

BUTTER, GUNS AND ICE-CREAM

THEORY AND EVIDENCE FROM SUB-SAHARAN AFRICA.

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ABSTRACT

*This paper is intended to complement the existing literature on civil wars. First, it presents a simple theoretical model of conflict which defines 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 hold secure property rights over the production of some goods. Agents split their resource endowment between ‘butter’, ‘guns’ and ‘ice-cream’. Following the theoretical insights the empirical analysis focuses on the relationship between civil wars 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: Civil war, resource curse, butter guns and ice-cream, structure of the economy, panel probit analysis

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Introduction: Civil Wars and the Structure of the Economy

There is an established literature on the economic causes of civil wars in LDCs. There is a widespread agreement that the incidence of civil wars is positively associated with the abundance of natural resources. In fact, in many territories, the government and various warlords or rebel groups compete over the appropriation of rents flourishing from exploitation of natural resources. This often leads to violent conflict, followed by social unrest and civil war. This has been studied in several empirical works¹. Although contrasting interpretations have been produced, most empirical studies confirm that: (i) there is positive relationship between abundance in natural resources and incidence of a civil war; (ii) incidence of a civil war is negatively associated with GDP per capita and GDP growth rate.

Thus, although the association between civil wars and natural resources is nowadays quite clear, less attention has been paid to the relation between incidence of a civil war and the whole structure of the economy. Surprisingly, previous works study the significant impact of natural resources on conflict by disregarding the potential impact of other economic activities. Contrariwise, in the current work I consider the impact of the whole structure of the economy on the likelihood of a civil conflict.

In particular, the structure of an economy is captured through the breakdown of GDP by main sectors: (i) manufacturing sector; (ii) mining sector; (iii) agriculture. That is, this paper is intended to complement the existing literature on civil wars by highlighting the relationship between different sectors of economy and the incidence of civil wars. Such an approach is theoretically underpinned by a distinction between contested and uncontested sectors. The first would fuel actual conflict whilst the latter

¹ See among others: Collier and Hoeffler (1998/2000/2004), Le Billon (2001a), De Soysa (2002), Sambanis (2001/2002), Bannon and Collier (2003), Fearon and Laitin (2003), Fearon (2005), Humphreys (2005), Lujala et al. (2005), De Soysa and Neumayer (2007), Collier and Rohner (2008).

would promote economic growth. The empirical analysis is focused upon a sample of Sub-Saharan African countries and the results show that: (1) the incidence of a civil war is decreasing in the size of manufacturing sector; (2) the incidence of civil war is increasing in the size of mining and agricultural sector.

The rest of this paper is designed as follows: in the first section, some theoretical pillars are discussed. Then, in the second section, a simple formal model is presented and finally in the third section an empirical application is presented. Finally, results are summarized and discussed.

1. Theoretical background for Production and Appropriation: Butter, Guns and Ice-Cream.

Conflict, as a rational activity, plays as large a role in economic development as do production and exchange, though only the latter two have traditionally been considered the classical domain of economic science. The argument for the inclusion of conflict is straightforward. You can buy something, but you can also steal it. You can appropriate, confiscate, grab, and plunder instead of producing, contracting or exchanging. In the present context, a fitting definition which embraces the main characteristics of conflict could be: *a conflict is a destructive interaction which involves strategic, interdependent decisions in the presence of coercion and anarchy.* By ‘destructive,’ I mean that some resources which could be allocated to more productive ends are wasted because of a conflictual interaction between certain parties. In the eyes of the economist, this tradeoff represents the main interest. In fact, in any society there are some resources allocated to productive activities, such as production of useful goods, and others which are allocated to unproductive activities, such as the efforts devoted to the seizure of goods produced

