomes of both agents are given by:

(10.1) $W_1^* = (\theta/4)TR + 2^{(2a-1)/(1-a)}(2-a)(a/\theta)^{a/(1-a)} - 2^{(2b-1)/(1-b)} b^{1/(1-b)} \theta^{b/(b-1)}$

(10.2) $W_2^* = (\theta/4)TR + 2^{(2b-1)/(1-b)}(2-b)(b/\theta)^{b/(1-b)} - 2^{(2a-1)/(1-a)} a^{1/(1-a)} \theta^{a/(a-1)}$

Eventually, note that incomes of both agents are decreasing in both degrees of returns to scale under some conditions. Verify for agent 1 that $\partial W_1^* / \partial a < 0 \Leftrightarrow (a-2)\ln(2a/\theta) + a - 1 > 0, \partial W_2^* / \partial b < 0 \Leftrightarrow (b-2)\ln(2b/\theta) + b - 1 > 0$, and $\partial W_1^* / \partial b < 0, \partial W_2^* / \partial a < 0$. Then, there is a combination of a and θ that makes the income of each agent decreasing in its own degree of returns to scale. In particular, the first condition states that as $\theta \to 1$ there are positive values for a allowing for a negative impact of the degree of returns upon the level of income. For example if $\theta = .75$, then $\partial W_1^* / \partial a < 0 \Leftrightarrow 0 < a < .24$. That is, when the uncontested sectors exhibits a sufficiently low degree of returns, each agent would interpret the unproductive activities of conflict and appropriation as more profitable than ordinary business activity in the uncontested sector. In other words, when each agent does not retain a high degree of returns in the uncontested sector and interprets the conflict as non-destructive, it will

have fewer incentives to invest in the secure and uncontested sector. In such a case, the income of each agent can decrease in any investment in 'ice-cream'. That is, the opportunity cost of conflict appears to be lower. This result opens the room for theoretical deepening about implementation of economic policies able to cope with the conflict. Namely, economic policies which increase the opportunity cost of conflict. In fact, it is not only the conflict which affects negatively welfare but it is also the absence of an adequate level of productivity which can guarantee a sufficiently high degree of returns in the production of ice-cream.

To summarise, more precisely, when agents are identical in their fighting abilities and asymmetric in their degrees of returns to scale in the uncontested sector, a combination of the destruction parameter and the degree of returns also affect the allocation of resources shaping the social outcome. It is clear that: (a) as the degree of returns to scale in the production of ice-cream increases each agent will prefer to allocate more resources to the uncontested sector; and its collateral (a.1) whenever the production of ice-cream exhibits sufficiently low productivity each agent will prefer to allocate fewer resources to the uncontested sector; (b) when the conflict is perceived to be non-destructive each agent has fewer incentives to allocate resources to the uncontested sector. Results (a) and its collateral (a.1) are akin with results presented in Garfinkel and Skaperdas (2007). Shortly, productivity of secure and uncontested sectors matters. The main difference relies upon two factors (i) the production of margarine is assumed to be an inferior good whereas this is not the case with ice-cream; (ii) the allocation of resources is driven by a combination of technology of conflict and the degree of inferiority of margarine with respect to butter. Whenever the margarine is not so inferior

compared to butter, agents invest only in the secure production of margarine and investments in both butter and guns. In our context, the technology of conflict does not matter because it has been ruled out with the functional form of CSF adopted in (3).

Using (5), (7.1) and (7.2) it is possible to compute the level of production emerging in the uncontested sector. Then we have:

$$UY^* = \left(2\left(a/\theta\right)\right)^{a/(1-a)} + \left(2\left(b/\theta\right)\right)^{b/(1-b)} \qquad (11)$$

First, the level of uncontested production is unambiguously larger than zero. Eventually it is worth noting that $\partial UY^*/\partial a > 0 \Leftrightarrow \ln\left(2a/\theta\right) - a + 1 > 0$ and $\partial UY^*/\partial b > 0 \Leftrightarrow \ln\left(2b/\theta\right) - b + 1 > 0$. That is, as the conflict is perceived to be less and less destructive the degree of returns in the uncontested sector must be sufficiently high. Otherwise, in the presence of low returns to scale both agents would be better off by allocating resources into the contested sector. In such a case, the level of production in the uncontested sector would decrease. In other words, when the returns in the uncontested sector are extremely low the level of uncontested production would decrease. For instance, setting arbitrarily $\theta = .75$, in order to have a level of UY^* increasing in a and b it is necessary to have $a, b > .16$. By contrast, as $\theta \to 0$ a very low degree of returns would even suffice to satisfy the positive relationship between total production in the uncontested sector and the degree of returns. Using (9.1) and (9.2) the level of production in the contested sector – namely the contested output - is given by:

$$(12)\ CY^* = x_1^* + x_2^* = \left(TR/2\right) - 2^{a/(1-a)}\left(a/\theta\right)^{1/(1-a)} - 2^{b/(1-b)}\left(b/\theta\right)^{1/(1-b)}$$

