

**INTERNATIONAL PRICES AND CONTINUING CONFLICT  
THEORY AND EVIDENCE FROM SUB-SAHARAN AFRICA (1980-2011)**

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**Abstract**

*This paper presents a theoretical model of conflict between two parties characterized by a two-sector economy. In a contested sector, they 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. Parties split their resource endowment between 'butter', 'guns' and 'ice-cream'. Eventually, tradable goods made of butter and ice-cream produced by conflicting parties are both sold to the Rest of the world. Therefore, the opportunity cost of conflict depends also on relative profitability of contested and uncontested production. In particular, productivity of uncontested production and profitability of contested sectors are countervailing forces. The empirical section focused on a panel of Sub-Saharan African countries for the period 1980-2011. Results are not fully conclusive. However, there is some evidence that prices of manufactures (interpreted as the uncontested ice-cream) are negatively associated with the likelihood of a civil war.*

**Keywords:** Theoretical model of conflict, Civil war, resource curse, butter guns and ice-cream, structure of the economy, commodity prices, MUV, panel probit analysis

**Jel Classification:** D74, O13, H56

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## Introduction

The purpose of this paper is twofold. On one hand, this paper is intended to be an enrichment of theoretical economic analysis of conflicts. On the other hand, it is intended to enrich the empirical economic literature on civil wars in Sub-Saharan Africa by pointing out the relationship between commodities, manufacturing and outbreak of actual violent conflicts. The basic intuition underlying this work is that the opportunity cost of continuing conflicts depend upon a combination of (i) specific and persistent characteristics of agents involved; (ii) institutional features and (iii) external factors. For sake of clarity in what follows assume henceforth that agents involved can be considered indistinguishably as governments or warlords governing regions or countries respectively. In the eyes of an economist, it is simple to consider as ‘persistent characteristics’ those related to the productive structure of economies which change only in the very long run. Secondly, by ‘institutional features’, I mean the set of norms governing the evolution of economic life as well as the distribution of both income and power among agents. As ‘set of norms’ the institutional features also favour the production of expectations about behaviour of agents considered. Needless to say, in the context of this work conflict is to be considered as a *social norm* in itself. Take a given point in time with no past behind. There are some positive initial endowments to be assigned to agents, and future distribution of income and power are eventually determined through conflict. More precisely, as social norm, the conflict is likely to produce expectations on each agent’s behaviour. Thirdly, by ‘external factors’ I refer to the set of factors which have to be assumed as exogenous to the economy considered as the structure of the market where goods and commodities are to be sold.

With this simple idea in mind, as noted above, this paper is firstly intended to complement a growing theoretical literature based upon the pioneering work of Hirshleifer (1988). In most of the existing literature, characteristics which fall within categories (i) and (ii) are frequently considered. Hence, this work is intended to complement the existing literature by combining factors which fall in all categories (i), (ii) and (iii). Let me highlight the general framework of Hirshleifer-like models. In brief, at a given point in time, agents are endowed with some positive resources endowments and some technological capabilities for both productive and unproductive activities. Nevertheless, warring parties are interdependent because they are assumed to produce a joint output whose re-distribution is the *casus belli*. Intuitively the continuing conflict is the generalization of rent-seeking behaviours which do shape the social outcome of economies. As suggested by Baumol (1990) the ratio between rent-seeking and innovative and entrepreneurial activities determines the outcome as well as the dynamics of a society. In the presence of a conflict this impact is even more pervasive. In fact, conflict is not only dissipative but it is destructive in itself. Actual conflicts in the eyes of an economist are destructive activities

because societies are worse off not only because of the decreased level of productive activities but also because of the destruction of existing productive investments.