by others. The first - productive activities - are beneficial to society, whilst the latter - unproductive and even destructive - are detrimental to welfare and development. By coercion, I refer to the behaviour shaped and influenced by the existence of a credible threat. A credible threat depends upon the potential exploitation of brute force. Under a credible threat the choices of an agent are made under coercion. Even though agents have options to make a choice, this is not purely voluntary. The set of possible choices shrinks. (on this point see Basu, 2007). Another characteristic feature of conflict is anarchy. By 'anarchy' I simply mean the absence of rules governing agents' behaviour. As noted above, it is a state-of-nature environment where allocations of resources are determined also through the exploitation of brute force. In short, the rules of the game are endogenous to the game. The conflict can be managed and solved only in the presence of endogenous 'rules-of-the-game' governing the interaction.

In recent years, Hirshleifer (1988) proposed a novel analytical theory of conflict in the form of a general equilibrium model that could be applied to a wide variety of conflicts. The basic idea surrounding the work of Hirshleifer and of a growing literature² is that rational agents struggle over the distribution of a joint output, so that they also make a choice in the allocation of a positive endowment of resources between 'butter' and 'guns'. The higher the level of butter the higher must be the welfare. Instead, the higher the level of guns, the more intense the conflict must be. Individuals, groups and organizations can acquire income by means of entrepreneurship and production of economic goods or by seizing and appropriating wealth and goods

² In more recent years several studies extended Hirshleifer basic model. See among others: Grossman (1991), Skaperdas (1992), Grossman and Kim (1995), Skaperdas and Syropoulos (1996), Neary (1997), Anderton et al. (1999), Noh (1999), Garfinkel (2004), Dixit (2004), Caruso (2006/2007), Hausken (2004/2006), Munster (2007). The literature on the economics of conflict has been recently surveyed in Garfinkel and Skaperdas (2007).

produced by other parties. There are some common results in this literature. Firstly, whenever the warring parties are largely asymmetric in terms of their resource endowments, the poorer party will devote all its endowment to guns. This is what Hirshleifer defined the paradox of power. Such a paradox could explain why individuals, who live under the subsistence level and have almost 'nothing to lose' from conflict, more readily take part in bloody conflict – i.e. the opportunity cost is very low. Secondly, the relative advantage of one conflict technology over another must be negligible to produce cooperation between parties. In other words, whenever technological abilities in fighting of parties are largely asymmetric, a dominance of one party over the others is predictable. The economic theory of conflict then predicts that shifts in military technology affect the economic incentives that may emerge in the presence of peaceful agreements. In other words, the more advanced the military technology, the fewer disincentives there are to starting a conflict. Thirdly, there is an inverse relationship between productivity and willingness to engage in conflict. That is, the most productive agent in the production of butter is less willing to be involved in a bloody conflict for appropriation.

The implicit assumption of Hirshleifer-style theoretical models of conflict is that all the productive activities are subject to appropriation. Thus, the trade-off is simple: as guns increase, butter must decrease. There is no alternative allocation for available resources. However, in reality, parties 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 to secure production. To simplify the reasoning, we can consider an economy characterized by two sectors. In a first sector - the **uncontested sector** - , each party

holds secure property rights over the production of some goods. In the second sector- the **contested sector** - agents struggle in order to appropriate the maximum possible fraction of a contestable output. Security of property rights in the uncontested sector need not to be established by means of an ordinary legal mechanism. In a scenario of continuing conflict a property rights system is established and enforced by means of brute force. In fact, this is currently the case of warlordism in many regions. Warlordism means that non-state violent actors challenge state power and monopoly of violence. This reasoning somehow recalls the distinction between governance and government as envisioned in Dixit (2009).

With a contested-uncontested distinction, it is possible to state that there are at least three possible allocations of resources, here termed (i) guns, (ii) butter, and (iii) ice-cream. Butter and guns denote the classical trade-off between production and appropriation. Ice-cream denotes all the productive activities which are not under threat of appropriation. In other words, ice-cream denotes all the business activities which are not directly affected by the existence of a bloody conflict. Needless to say, the opportunity cost of conflict would be related not only to the contested production but also to the production of goods which are not subject to appropriation. Namely, in our terminology, the opportunity cost of conflict is related not only to the production of butter but also to the production of ice-cream.