The level of contested production of butter is increasing in both the level of resources ($\partial CY^* / \partial TR > 0$) and in the destruction parameter ($\partial CY^* / \partial \theta > 0$). At the same time it is decreasing in both a and b, $\partial CY^* / \partial a < 0, \partial CY^* / \partial b < 0$. The higher are the returns in the uncontested sector within the bounds $(0,1)$ the lower would be the level of production in the contested sector. That is, as the production of ice cream becomes more attractive both agents are likely to allocate resources to it. Total production in the economy is simply given by the sum of (9.1) and (9.2)

(13) $TY^* = CY^* + UY^* = (TR/2) + \theta^{1/(a-1)}(\theta - a)2a^{a/(1-a)} + \theta^{1/(b-1)}(\theta - b)2b^{b/(1-b)}$

Also in this case it is clear that $\partial TY^* / \partial \theta > 0, \partial TY^* / \partial TR > 0$. Given the results presented above, it appears to be predictable that the degree of returns can have an ambiguous impact on the level of total production. In particular, the partial derivatives with respect to a and b show that:

$\partial TY^* / \partial a < 0 \Leftrightarrow (a - \theta)\ln(2a/\theta) + (a-1)(\theta - 1) > 0$ and

$\partial TY^* / \partial b < 0 \Leftrightarrow (b - \theta)\ln(2b/\theta) + (b-1)(\theta - 1) > 0$.

In fact, when the conflict is perceived to be more destructive both agents allocate more resources to the uncontested sector. This can decrease the level of production in the contested sector. This would depend upon specific combinations of a, b and θ. Total income is computed as the sum of attainable incomes:

(14) $$TW^* = W_1^* + W_2^* = \\ = \theta(TR/2) + (1-a)(2a/\theta)^{a/(1-a)} + (1-b)(2b/\theta)^{b/(1-b)}$$

The level of total income is increasing in the level of resources $\partial TW^* / \partial TR > 0$. Note also that $\partial TW^* / \partial a > 0 \Leftrightarrow \ln(2a/\theta) > 0$ and $\partial TW^* / \partial b > 0 \Leftrightarrow \ln(2b/\theta) > 0$. Therefore, as the conflict becomes less destructive the degrees of returns in the uncontested sector

must be sufficiently high. Moreover, the level of total welfare is increasing in θ , unless the degrees of returns in the uncontested sector are large enough.

3. Conflict and production in the second period

In the foregoing section, a one-period model has been analysed. In this section the model will be extended in order to take into account the impact of the future on the choices of agents in a very simple way. Consider for sake of simplicity two periods and no future beyond them. A more detailed description of the timing could be as follows:

1) in the first period, agents move simultaneously and choose an optimal level of guns and ice cream;
2) payoffs are assigned the outcome in the first period of the economy is realised
3) at the beginning of the second period agents observe the outcome of the first period.
4) Agents play simultaneously and choose an optimal level of guns and ice cream;
5) Payoffs are assigned and the final outcome of the economy is realised.

Agents are myopic and do not evaluate the impact of longer time-horizon. Moreover, there is no induction whatsoever. In every period, agents make their own choices without taking into consideration any future. They are 'timeless' decision-makers. They do not maximize a two-period objective function. They only care about immediate rewards. In every period, they maximize an objective function. In particular, in the second period, they do this in the awareness of a resource endowment which depends on first-period payoffs. Thus, there is no discount factor is considered. Later utility is

evaluated as much as the earlier utility. In other words, in the second period agents observe the outcome of the first period, evaluate their initial resources endowment and maximize an objective function which is equivalent to (6).

For sake of simplicity, as limiting assumption hereafter, I assume that conflict is perceived to be non destructive. Namely the destruction parameter equals the unity., $\theta = 1$. Moreover, there is no advancement of productive technologies in the second period. Thus, in the period 2, both agents retains the previous degrees of productivity. As noted above, let me also assume that the initial endowment of resources of period 2 is nothing but the income attained in the period 1. Thus, let R_{it} denote the initial endowment of resources of agent $i, i = 1,2$ at time $t = 1,2$. Thus it is possible to write:

$$R_{i2} = W_i^*, i = 1,2. \tag{15}$$

The payoff functions in the second period become:

$$W_{12} = y_{12}^a + p(G_{12}, G_{22})(W_1^* - G_{12} - y_{12} + W_2^* - G_{22} - y_{22}) \tag{16.1}$$

$$W_{22} = y_{22}^b + p(G_{12}, G_{22})(W_1^* - G_{12} - y_{12} + W_2^* - G_{22} - y_{22}) \tag{16.2}$$