Recurring results of this established theoretical literature are: (a) in the presence of a large asymmetry in resource endowments, the poorer party will devote all its endowment to guns. This has been labeled 'the paradox of power' by Hirshleifer; (b) cooperation between parties is feasible if and only if the relative advantage of one conflict technology over another is negligible. Yet, shifts in military technology can affect the economic incentives that may emerge in the presence of peaceful agreements; (c) there is an inverse relationship between productivity and willingness to be engaged 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 opportunity cost of conflict is higher in the presence of a superior productivity. This literature is surveyed in Garfinkel and Skaperdas (2007)<sup>1</sup>.

The theoretical model presented hereafter draws extensively from this literature. In particular, it is an extension of a baseline model presented in Caruso (2010b). It considers 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 fight in order to appropriate the maximum possible fraction of a contestable output. In a scenario of continuing conflict a property rights system is established and enforced by means of brutal force. Drawing from reality, this is currently the case of warlordism in many regions of the world. Warlordism means that non-state violent actors challenge state power and monopoly of violence. This line of reasoning recalls the distinction between governance and government as envisioned in Dixit (2009).

The conflict also determines the allocation of available resources and the distribution of income and power. 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. Production of both goods

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<sup>1</sup>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), Genicot and Skaperdas (1992), Baker (2003), Bös and Kolmar (2003), Garfinkel (2004), Dixit (2004), Alesina and Spolaore (2005), Maxwell and Reuveny (2005), Caruso (2006/2007/2010), Hausken (2004/2006), Munster (2007), Garfinkel, Skaperdas and Syropoulos (2008), Munster and Staal (2011), De Luca and Sekeris (2011).

would eventually also depend on the relative price of butter in terms of ice-cream.

Among Hirshleifer-style models there are few studies which address directly the impact of prices of contested stake upon the intensity and dynamic of conflict. Following insights emerging from literature on civil wars, Garfinkel, Skaperdas and Syropoulos (2008) model a conflict over a tradable natural resource [say Oil] whose exploitation is contested by different domestic groups. In particular, the authors model and compare autarky and free trade scenarios in order to analyze the impact of conflict and international prices on domestic welfare. Under free trade for a wide range of prices, an increase of international price of the contested resource fuels conflict. The most interesting result is the reverse of the comparative advantage. That is, in the absence of conflict the country would be a net importer of Oil whereas domestic conflict implies that the country becomes a net exporter. Productive structure of countries is shaped by conflict.

In the second part of the paper, I present an empirical application to the emergence of civil wars in Sub-Saharan Africa for the period 1980-2011. The empirical study is based upon the testable implications developed by means of the theoretical model. On civil wars, there is a widespread agreement that the incidence of civil wars is positively associated with the abundance of natural resources. This is also studied as ‘resource curse’. 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<sup>2</sup>.

As a first enrichment to the existing literature the current paper does constitute an attempt to analyse punctually the association between the world price of commodities and the incidence of actual conflicts. In fact, within a large empirical literature on economics causes of civil wars, there are few studies which focus punctually on relationship and causality between actual conflicts and commodity prices. Besley and Persson (2008) show how both export and import price indexes for commodities are positively and significantly correlated with the incidence of civil war. In particular, disentangling agricultural and minerals, the authors found that agricultural export and import prices are positively and significantly associated with the incidence of a civil war. Instead, only mineral import prices are significantly and positively associated with the incidence of a civil war whereas the mineral price index shows no significant correlation. Interestingly, there is no significant association between oil export price and the incidence of a civil war. Bruckner and Ciccone (2010) found that there is a significant negative association between international commodity prices and the onset of civil wars. In particular, the authors show that civil war onset in year  $t$  is negatively associated with the growth of international

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<sup>2</sup>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), Caruso (2010b).

commodity prices over the 3 previous years. Angrist and Kugler (2008) study the relationship between coca prices, income and civil conflict in Colombia. In particular, the authors analyse the impact of the consequences of an abrupt rise in coca prices upon violence. The empirical strategy is a logit estimation whose dependent variable is the ratio of violent deaths upon the population. The findings show increased violent death rates after the increase in coca cultivation associated with a rise in price of Colombian coca. Another interesting paper is about Columbian conflict, is by Dube and Vargas (2013) that explore how international commodity prices shocks affect armed conflict in Colombia. The authors found that exogenous price shocks in the coffee and oil markets have significant effects on armed conflict in Colombia. A severe fall in coffee prices in the late 1990s increased dramatically the level of violence in coffee-intensive municipalities, by lowering wages and therefore the opportunity cost of recruitment into armed groups. By contrast, a rise in oil prices increased conflict in the oil region, by raising potential gains from its exploitation. That is, the higher the oil world price the higher is the bloody rent-seeking associated with it.