Fitting examples could be punctually drawn from war-torn African countries. As noted above, it is clear that resource-abundant sectors have to be considered 'contested' implying the trade-off between butter and guns. In fact, in many cases, bloody conflicts are localized in resource-abundant regions (Buhaug and Rod, 2006; Buhaug and Gates, 2002). At the same time, other territories are not greatly affected by war and predation.

Agriculture and small manufacturing presumably constitute a large portion of economic activity of these uncontested territories. Such sheltered sectors can also be included within the class of ice-cream.

Eventually, social welfare and national income depend upon the combination of butter, guns and ice-cream. All being equal, a society with a higher proportion of resources devoted to ice-cream could be considered preferred. In fact, whenever a higher proportion of resources is allocated to the uncontested sector, fewer resources are allocated to the contested sector. Such a shift in allocation of resources could be driven by productivity in the production of ice-cream. In fact, whenever the returns emerging in the ice-cream sector are sufficiently high, a higher level of resources will be allocated to this uncontested production. In a nutshell, in war-torn and post conflict societies, investments in the production of ice-cream can raise the opportunity cost of conflict.

	Period	Agriculture	Manufacturing	Mining
Angola	1995-2000	8.2	4.1	59.1
	2001-2006	8.0	3.8	58.8
Nigeria	1995-2000	33.64	9.0	24.6
	2001-2006	34.0	4.7	29.3
Chad	1995-2000	39.7	11	0.6
	2001-2006	30.2	8.9	24.4

Source: Unctad

Table 1 reports sectoral contributions to gross domestic product (GDP) for Angola, Chad, and Nigeria. Angola, Chad and Nigeria are resource-dependent economies and they are commonly included among countries affected by the *resource curse*. Angola, Nigeria and Chad are dependent upon oil, whereas Angola is also dependent upon diamonds. Though by no means a perfect proxy, for the sake of argument, consider the mining sector to be the contested sector, and the manufacturing sector to be the

uncontested sector. As you can note, the manufacturing sector contributes to GDP less than mining and agriculture, and its contribution has decreased over time. Fewer resources have been allocated to ice-cream. The economies of these countries seem to be characterized by dominance of contested butter. In fact, all of them experienced violent internal conflicts. In Chad, which is listed among the poorest countries in the world, a civil war began in December 2005. 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 Le Billon, 2001b, Malaquias, 2001, and Ferreira, 2006). Nigeria is plagued by an endless war in the oil-rich Niger Delta (see Omeje 2004, Ross 2003).

2. A simple theoretical Model

The following theoretical model is drawn from Caruso (2008). The world is made of two risk-neutral agents indexed by $i = 1, 2$. They interact simultaneously à la Nash-Cournot. Both agents have a 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 investments in unproductive activities of fighting. By 'butter' I indicate any investment in productive activities in the contested sector, whilst by 'ice-cream' I indicate any investments in productive activities in the uncontested sector. The interaction between the two agents generates an equilibrium allocation of resources endowment among 'guns', 'butter' and 'ice-cream'. The resources constraint is:

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

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: $G_i \in (0, \infty), y_i \in (0, \infty), x_i \in (0, \infty), i = 1, 2$. The contested joint production –CY– can be described as a simple linear additive function:

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

where $TR = R_1 + R_2$. 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 a Contest success function³ (CSF) in its ratio form:

$$p_i(G_1, G_2) = \frac{G_i}{G_1 + G_2}, i = 1, 2 \quad (3)$$

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 assumed to be 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 technology of conflict. Whenever $m > 1$ the CSF does exhibit increasing returns in the technology of conflict. Thus with $m = 1$, 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 is also crucial when discussing the positivity assumption for guns. The ratio form of the CSF implies that if one of the two contestants does not allocate any resource to ‘guns’, the other party appropriates all the contested output, namely $p_i(G_i, 0) = 1, \forall G_i \in (0, \infty)$. Thus, if one agent chooses not to