Agents 1 and 2 maximize (16) and (17) respectively with respect to G_{i2} and y_{i2}. Under an ordinary process of maximization the Nash equilibrium choices of 'ice-cream' in the second period are:

$$y_{12}^* = (2a)^{1/(1-a)} \tag{17.1}$$

$$y_{22}^* = (2b)^{1/(1-b)} \tag{17.2}$$

Too trivial to say, both agents invest the same amount of resources in the second period in 'ice-cream'. In fact, under the limiting assumption of $\theta = 1$, it is clear that $y_{i2}^* = y_i^*, i = 1,2$. This result is largely predictable because in every period the optimal choice of 'ice-cream' is driven only by productivity. At the same time, in the absence of

any improvement in technology the uncontested production does not increase. The equilibrium choices of guns in the second period are:

$$G_{12}^{*} = G_{22}^{*} = (TR/8) + 2^{(3a-2)/(1-a)} a^{a/(1-a)} (1-3a) + 2^{(3b-2)/(1-b)} b^{b/(1-b)} (1-3b) \qquad (18)$$

Set $\theta = 1$ to compare (8) and (18). It is simple to note that $G_{12}^{*} > G^{*} \Leftrightarrow 2^{1/(a-1)} a^{a/(a-1)} \left(2^{1/(b-1)} TRb^{b/(b-1)} + b - 1\right) + 2^{1/(b-1)} ab^{b/(b-1)} < 2^{1/(b-1)} b^{b/(b-1)}$. As $TR \to \infty$ the latter condition does not hold. Instead as $TR \to 0$ the latter condition always hold. It seems that whenever the initial resources endowment is very large the intensity of conflict can decrease over time. By contrast, whenever the initial resources endowment is very small the intensity of conflict can increase over time. Namely the amount of resources invested into guns can increase over time. This result seems to be counterintuitive. In fact, since the level of guns in the first period depends positively upon the level of resources and negatively upon the degree of productivity, it could be expected that in the second period the investment in guns are likely to decrease. Instead, in the presence of sufficiently high degrees of productivity, in order to have a lower level of guns in the second period, the resources endowment must be sufficiently large. At a deeper reasoning, the feasible interpretation is that only in the presence of a sufficiently large resources endowment, agents are able to exploit the advantages of a superior productivity. Set for example $a = b = .8$. In such a case, it is simple to compute that $G_{12}^{*} > G^{*} \Leftrightarrow TR < 5.24$. Yet, set $a = b = .9$. In the latter case, note that $G_{12}^{*} > G^{*} \Leftrightarrow TR < 79.34$. Therefore, by a simple comparison of the level of guns, it is possible to write that even if the resources endowment can fuel the conflict, at the same time the resource scarcity can also make the conflict more intense by leading to a higher level of guns. This partly contrasts with the widespread idea of 'resource curse'

according to which a plenty of resources can induce higher level of bloody conflicts. Eventually, the resources invested in butter are:

$$x_{12}^{*} = W_{1}^{*} - G_{12}^{*} - y_{12}^{*} = \\ = (TR/8) + 2^{(3a-2)/(1-a)} a^{a/(1-a)} (3-7a) + 2^{(3b-2)/(1-b)} b^{b/(1-b)} (b-1) \quad (19.1)$$

$$x_{22}^{*} = W_{2}^{*} - G_{22}^{*} - y_{22}^{*} = \\ = (TR/8) + 2^{(3a-2)/(1-a)} a^{a/(1-a)} (a-1) + 2^{(3b-2)/(1-b)} b^{b/(1-b)} (3-7b) \quad (19.2)$$

Whereas the attainable incomes in equilibrium are:

$$W_{12}^{*} = (3TR/8) + 2^{(3a-2)/(1-a)} a^{a/(1-a)} (9-5a) + 2^{(3b-2)/(1-b)} b^{b/(1-b)} (1-5b) \quad (20.1)$$

$$W_{22}^{*} = (TR/8) + 2^{(3a-2)/(1-a)} a^{a/(1-a)} (1-3a) + 2^{(3b-2)/(1-b)} b^{b/(1-b)} (5-3b) \quad (20.2)$$

Note that $W_{12}^{*} > W_{22}^{*} \Leftrightarrow a(b-1)\ln(a) - ab\ln(b) - a\ln(2) < -b\ln(2b)$. Total income in the second period is given by :

$$TW_{2}^{*} = (TR/4) + 3 \times 2^{(2a-1)/(1-a)} a^{a/(1-a)} (1-a) + 3 \times 2^{(2b-1)/(1-b)} b^{b/(1-b)} (1-b) \quad (21)$$

Comparing (21) and (14) it is possible to write that total welfare in the second period is higher only in the presence of a specific combination of a, b and TR. Namely:

$$TW_{2}^{*} > TW^{*} \Leftrightarrow TR < -2^{(a+b-2)/((1-b)(a-1))} a^{a/(1-a)} b^{b/(1-b)} \left(2^{1/(a-1)} a^{a/(a-1)} (b-1) + 2^{1/(b-1)} b^{b/(b-1)} (a-1)\right)$$

As $TR \to \infty$ the latter condition does not hold. As $TR \to 1$ the condition reduces to $2^{1/(1-a)} a^{a/(1-a)} (a-1) < 2^{1/(1-b)} b^{b/(1-b)} (1-b) - 1$ which holds under the positivity assumption for both a and b. As in the case of guns it is possible to attain a higher level of total welfare only in the presence of a sufficiently high resource endowment. In the special case of equally productive agents, $a = b$, the latter condition becomes: $TR < 2^{(b-2)/(b-1)} b^{b/(1-b)} (1-b)$.