Therefore, the present work also contributes also to this growing empirical literature by analysing the relationship between the international commodity prices and the incidence of a civil war. In particular, there is a significant novel contribution to the literature. In fact, drawing from the theoretical model of the previous section, the analysis focuses not only on the commodity prices but rather on the relative price of commodities in terms of manufactures. The implicit assumption of studies which focus on commodity prices is that economies descending into bloody conflicts are dependent upon primary sectors. The hypothesis here is that the existence and size of manufacturing sectors, can dramatically affect the opportunity cost of conflict for individuals. Needless to say, the expected returns of productive activities in manufacturing sectors would depend also upon prices of manufactured goods. Therefore, the world price of manufactured goods may be predicted to affect the likelihood of a bloody civil war. This is crucial nowadays when the Prebisch-Singer hypothesis of persistent decline in LDCs' terms of trade appears to be challenged by the sharp increase of commodity prices occurred in the latest years. In fact, the copious literature about commodity prices and growth in LDCs needs to be enriched by analysing this new current trend. This is particularly significant when considering that most low-income African countries depend on primary commodities for the larger share of their exports<sup>3</sup>.

The paper is structured as follows. In a first section a formal model is presented. Eventually, on the basis of the theoretical analysis, an empirical application to the emergence of civil wars in Sub-Saharan Africa is presented. Conclusions summarise the results.

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<sup>3</sup> On the relation between commodity prices and economic development see Deaton (1999) and Deaton (2010).

## 1. A BASIC MODEL OF CONFLICT AND PRODUCTION

There are two conflicting risk-neutral groups indexed by  $i = 1, 2$ . These conflicting behaving units can be interpreted alternatively as countries, regions, groups or communities. For sake of simplicity in the continuation of the work I shall refer to them as ‘regions’. They are assumed to be unitary actors. They both produce two tradable goods (butter and ice-cream) which are to be sold to the rest of the world (ROW). That is, the world is made of region 1, region 2 and the rest of the world. Both regions have a positive resources endowment denoted by  $R_i \in (0, \infty), i = 1, 2$ . The positive resources endowment 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. In fact, given the continuing conflict, the two regions also allocate a fraction of their resources endowment to unproductive activities of fighting (for appropriation). It is assumed that only one good (say the butter) is contested, namely subject to appropriation. Uncontested production of ice-cream is secure from appropriation. Henceforth, I also shall refer to them as ‘contested’ and ‘uncontested’ sectors respectively. For sake of simplicity, henceforth I shall use indistinguishably butter, guns and ice-cream to indicate both input and output of production processes. The two regions interact simultaneously. The interaction between the two regions generates a Nash-equilibrium allocation of resources endowment to ‘guns’, ‘butter’ and ‘ice-cream’. The timing of such interaction is as follows:

- 1) in the first stage, parties observe an exogenous price for both butter and ice-cream.
- 2) parties move simultaneously and choose an optimal level of guns and ice cream. The supply of both butter and guns is determined;
- 3) Market clears and new prices for butter and ice-cream take shape.
- 4) Payoffs are assigned, final incomes are attained and the final outcome of the regions is realised.