³see Skaperdas (1996) for an axiomatization.

invest in ‘guns’, it will receive a zero payoff, while the opponent will receive the full payoff. 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. Equation (3) is differentiable and follows the conditions below:

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

the outcome in the contested sector is given by:

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

Where $\theta \in (0,1)$ denotes a physical destruction parameter. It can be interpreted as an ex-ante perception of destructiveness of conflict or a short-term evaluation of the outcome of the conflict. Given the analytical complexity I assume that it is equal for both agents. As θ increases - goes to unity - the conflict is perceived less and less destructive. Given (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 production function in the uncontested sector is a standard intensive production function:

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

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. The production in the uncontested sector is: $UY = Y_1 + Y_2$. 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:

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

This kind of function can lead to ambiguous results. On one hand, an increase of ‘guns’ depresses 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:

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

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

The level of ‘ice-cream’ is increasing in the degree of returns to scale, $\partial y_1^* / \partial a > 0, \partial y_2^* / \partial b > 0$ and decreasing in the destruction parameter $\partial y_i^* / \partial \theta < 0$. A smaller degree of destruction implies fewer resources allocated to production in the uncontested sector. The equilibrium level of ‘guns’ is given by:

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

A necessary and sufficient condition to have an equilibrium for the solutions shown in (7.1), (7.2) and (8) is $TR > (2a/\theta)^{1/(1-a)} + (2b/\theta)^{1/(1-b)}$. Note that $\partial G^* / \partial \theta > 0$. Namely, the lower the perceived potential destruction, the higher the investment in guns. Note also that $\partial TG^* / \partial TR > 0$ where $TG^* = G_1^* + G_2^*$. Namely, considering the level of guns as a proxy of a violent destructive conflict, it can be maintained that it increases in the level

of resources. Needless to say, this simply describes the idea of *resources curse*. At equilibrium, the level of butter is:

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

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

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:

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

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

Eventually, note that incomes of both agents are decreasing in both degrees of returns to scale under some conditions. Verify 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 $\theta \rightarrow 1$ 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 $\partial W_1^* / \partial a < 0 \Leftrightarrow 0 < a < .24$. Put differently, when agent 1 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.

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

$$UY = y_1^* + y_2^* = \left(2\frac{a}{\theta}\right)^{a/(1-a)} + \left(2\frac{b}{\theta}\right)^{b/(1-b)} \quad (11)$$

It is worth noting that $\partial UY / \partial a > 0 \Leftrightarrow \ln(2a/\theta) - a + 1 > 0$ and $\partial UY / \partial b > 0 \Leftrightarrow \ln(2b/\theta) - b + 1 > 0$. 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. In the presence of low returns to scale, both agents would be better off by allocating resources into the contested sector. 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 $\theta \rightarrow 0$ a very low degree of returns would suffice. Using (9.1) and (9.2) the level of production in the contested sector – namely the contested output - is given by:

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

It is trivial to say that the contested production CY 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 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. Eventually, it is possible to compute the total income in the economy.

$$TW = W_1^* + W_2^* = \theta \frac{TR}{2} + (1-a) \left(\frac{2a}{\theta} \right)^{a/(1-a)} + (1-b) \left(\frac{2b}{\theta} \right)^{b/(1-b)} \quad (13)$$

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. This is particularly relevant when considering that the contested sector has been assumed to exhibit CRS, whilst the uncontested sector has been assumed to be DRS.