In other words the total income in the economy increases if and only if an adequate level of productivity does exist and the resource endowment is sufficiently high. To summarise, it is possible to write:

PROPOSITION: *when the agents are myopic and identical in their fighting then: (i) the intensity of conflict - proxied by the level of guns – can decrease due to an adequate level of productivity and a large enough resource endowment;* (ii) *Total income in the economy grows in the presence of a sufficiently large resource endowment and an adequate level of productivity; (iii) both agents allocate the same amount of resources to 'ice-cream' in both periods.*

The emphasis on the impact of a superior productivity marks a difference with the argument developed in Baland and Francois (2000) where the authors emphasize that the initial equilibrium is the most important factor shaping the distribution of income between rent-seekers and entrepreneurs. In particular, whenever an economy is characterized by a 'full entrepreneurship equilibrium' (that is, there are entrepreneurs in all sectors) a resource boom raises returns to entrepreneurship relative to rent-seeking. Whenever entrepreneurship does not dominate rent-seeking in the initial scenario, an exogenous resources boom lowers the returns to entrepreneurship relative to rent-seeking. Such emphasis upon the resources endowment is also in Torvik (2002) that shows how an increased amount of natural resources decreases total income. The driving assumption is that with rent seeking more profitable than modern production, entrepreneurs move into rent seeking.

4. Empirical Implications

The simple theory expounded in the foregoing sections, can have important empirical implications. It provides predictions on how the whole structure of economy can affect the incidence of a civil war. In order to implement this in an econometric specification, some further reasoning is needed. In reality, disentangling contested sectors from uncontested sectors is not an easy task. However, in LDCs this appears to be easier. In particular, as noted above, even though a perfect proxy is not available at this stage, let me consider the mining and agricultural sector to be the contested sectors, and the manufacturing and services sectors to be the uncontested sectors. Such a distinction can be defended while looking at the evidence of bloody competition for exploitation of natural resources or export-oriented production. At the same time, the level of guns in an economy can be considered as a proxy for the intensity of a conflict. In fact, by guns I consider the whole bundle of unproductive activities undertaken by agents. Hence, the emergence of a bloody conflict can be assumed to be related to the existence of contested sectors. To sum up, along the theoretical lines the probability of bloody conflict is increasing in the size of contested sectors and decreasing in the size of uncontested sectors.

Hence, I created a panel dataset for the occurrence of civil wars which spans from 1995 from 2006 and reports a GDP breakdown by sectors for countries considered. STATA has been used as econometric software package. Incidence of a civil war has been captured through a dummy variable which takes the value of unity in the presence of a civil war and zero otherwise. Data about civil wars have been drawn from UCDP/Prio Armed Conflict Database[6]. Figures of the breakdown of GDP have

[6] The dataset is available at http://www.prio.no/CSCW/Datasets/Armed-Conflict/UCDP-PRIO/ (January 2009) The dataset is described in Gleditsch et al. (2002)

been drawn from UNCTAD database. Figures are expressed as percentages of GDP. I estimate the following random effects panel probit model in its basic specification.

$$CivilWar = \beta_0 + \beta_1 Manufacturing_{it} + \\ + \beta_2 Agriculture_{it} + \beta_3 Mining_{it} + u_{it} \qquad (22)$$

Note that $t = \{1995,...,2006\}$ and $i = \{1,...,40\}$. In further estimations some covariates have been also added. Many of them are drawn from existing literature on civil conflict. In particular, I am including: density of population, ethnic fractionalization and polarization, forest area in the country, the polity score and a dummy capturing the colonial legacy, and eventually whether a country is landlocked or not. Data about forest areas have been extracted by FAO's Global Forest resources Assessment 2005. Data for density of population per square km have been extracted from U.S. Census Beaureau International Database. Indexes of ethnic fractionalization and polarization are from Montalvo and Reynal Queirol (2005) [7]. The institutional regime has been captured through the polity index as developed in Polity IV project, Political Regime Characteristics and Transitions, 1800-2006. This index is bounded between -10 and 10 where 10 means perfect democracy. In table 2 the descriptive statistics are presented.

TABLE II. DESCRIPTIVE STATISTICS

Variable	Source	Obs	Mean	St. Dev.	Min	Max
War (dummy)	**PRIO/UCDP**	480	0.28	0.44	0	1
Agriculture % (logged)	**UNCTAD**	480	3.18	0.81	0.86	5
Mining % (logged)	**UNCTAD**	468	1.65	1.32	-0.99	4
Manufacturing % (logged)	**UNCTAD**	480	2.15	0.7	-2	4
polity2	**Polity**	480	0.2	5.04	-9	9
Forest (logged)	**FAO**	480	8.6	1.88	2	1
Density of Population (logged)	**U.S. Census**	480	3.36	1.23	0.69	6
Ethnic Polarization	**Reynal- Queirol**	432	0.56	0.15	0.27	0.84
Ethnic Fractionalization	**Reynal- Queirol**	432	0.68	0.22	0.18	0.96

[7] Data on ethnic and religious fractionalization and polarization are available at http://www.econ.upf.edu/~reynal/data_web.htm (january 2009).