To summarise formally it is possible to write the resources constraint as:

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

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:

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

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 an ordinary Contest Success Function<sup>4</sup> (henceforth CSF for brevity) in its ratio form:

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

The functional form adopted for CSF is a special case of the general ratio form of CSF<sup>5</sup>. The functional form of CSF adopted is 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  $q_i(G_i, 0) = 1, \forall G_i \in (0, \infty)$ . 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. Thus, if one region chooses not to invest in ‘guns’, it 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. That is, given the ratio form adopted for CSF, the positivity assumption for guns does capture the coerced participation in the conflict. The CSF is differentiable and follows the conditions below:

$$\begin{cases} q_1 + q_2 = 1; q_i = .5 \text{ at } G_1 = G_2 \\ \partial q_i / \partial G_i > 0 \quad \partial q_i / \partial G_j < 0 \\ \partial^2 q_i / \partial G_i < 0 \quad \partial^2 q_i / \partial G_j > 0 \end{cases}$$

The outcome in the contested sector is given by:

$$S_i = q_i(G_1, G_2)CY$$

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:

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<sup>4</sup>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).

<sup>5</sup> The general form of CSF is:  $b_i G_i^\gamma / (b_1 G_1^\gamma + b_2 G_2^\gamma), \gamma > 0, b_i > 0, i = 1, 2$  which is extensively adopted in literature. Whenever  $\gamma < 1$ , it could be said that the CSF does exhibit decreasing returns in the technology of conflict. Whenever  $\gamma > 1$ , the CSF exhibits increasing returns to fighting. With  $\gamma = 1$  it could be said the CSF exhibits constant returns to fighting. In our context, firstly regions are assumed to be identical in their fighting abilities ( $b_1 = b_2 = 1$ ). Moreover, the parameter  $\gamma$  is set to unity. Such assumption appears to be particularly fitting in our context.

$$Y_1(y_1) = y_1^s, Y_2(y_2) = y_2^s$$

where  $y_i$  denotes the level of resources devoted to the uncontested production by region  $i$  and  $s \in (0,1)$  is the parameter capturing the degree of returns of scale. Regions are assumed to be equally productive. Eventually, final income of each region can be described as:

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

With  $p = \bar{p}_b/\bar{p}_{ice}$  denoting the initial relative price of butter in terms of ice-cream. Regions in the first stage observe initial exogenous prices  $(\bar{p}_b, \bar{p}_{ice})$ . Regions are assumed to be rational and to interact simultaneously à la Nash-Cournot. Therefore, treating the opponent's choice as given each region  $i$  maximizes (6) with respect to  $G_i$  and  $y_i$ . Under an ordinary process of maximization the Nash equilibrium choices of 'ice-cream' are:

$$y^* = y_1^* = y_2^* = \left(\frac{p}{2s}\right)^{1/(s-1)}$$

It is clear that  $\partial y_i^*/\partial p < 0$ . Evidently, the higher is the initial relative price of butter in terms of ice-cream, the smaller will be the production of ice-cream. In particular, it is also interesting that the supply of ice-cream increases in the degree of productivity only in the presence of a combination of  $p$  and  $s$ ,  $\partial y_i^*/\partial s > 0 \Leftrightarrow p < 2se^{1/(s-1)}$ . That is, when  $p$  is high enough, it can dominate the positive impact on production emerging in the presence of an adequate degree of productivity. The level of guns in equilibrium is given by:

$$G_1^* = G_2^* = G^* = \frac{TR}{4} - 2^{s/(1-s)} \left(\frac{p}{s}\right)^{1/(s-1)}$$

Clearly the optimal level of guns is increasing in the initial relative price of butter in terms of ice-cream, namely  $\partial G^*/\partial p > 0, \partial G^*/\partial \bar{p} > 0$ . Eventually, the level of butter is given by:

$$x_1^* = R_1 - y_1^* - G_1^* = ((3R_1 - R_2)/4) - 2^{s/(1-s)}(p/s)^{1/(s-1)}$$

$$x_2^* = R_2 - y_2^* - G_2^* = -2^{s/(1-s)}(p/s)^{1/(s-1)} - ((R_1 - 3R_2)/4)$$

Where  $\partial x_1^*/\partial p > 0$  and  $\partial x_2^*/\partial p > 0$ . That is, reasonably the quantity of butter is increasing in the initial relative price of butter in terms of ice-cream. Evidently, given that  $G^* = G_1^* = G_2^*$  and  $y^* = y_1^* = y_2^*$ , hence  $x_1^* \neq x_2^* \Leftrightarrow R_1 \neq R_2$ .