There is an interaction between the abilities of warring parties in fighting, productive characteristics and the allocation of resources. More precisely, when warring parties are relatively balanced in their war-making capabilities – as is often the case in developing countries - and asymmetric in their productive structure in the production of ice-cream, the allocation of resources and efforts will also depend upon the short-term evaluation of the outcome of conflict. It can be demonstrated that: (a) as the

productivity in the ice-cream increases, a party will prefer to allocate more resources to it; and (b) whenever the warring parties do not sufficiently value the losses from foregone production and destruction in the short-term, they have fewer incentives to allocate resources to the uncontested sector. Incentives for conflict are then higher than those of investing in the production of ice-cream. The good news, however, is that productivity in the ice-cream sector is a powerful force countervailing the incentives to fight. Hence, the casual mechanism appears to be clear. The opportunity cost of conflict depends upon the production of ice-cream and not only on the production of butter. In particular, the opportunity cost of conflict rises in the presence of sufficiently high productivity in the uncontested sector. This holds even in the presence of decreasing returns to scale as is the case in many less developed economic systems.

3. Empirical Implications

The simple theory expounded in the foregoing section, 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 prediction in a proper 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 sectors 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 a broader view, 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 to 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 Database⁴. Figures of the breakdown of GDP have 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.

$$CivilWar = \beta_0 + \beta_1 Manufacturing_{it} + \beta_2 Agriculture_{it} + \beta_3 Mining_{it} + u_{it} \quad (17)$$

Note that $t = \{1995, \dots, 2006\}$ and $i = \{1, \dots, 40\}$. 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 variable capturing the colonial legacy, and finally 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 Bureau International Database. Indexes of ethnic fractionalization and polarization are from

⁴ The dataset is available at <http://www.prio.no/CSCW/Datasets/Armed-Conflict/UCDP-PRIO/> (accessed on January 2009). The dataset is described in Gleditsch et al. (2002)

Montalvo and Reynal Queirol (2005) ⁵. 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.

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

I apply a random effects probit model. The random effects panel probit model is the best viable option. Without going to deeply into the explanation, it is not possible to estimate a fixed effects probit model consistently with a fixed number of periods. (please see Verbeek, 2000, p. 337). At the same time for the sake of robustness and clarity, I also apply a logit model. 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. Instead, 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 the level of manufacturing (i.e. the level of uncontested productive activities), the lower the

⁵ Data on ethnic and religious fractionalization and polarization are available at http://www.econ.upf.edu/~reynal/data_web.htm (accessed on January 2009).

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 an/the economy as explanatory variables. Columns (2) and (3) report estimated coefficients for specifications which include institutional variables. In particular, column (2) includes the polity index as proxy of an institutional regime, whereas column (3) includes dummy variables for colonial legacy. As expected, polity index is negatively associated with the occurrence of civil war. Namely, the common interpretation is that there is a negative association between democracy and civil wars. At the same time, it seems that former British colonies are less likely to be involved in an actual civil war. This result seems to be fairly robust. In column (4) I included some demographic measures as density of population and ethnic polarization and fractionalization. There is negative association between ethnic fractionalization and the likelihood of civil conflicts. In columns (6) and (7) I include only the covariates whose coefficients turned to be significant in the previous regressions. In the logit specifications (columns 8-14) the negative association between the size of manufacturing sector and the incidence of civil war is confirmed. At the same time, the likelihood of a civil war is positively associated with the size of the mining and agricultural sectors. Hence, to summarize briefly it is possible to write the main results:

- (1) There is a robust negative correlation between the size of manufacturing sector and the incidence of a civil war. Namely the higher the ratio of manufacturing activities in GDP, the lower the probability of occurrence of a civil conflict.
- (2) The incidence of a civil war increases in the size of agricultural and mining sectors.

(3) Some results already obtained in the existing literature are confirmed: (i) there is negative association between ethnic fractionalization and the likelihood of civil conflicts; (ii) there is a negative association between democracy and civil wars.