I apply a random effects probit model. The random effects panel probit model is the best viable option. Without deepening too much the explanation, it is not possible to estimate a fixed effects probit model consistently with a fixed number of periods. (please see Verbeek, 2000). The results of the regressions are illustrated in table 3.

As expected, agriculture and mining are positively associated with the incidence of a civil war. This is in line with results existing in literature when considering that rents flourishing from export-oriented sectors emerge in agriculture and mining sectors. Contrariwise, manufacturing appears to be negatively associated with the likelihood of a bloody conflict. Of course, such a negative correlation can be explained in the light of the model expounded in the previous section. Namely the higher is the level of manufacturing (i.e. the level of uncontested productive activities) the lower is the intensity of a continuing conflict and then the incidence of a civil war. Such a result is robust for all the specifications adopted (columns 1-7). In particular, column (1) reports estimated coefficients for a baseline specification which includes only the main sectors of economy as explanatory variables. Columns (2) and (3) reports estimated coefficients for specifications which include institutional variables. In particular, column (2) includes the polity index as proxy of institutional regime, whereas column (3) includes dummy variables for colonial legacy. As expected, polity index is negatively associated with the occurrence of civil war. In column (4) I include in the regression some demographic measures as density of population and ethnic polarization and fractionalization. In column (5) I included some geographical factors as the forest areas and whether or not the country is landlocked. The latter – as widely known – is positively associated with the incidence of a civil war. In column (7) I included almost all covariates. The main results are confirmed. Columns (8)- (14) replicates the previous

specifications by applying a logit model. Main results are confirmed and robust. The likelihood of a civil war is negatively associated with the size of manufacturing sector whilst it is positively associated with the size of mining and agriculture.

Probit and Logit Analysis for the incidence of Civil War

	Probit							Logit						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**
Agriculture	**1,46**	**0,88**	**1,58**	**1,23**	**1,42**	**1,74**	**0,58**	**2,94**	**1,59**	0,62	**1,99**	**2,64**	**3,08**	1,38
	(0,332)	(0,33)	(0,36)	(0,39)	(0,67)	(0,50)	(0,62)	(0,60)	(0,54)	(0,54)	(0,74)	(0,61)	(0,87)	(0,87)
	[0,00]	[0,00]	[0,00]	[0,00]	[0,03]	[0,00]	[0,35]	[0,00]	[0,00]	[0,25]	[0,00]	[0,00]	[0,00]	[0,11]
Mining	**0,242**	**0,47**	**0,30**	**0,47**	**0,51**	**0,50**	**1,43**	**0,52**	**0,61**	0,48	**0,78**	**0,42**	0,47	**2,38**
	(0,113)	(0,18)	(0,16)	(0,19)	(0,29)	(0,20)	(0,50)	(0,20)	(0,25)	(0,32)	(0,34)	(0,21)	(0,31)	(0,67)
	[0,03]	[0,01]	[0,06]	[0,01]	[0,07]	[0,01]	[0,00]	[0,00]	[0,01]	[0,13]	[0,02]	[0,00]	[0,13]	[0,00]
Manufacturing	**-1,02**	**-0,39**	**-1,17**	**-1,74**	**-1,64**	**-1,80**	**-1,22**	**-1,79**	**-0,84**	**-1,01**	**-3,81**	**-1,87**	**-2,62**	**-2,67**
	(0,208)	(0,24)	(0,26)	(0,31)	(0,29)	(0,33)	(0,45)	(0,36)	(0,30)	(0,37)	(0,66)	(0,42)	(0,52)	(0,80)
	[0,00]	[0,10]	[0,00]	[0,00]	[0,00]	[0,00]	[0,00]	[0,00]	[0,00]	[0,00]	[0,00]	[0,00]	[0,00]	[0,00]
Polity		**-0,10**		**-0,11**	**-0,09**				**-0,23**				**-0,24**	
		(0,04)		(0,04)	(0,04)				(0,06)				(0,06)	
		[0,01]		[0,00]	[0,02]				[0,00]				[0,00]	
UK		**-2,0**	-0,87				**-3,42**			**-1,99**				-2,04
		(0,65)	(0,55)				(1,17)			(0,92)				(1,37)
		[0,00]	[0,11]				[0,00]			[0,03]				[0,14]
France		-2,05	-0,35				**-2,47**			-0,74				-0,90
		(0,66)	(0,51)				(0,97)			(0,80)				(1,34)
		[0,00]	[0,49]				[0,01]			[0,36]				[0,50]
Belgium		**2,09**	**4,03**				**9,57**			**4,67**				**23,77**
		(0,63)	(0,75)				(3,24)			(0,98)				(5,75)
		[0,00]	[0,00]				[0,00]			[0,00]				[0,00]
Portugal		1,12	0,4				0,99			1,5				4,91
		(1,25)	-				2,97			(1,81)				(16,46)
		[0,37]	-				[0,74]			[0,41]				[0,77]
Italy		**1,60**	**1,89**				**7,30**			**3,30**				11,19
		(0,58)	(0,57)				(1,88)			(1,00)				(2,84)
		[0,01]	[0,00]				[0,00]			[0,00]				[0,00]
Density of Population				-0,05			-0,61				**0,38**		**0,34**	-2,54
				(0,17)			(0,48)				(0,18)		(0,19)	(0,82)