## 2. Empirical Implications

The theoretical analysis suggested that the relative price of commodities of contested sectors in terms of goods produced in the uncontested sector has a role in explaining the intensity of destructive investments undertaken by a rational actor. Broadly stated, the opportunity cost of conflict also depends on relative profitability of contested and uncontested production. Hereafter I propose an empirical application focused on Sub-Saharan Africa for the period 1980-2011.

As noted above in the introductory section of this paper, there is an established literature which uncovered the relationship between the exploitation of primary commodities and the incidence of civil wars. At the same time, echoing the theoretical section, in some cases manufacturing presumably can be assumed to constitute the portion of economic activity which can be modeled as ice-cream, namely as uncontested production. Clearly, choices of producers of contested commodities are based on world prices. In fact, the producers are likely to supply more when the prices are high in order to increase expected revenues. Therefore, a reasonable empirical application must consider the ratio between a commodity price index and a manufactures price index. Such ratio has been extensively used in literature which focused on terms of trade, prices of primary commodities and the Prebisch-Singer hypothesis.

There are no available data on prices of manufactures of Africa countries. Therefore, the manufactures price index adopted is the Manufactures Unit Value Index (henceforth MUV). It is a trade-weighted index of the five major developed countries' (France, Germany, Japan, United Kingdom, and United States) exports of manufactured goods to developing countries. The MUV is the only readily available trade-based manufacturing price measure available over a long time horizon. In fact, it has been commonly used as a measure of developing country imports. Its use in the present context is based on the rather strong assumption that G-5 manufacturing exports can be considered as a representative benchmark for the manufacturing exports of the rest of the world, especially of developing countries. In particular, the MUV can be considered representative for world price of manufactures. This assumption can be reasonable when considering that (i) economic integration occurred in the latest years induced also a convergence of prices of like goods; (ii) the 'geography of trade' has been re-shaping in the latest fifteen years. First, according to UNCTAD, developing countries' participation in world trade has increased up to 36% in 2005. Secondly a dramatic increase of South-South also trade took place.

In the latest years, in particular, the rising weight of China in world trade of manufactures which put a remarkable pressure on international prices towards convergence. Shortly, China's rapid technological progress, low labour costs and economies of scale are putting a downward pressure on prices of manufactured goods. For example Kaplinsky (2006) explains that

within a significant number of product groups, the prices of products exported into the EU by China and low-income economies was more likely to decline than the prices of the same products-groupings sourced from other high-income economies. This is because of the intense competition between China and low-income countries. Villoria (2009) also finds, that China has significantly decreased world prices in major markets for manufactures, especially textiles, wearing apparel and footwear, potentially displacing the clothing exports of African countries. As a consequence of China's export growth, less-developed countries have also experienced substantial reductions in both their import and exports prices across all manufacturing sectors. Fu, Kaplinsky and Zhang (2009) show that China's exports have influenced not only prices of low-skilled and labour-intensive exporters but also prices of exports originating from high and middle-income countries. That is, under the emerging convergence of world prices for many categories manufactures, I henceforth assume that the MUV index can be used as world price of manufactures index.

### The empirical specification

Hence, I created a panel dataset for the occurrence of civil wars in Sub-Saharan Africa which spans from 1980 to 2011. Eventually I estimate the following random effects panel probit model:

$$civilwar_{it} = \beta_0 + \beta_1 commodity_{ikt-1} + \beta_2 MUV_{it-1} + u_{it}$$

The incidence of a civil war has been captured through a dummy variable (*civilwar*) which takes the value of unity in the presence of a civil war in country *i* at time *t* and zero otherwise. Data about civil wars have been drawn from UCDP/Prio Database<sup>6</sup>. I take into consideration alternatively two types of conflict coded by UCDP; (a) **Internal armed conflict** that occurs between the government of a state and one or more internal opposition group(s) without intervention from other states; (b) the **Internationalized internal armed conflict** that occurs between the government of a state and one or more internal opposition group(s) with intervention from other states (secondary parties) on one or both sides. Disentangling between different types of conflict is functional to study whether different types of conflict exhibit different economic correlates.