Table III - 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*** (0.332) [0.00]	0.88*** (0.33) [0.00]	1.58*** (0.36) [0.00]	1.23*** (0.39) [0.00]	1.42** (0.67) [0.03]	1.74*** (0.50) [0.00]	0.58 (0.62) [0.35]	2.94*** (0.60) [0.00]	1.59*** (0.54) [0.00]	0.62 (0.54) [0.25]	1.99*** (0.74) [0.00]	2.64*** (0.61) [0.00]	3.08*** (0.87) [0.00]	1.38 (0.87) [0.11]
Mining	0.242** (0.113) [0.03]	0.47*** (0.18) [0.01]	0.30** (0.16) [0.06]	0.47*** (0.19) [0.01]	0.51** (0.29) [0.07]	0.50*** (0.20) [0.01]	1.43*** (0.50) [0.00]	0.52*** (0.20) [0.00]	0.61*** (0.25) [0.01]	0.48 (0.32) [0.13]	0.78*** (0.34) [0.02]	0.42*** (0.21) [0.00]	0.47 (0.31) [0.13]	2.38*** (0.67) [0.00]
Manufacturing	-1.02*** (0.208) [0.00]	-0.39* (0.24) [0.10]	-1.17*** (0.26) [0.00]	-1.74*** (0.31) [0.00]	-1.64*** (0.29) [0.00]	-1.80*** (0.33) [0.00]	-1.22*** (0.45) [0.00]	-1.79*** (0.36) [0.00]	-0.84*** (0.30) [0.00]	-1.01*** (0.37) [0.00]	-3.81*** (0.66) [0.00]	-1.87*** (0.42) [0.00]	-2.62*** (0.52) [0.00]	-2.67*** (0.80) [0.00]
Polity		-0.10*** (0.04) [0.01]		-0.11*** (0.04) [0.00]	-0.09*** (0.04) [0.02]				-0.23*** (0.06) [0.00]				-0.24*** (0.06) [0.00]	
UK		-2.0*** (0.65) [0.00]	-0.87 (0.55) [0.11]				-3.42*** (1.17) [0.00]			-1.99** (0.92) [0.03]				-2.04 (1.37) [0.14]
France		-2.05*** (0.66) [0.00]	-0.35 (0.51) [0.49]				-2.47*** (0.97) [0.01]			-0.74 (0.80) [0.36]				-0.90 (1.34) [0.50]
Belgium		2.09*** (0.63) [0.00]	4.03*** (0.75) [0.00]				9.57*** (3.24) [0.00]			4.67** (0.98) [0.00]				23.77** (5.75) [0.00]
Portugal		1.12 (1.25) [0.37]	0.4 - -				0.99 2.97 [0.74]			1.5 (1.81) [0.41]				4.91 (16.46) [0.77]
Italy		1.60*** (0.58) [0.01]	1.89*** (0.57) [0.00]				7.30*** (1.88) [0.00]			3.30** (1.00) [0.00]				11.19*** (2.84) [0.00]
Density of Population				-0.05 (0.17) [0.78]			-0.61 (0.48) [0.21]				0.38** (0.18) [0.03]		0.34* (0.19) [0.07]	-2.54*** (0.82) [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 increase accuracy. in regressions 1-7 number of points for Gauss-Hermite quadrature has been set to 24.

Concluding Remarks

There is robust empirical evidence that the incidence of civil wars is increasing in the size of agricultural and mineral sectors. In addition, the results presented here 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 provides insights 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, favoring the production of ice-cream could imply 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. Some future directions for research can be highlighted. Firstly, the main point, is a thorough diagnosis of which businesses (and sectors) are likely to be contested in war-torn economies. Secondly, 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.

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APPENDIX

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
 Lesotho
 Liberia
 Malawi
 Mali
 Mauritania

Mozambique
Namibia
Niger
Nigeria
Rwanda
Senegal
Sierra Leone
Somalia
South Africa
Sudan
Swaziland
Tanzania
Togo
Uganda
Zambia
Zimbabwe