				[0,78]			[0,21]				[0,03]		[0,07]	[0,00]
Ethpol				-1,80			-2,14							0,66
				(1,78)			(1,67)							(2,70)
				[0,31]			[0,20]							[0,81]
Ethfrac				**-1,74**	-0,52	-1,05	**13,83**				**-3,40**		0,51	26,37
				(0,76)	(1,34)	(0,77)	3,26				(1,30)		(1,40)	(5,78)
				[0,02]	[0,70]	[0,17]	[0,00]				[0,00]		[0,71]	[0,00]
Forest area					0,01		**-1,23**					0,17		-2,88
					(0,12)		(0,38)					(0,13)		(0,70)
					[0,93]		[0,01]					[0,19]		[0,00]
Landlocked					**1,15**	**1,46**	**3,32**					**4,47**	**2,20**	1,68
					(0,38)	(0,41)	(0,92)					(0,79)	(0,65)	(0,95)
					[0,00]	[0,00]	[0,00]					[0,00]	[0,00]	[0,08]
Const	-5,79	-3,73	-5,75	-0,17	-3,29	-4,00	-0,15	-7,8	-6,82	-2,46	-1,73	**-12,06**	**-8,55**	5,03
	(1,522)	(1,63)	(1,68)	(2,23)	(2,47)	(1,81)	(2,11)	(2,35)	(2,41)	(2,62)	(2,75)	(2,90)	(3,00)	(3,83)
	[0,00]	[0,02]	[0,00]	[0,93]	[0,18]	[0,02]	[0,94]	[0,00]	[0,00]	[0,35]	[0,53]	[0,00]	[0,00]	[0,19]
Obs.	468	468	468	420	420	420	420	468	468	468	420	468	420	420
Groups	40	40	40	35	35	35	35	40	40	40	35	40	35	35
Log Likelihood	-140,238	-132,849	-133,85	-124,054	-124,627	-128,36	-116,118	-142,328	-140,016	-136,36	-126,50	-137,97	-122,161	-111,457
Wald	42,93	49,43	-	45,79	43,43	40,99	49,21	48,01	24,65	50,81	40,81	50,79	53,22	45,41
LR	203,24	119,28	127,52	166,28	130,87	159,83	59,66	200,88	193,42	124,06	181,59	192,44	141,22	61,96

Notes: standard errors in parenthesis, p-values in square brackets, * **significant at 1%, ** significant al 5%, *significant at 10%. For sake of readability statistically significant coefficients are in bold; In order to incerase accurcay, in regressions 1-7 number of points for Gauss-Hermite quadrature has been set to 24.

5. Concluding remarks

This paper examines the conflictual interaction between two risk-neutral agents that can allocate their own resources both to a contested sector and an uncontested sector. The main general result is that the level of productivity in the uncontested sector can be a powerful factor inducing a higher allocation of resources to ordinary entrepreneurial activity. It is shown that the higher are the returns in the uncontested sector the lower would be the level of production in the contested sector. Hence, in general terms, the results of the paper recall the famous discussion posed by Baumol (1990) that suggested how entrepreneurs allocate their resources depending on the relative returns of productive and unproductive activities. The analysis confirms how the allocation of resources is significantly affected by the degrees of returns in the uncontested sectors. Briefly, a sufficiently high productivity in the uncontested sector does divert resources from the contested sector to the uncontested sector increasing the opportunity cost of a bloody conflict. In other words, increased entrepreneurship can also contribute to crowd out bloody rent-seeking in contested sectors. This holds even if it is assumed that the contested sector exhibit greater returns than the uncontested sector. In fact, it has been assumed that the contested sector exhibits constant returns to scale, whereas the uncontested sector exhibits decreasing returns to scale.