The commodities indexes considered are alternatively: (i) an Oil price index; (ii) the Commodity Nonfuel Price Index; (iii) a metals price index; (iv) an agricultural raw price index. Source of these indexes is the IMF database.

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<sup>6</sup> The dataset is available at [www.ucdp.uu.se](http://www.ucdp.uu.se)

In particular, annual averages have been computed on the basis of monthly averages. The MUV index is available on the World Bank website<sup>7</sup>. I use lagged values for all indexes mentioned above. Eventually, in order to take into account the whole economic structure of the economy I include both the manufacturing and agricultural share of GDP as in Caruso (2010). Finally, I am also including some covariates drawn from existing literature on civil conflict. In particular, I am including: the degree of openness, the population, the polity score and a dummy variable capturing whether a country is an oil exporter or not, and finally whether a country is landlocked or not. The institutional regime has been captured through the polity index as developed in Polity IV project. This index is bounded between -10 and 10 where 10 means perfect democracy.

The results as presented in table 2 are somehow puzzled. The coefficient associated with MUV index is statistically significant only in column 1 when the dependent variable is the likelihood of internal conflict whereas it is statistically significant in all specifications when the dependent variable is the likelihood of internationalized conflict. Coefficients have the expected negative sign. In brief, a higher international price index for manufactures is associated with a lower probability of a civil war.

By contrast there is no clear-cut evidence on the association between commodity prices and the probability of a civil war. In the case of internal civil war, different commodity prices indexes appear to be negatively associated with the probability of an internal civil war. Only the agricultural raw price index is positively associated with the probability of an internal conflict. Put differently, shocks in oil or metals prices should not be blamed to inflame internal conflicts. By contrast, they are negatively associated with the likelihood of a civil war. In other words, whenever the oil price increases the probability a Sub-Saharan country experiences an internal war decreases. Results differ when dealing with internationalized conflict. In such a case, commodity indexes do not show any significant association with the probability of a conflict.

	Internal Conflict			Internationalized conflict		
	RE	RE	RE	RE	RE	RE
<b>OIL price index</b>	<b>-0.406***</b>			-0.009		
	(.134)			(.211)		
<b>Non fuel price index</b>		<b>-1.879**</b>			.160	
		(.447)			(.680)	
<b>metals price index</b>			<b>-1.02***</b>			.212
			(.227)			(.342)
<b>Agricultural raw price</b>	<b>1.566***</b>	<b>1.424**</b>	<b>1.454***</b>	.978	1.080	1.184
	(.749)	(.735)	(.725)	(1.180)	(1.153)	(1.142)
<b>MUV</b>	<b>-1.881**</b>	-0.039	-0.0261	<b>-3.080**</b>	<b>-3.348**</b>	<b>-3.716**</b>
	(1.089)	(1.274)	(1.212)	(1.722)	(1.928)	(1.911)

<sup>7</sup> The MUV is available at <http://go.worldbank.org/VDO5AA3VP0> [accessed on december 2009].