In a second part of the paper, the basic model has been extended in order to take into account the impact of the future on the choices of agents in a very simple way. However, agents are myopic and do not evaluate the impact of longer time-horizon. There is no induction whatsoever. In every period, agents make their own choices without taking into consideration any future. They are 'timeless' decision-

makers. They do not maximize a two-period objective function. They only care about immediate rewards. Thus, in every period, they maximize an objective function. In particular, in the second period, they do this in the awareness of a resource endowment which depends on first-period payoffs. Thus, there is no discount factor is considered. Later utility is evaluated as much as the earlier utility. In other words, in the second period agents observe the outcome of the first period, evaluate their initial resources endowment and maximize an objective function. The results show that: (i) the intensity of conflict - proxied by the level of guns – can decrease due to an adequate level of productivity and a large enough resource endowment; (ii) Total income in the economy grows in the presence of a sufficiently large resource endowment and an adequate level of productivity; (iii) both agents allocate the same amount of resources to 'ice-cream' in both periods.

As noted above, the emphasis on the impact of a superior productivity marks a difference with the argument developed in Baland and Francois (2000) where the authors emphasize that the initial equilibrium is the most important factor shaping the distribution of income between rent-seekers and entrepreneurs. In particular, whenever an economy is characterized by a 'full entrepreneurship equilibrium' (that is, there are entrepreneurs in all sectors) a resource boom raises returns to entrepreneurship relative to rent-seeking. Whenever entrepreneurship does not dominate rent-seeking in the initial scenario, an exogenous resources boom lowers the returns to entrepreneurship relative to rent-seeking. Such emphasis upon the resources endowment is also in Torvik (2002) that shows how an increased amount of natural resources decreases total income and welfare. The

driving assumption is that with rent seeking more profitable than modern production, entrepreneurs move into rent seeking.

However, it must be stressed that under the assumption of no improvement in productivity the present model predicts that in the second period an increase in the total income is driven by a decrease in guns leading clearly an increase of butter.

In a third part of the paper, there is a robust empirical evidence that the incidence of civil wars is increasing in the size of both agricultural and mineral sectors. In addition, the results show that the incidence of civil wars is decreasing in the size of manufacturing sector. Hence this short paper complements the existing works which analyzed the link between incidence of civil wars and exploitation of natural resources.

In particular, it sheds new light on the economic causes of internal armed conflicts. Whenever the whole structure of the economy is considered, empirical evidence also provides insight for designing economic policies. First, economic growth by itself should not be the sole policy goal. Of course, as noted by many scholars and policy-makers the governance of natural resources is a crucial point to establish a durable peace. However, empirical results also suggest that the relative size of manufacturing sector should be a policy goal in itself. To use the terminology adopted in the theoretical section, favouring the production of ice-cream implies a broad spectrum of policies favoring and encouraging the development of businesses not directly affected by conflict - that is, the whole set of businesses and sectors which I defined as *uncontested*. In the long-run, this policy can shape the whole structure of the economy. However, a discussion about

evaluation criteria for investment in the uncontested sector exceeds the scope of this short paper. However, some future directions for research can be highlighted. First, the main point, is a thorough diagnosis of which businesses (and sectors) are likely to be contested in war-torn economies. Second, as expounded in the theoretical section, another crucial point is given by productivity. In fact, the negative relationship between conflict and manufacturing perhaps is mainly driven by productivity. In particular, the latter relationship should be further deepened.

APPENDIX

To check whether the critical points (18) and (19) constitute a Nash equilibrium I have to compute the Hessian matrices for both agents. Consider first the objective function of agent 1 evaluated at critical points G_2^{g*} and y_2^{g*}, namely (omitting superscripts):

$$W_2^{gs}\left(G_1^{gs}, G_2^{gs*}, y_1^{gs}, y_2^{gs*}\right) =$$
$$= -\frac{\left[\left(G_1\left(4G_1 - 3TR + 4y_1\right) - y_1^b\left(4G_1 + TR\right)\right)\left(2b\left(1-q\right)\right)^{(b+1)/(b-1)} - \left(\left(1-q\right)^{b/(b-1)}\left(2bG_1 - 2by_1^b\right) + 2by_1^b\left(q-1\right) + 2b\left(1-q\right)\left(G_1\left(4t-3\right) + TRt\right) - w\left(4G_1 + TR\right)\right)\left(2b\left(1-q\right)\right)^{1/(b-1)} - \left(\left(1-q\right)^{1/(b-1)} + 1\right)\left(2bt\left(q-1\right) + w\right)\right]}{\left(4G_1 + TR\right)\left(2b\left(1-q\right)\right)^{1/(b-1)} - \left(1-q\right)^{1/(b-1)} - 1} \times$$
$$\times \left(2b\left(1-q\right)\right)^{b/(1-b)}$$

and the Hessian matrix for agent 1 after substituting also the critical values G_1^{g*} and y_1^{g*} is given by:

$$H_1 = \begin{pmatrix} \dfrac{\partial W_1^{gs}}{\partial G_1 G_1} & \dfrac{\partial W_1^{gs}}{\partial y_1 G_1} \\ \dfrac{\partial W_1^{gs}}{\partial G_1 y_1} & \dfrac{\partial W_1^{gs}}{\partial y_1 y_1} \end{pmatrix} =$$

$$= \begin{pmatrix} -\dfrac{2^{(2b-1)/(b-1)}\left(b(1-q)\right)^{1/(b-1)}}{TR\left(2b(1-q)\right)^{1/(b-1)} - (1-q)^{1(b-1)} - 1} & -\dfrac{\left(2b(1-q)\right)^{1/(b-1)}}{TR\left(2b(1-q)\right)^{1/(b-1)} - (1-q)^{1/(b-1)} - 1} \\ -\dfrac{\left(2b(1-q)\right)^{1/(b-1)}}{TR\left(2b(1-q)\right)^{1/(b-1)} - (1-q)^{1/(b-1)} - 1} & 2^{(b-2)/(1-b)} b^{1/(b-1)}(b-1) \end{pmatrix}$$

Let H_{1k} denote the k_{th} order leading principal submatrix of H_1 for $k = 1,2$. The determinant of the kth order leading principal minor of H_{1k} is denoted by $|H_{2k}|$. The leading principal minors alternate signs as follows:

(A.1) $|H_{11}| < 0 \Leftrightarrow TR > \left((1-q)^{1/(b-1)} + 1\right)\left(2b(1-q)\right)^{1/(1-b)}$

(A.2) $|H_{12}| > 0 \Leftrightarrow TR(b-1)\left(2b(1-q)\right)^{1/(b-1)} < \left(\left((1-q)^{1/(b-1)}(2b-3)\right)/2\right) + b - 1$

As $TR \to \infty$ both A.1 and A.2 hold and $|H_1|$ is negative semidefinite. As $TR \to 1$, $|H_1|$ is negative semidefinite if and only if $2^{b/(b-1)}(b-1)\left[b(1-q)\right]^{1/(b-1)} + (3-2b)(1-q)^{1/(b-1)} - 2b < -2$.

The Hessian matrix for agent 2 is given by:

$$H_2 = \begin{pmatrix} \dfrac{\partial W_2^{gs}}{\partial G_2 G_2} & \dfrac{\partial W_2^{gs}}{\partial y_2 G_2} \\ \dfrac{\partial W_1^{gs}}{\partial G_2 y_2} & \dfrac{\partial W_2^{gs}}{\partial y_2 y_2} \end{pmatrix} =$$

$$= \begin{pmatrix} -\dfrac{2^{(2b-1)/(b-1)}\left(b(1-q)\right)^{1/(b-1)}}{TR\left(2b(1-q)\right)^{1/(b-1)} - (1-q)^{1(b-1)} - 1} & -\dfrac{\left(2b(1-q)\right)^{1/(b-1)}}{TR\left(2b(1-q)\right)^{1/(b-1)} - (1-q)^{1/(b-1)} - 1} \\ -\dfrac{\left(2b(1-q)\right)^{1/(b-1)}}{TR\left(2b(1-q)\right)^{1/(b-1)} - (1-q)^{1/(b-1)} - 1} & 2^{(b-2)/(1-b)}(b-1)\left(b(1-q)\right)^{1/(b-1)} \end{pmatrix}$$

The leading principal minors alternate signs as follows:

(A.3) $|H_{21}| < 0 \Leftrightarrow TR > \left((1-q)^{1/(b-1)} + 1\right)\left(2b(1-q)\right)^{1/(1-b)}$

(A.4) $|H_{22}| > 0 \Leftrightarrow TR(b-1)\left(2b(1-q)\right)^{1/(b-1)} + (1-b)(1-q)^{1/(b-1)} - b < -(3/2)$

Also in this case, as $TR \to \infty$ A.3 and A.4 hold. As $TR \to 1$ $|H_2|$ is negative semidefinite if and only if $(b-1)\left(2b(1-q)\right)^{1/(b-1)} + (1-b)(1-q)^{1/(b-1)} - b < -(3/2)$.

That is, as the resources endowment goes to infinity the critical points $\left(G_1^{g*}, G_2^{g*}, y_1^{g*}, y_2^{g*}\right)$ do constitute a Nash equilibrium. As the resources endowment goes to its lower bound $(TR = 1)$ conditions (A.2) and (A.4) must hold.

Since A.2 is stricter than A.4 the condition for a Nash equilibrium becomes $2^{b/(b-1)}(b-1)\left[b(1-q)\right]^{1/(b-1)} + (3-2b)(1-q)^{1/(b-1)} - 2b < -2$.

That is, as the whole resources endowment decreases the room for a stable Nash equilibrium shrinks.

COUNTRIES INCLUDED IN THE PANEL

Angola
Benin
Botswana
Burkina Faso
Burundi
Cameroon
Central African Republic
Chad
Congo
Dem.Rep.Congo
Equatorial Guinea
Eritrea
Ethiopia
Gabon
Gambia
Ghana
Guinea
Ivory Coast
Kenya
Lesohto
Liberia
Malawi
Mali
Mauritiana
Mozambique
Namibia
Niger
Nigeria
Rwanda
Senegal
Sierra Leone
Somalia
South Africa
Sudan
Swaziland
Tanzania
Togo
Uganda
Zambia
Zimbabwe

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