<b>Manufacturing Share of GDP</b>	-0.058 (.137)	-0.003 (.137)	-0.036 (.137)	-0.078 (.248)	-0.081 (.246)	-0.074 (.247)
<b>Agricultural Share of GDP</b>	<b>.414**</b> (.212)	<b>.476**</b> (.216)	<b>.437**</b> (.216)	<b>.856***</b> (.363)	<b>.862***</b> (.354)	<b>.878***</b> (.355)
<b>Openness</b>	-0.162 (.175)	-0.147 (.177)	-0.120 (.179)	-0.093 (.247)	-0.096 (.246)	-0.107 (.248)
<b>Polity</b>	-0.009 (.016)	<b>-.024*</b> (.015)	-0.0189 (.016)	.025 (.022)	.025 (.022)	.025 (.022)
<b>Population (logged)</b>	<b>.380***</b> (.161)	<b>.323**</b> (.157)	<b>.396***</b> (.163)	-0.078 (.224)	-0.079 (.220)	-0.094 (.223)
<b>Landlocked (dummy)</b>	.165 (.423)	.136 (.431)	.152 (.432)	.183 (.639)	.185 (.642)	.191 (.647)
<b>Oil exporter (dummy)</b>	-0.104 (.440)	-0.090 (.447)	-0.133 (.449)	.809 (.658)	.814 (.6559)	.834 (.666)
<b>Const</b>	-2.526 (2.822)	-3.180 (2.889)	<b>-8.077***</b> (3.193)	4.476 (4.252)	4.72 (4.232)	5.821 (4.582)
<b>Obs.</b>	1174	1174	1174	1173	1173	1173
<b>Groups</b>	39	39	39	39	39	39
<b>Log likelihood</b>	-365.275	-360.577	-359.090	-152.846	-152.82	-152.654

Notes: standard errors in parenthesis, \* \*\*significant at 1%, \*\* significant al 5%, \*significant at 10%. For sake of readability statistically significant coefficients are in bold;

To summarize:

- 1) Among commodities the agricultural price index has a positive association with the likelihood of a internal conflict.
- 2) Oil price index and metals index show a negative association with the likelihood of a internal conflict.
- 3) MUV presents a significant negative association with the likelihood of a internationalized conflict.

Therefore, the evidence on the impact of commodity prices on actual civil conflict is not conclusive. One possible explanation for such weak evidence is that composition of exports is different from one country to another. Hence, aggregate price indexes supposed to apply to all countries can be interpreted as inappropriate. In this respect, it must be not surprising that agricultural raw price index performs better than other indexes.

Evidence about MUV is more robust in the case of internationalized conflicts and partly confirms the root idea of this work. Namely, it is not only the price of primary commodities which affected the incidence of actual conflicts in Sub-Saharan Africa but the relative price of commodities in terms of manufactures.

In order to highlight in depth the impact of prices of manufactures on likelihood of civil wars, I eventually ran two regressions where the among the explanatory variables I included an interaction term between the size of manufacturing sector and MUV. Table 3 reports the results. Results are puzzled. In the case of internal conflict, the relationship between both MUV and size of manufacturing sector and the probability of a civil war is positive. That is, the probability of an internal conflict increases with MUV and the size of manufacturing. However, there is robust negative association between the likelihood of a civil war and the interaction term between the size of manufacturing sector and the MUV. This would suggest perhaps that only the manufacturing which is tradable to the rest of the world have a detrimental effect on conflicts. Interestingly, the size of manufacturing sector is positively related to the incidence of internal civil wars and not for internationalized conflict.

	Internal	Internazionalized
	RE	RE
MUV	<b>3.27***</b> (.787)	.800 (1.163)
Manufacturing Share of GDP	<b>4.574***</b> (1.368)	.894 (2.150)
Manufacturing Share of GDP*MUV	<b>-1.030***</b> (.303)	-.227 (.488)
Agriculture Share of GDP	<b>.299**</b> (.157)	<b>.707***</b> (.282)
Openness	<b>-.450***</b> (.138)	-.077 (.214)
Polity	.018 (.014)	.019 (.022)
Population (logged)	<b>.262**</b> (.137)	-.055 (.213)
Landlocked (dummy)	.187 (.363)	.182 (.572)
Oil exporter (dummy)	.156 (.373)	.930 (.589)
Const	-16.999 (3.774)	-7.731 (5.483)
Time Trend	YES*	YES
Obs.	1523	1522
Groups	39	39
Log likelihood	-466.769	-182.172

## **Concluding remarks.**

This paper was an attempt to examine the impact of international relative price between commodities and manufactured goods on the probability of actual civil conflicts and eventually on economic development in Sub-Saharan Africa. The paper presents first a theoretical enrichment of economic analysis of conflict and eventually an empirical section focused on sub-saharan Africa for the period 1980-2011. Economies are interpreted as being divided into contested and uncontested productions. Briefly, a two-sector economy for two risk-neutral agents is presented. In a contested sector the 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'. The latter denote productive activities secure from appropriation. The most interesting result is that productivity of uncontested production and profitability of contested sectors appear to behave as countervailing forces. The first raises the opportunity cost of being involved in a continuous conflict, whereas the latter fuels higher level of unproductive conflict.

The empirical section also presents interesting results. First of all, I take into account the two types of conflict (internal and internationalized) as coded by the UCDP dataset. In brief, what appears to be clear is that a higher international price index for manufactures is associated with a lower probability of an internal civil war. By contrast there is no robust evidence about an association between commodity prices and the probability of a civil war. To summarise the main results:

- 1) There is a significant difference between internal and internationalized conflicts.
- 2) Among commodities, the agricultural price index has a positive association with the likelihood of a internal conflict.
- 3) Oil price index and metals index show a negative association with the likelihood of a internal conflict.
- 4) MUV presents a significant negative association with the likelihood of a internationalized conflict.
- 5) There is robust negative association between the likelihood of a civil war and the interaction term between the size of manufacturing sector and the MUV. This would suggest perhaps that only the manufacturing which is tradable to the rest of the world have a detrimental effect on conflicts.

In spite of the puzzled results, this study appears to be crucial nowadays when the new geography of trade is likely to induce in the next future a downward pressure on prices of several categories of manufactures. In many developing countries, in the presence of low prices for low-tech

manufactures, the relative profitability of contested production would increase thereby fuelling the emergence of actual conflicts. This also poses an intriguing question in terms of policy prescriptions. In fact, enhancing protectionism to raise prices of manufactures would also build systems of rents which may be even counterproductive by fuelling other conflicts. Therefore, the question is open and this work is nothing but an intriguing spare part of a broader and more complex work.

## References

- Acemoglu D., Robinson J.A.**, (2006), De facto Political Power and Institutional Persistence, *American Economic Review, Papers and Proceedings*, vol.96, n.2, pp.325-330.
- Anderton, C. H., Anderton R. A., and Carter J.** (1999), Economic Activity in the Shadow of Conflict, *Economic Inquiry*, vol. 17, n.1, pp. 166-179.
- Angrist, J., Kugler A.**, (2008). Rural Windfall or a New Resource Curse? Coca, Income and Civil Conflict in Columbia. *Review of Economics and Statistics*, vol. 90, n.2, pp.191-215.
- Arrow, K.**, (2000), The Basics Economics of Arms Reduction, *Peace Economics, Peace Science and Public Policy*, vol. 6, no. 3, pp.12-26.
- Baker M.J.**, (2003), An Equilibrium Conflict Model of Land Tenure in Hunter-Gatherer Societies, *Journal of Political Economy*, vol. 111, n.1, pp. 124-173.
- Baland, J.M., Francois P.** (2000), Rent-Seeking and Resource Booms., *Journal of Development Economics*, vol. 61, n.2, 527-542.
- Baumol, W.J.**, (1990), Entrepreneurship: Productive, Unproductive, and Destructive, *The Journal of Political Economy*, vol. 98, n.5, pp. 893-921.
- Besley, T. Persson T.** (2008), The Incidence of Civil War: Theory and Evidence, NBER Working Paper No. 14585.
- Bös D., Kolmar M.**, (2003), Anarchy, efficiency and redistribution, *Journal of Public Economics*, vol. 87, n.11, pp. 2431-2457,
- Boulding, K. E.**, (1963), Towards a Pure Theory of Threat Systems, *The American Economic Review, Papers and Proceedings*, vol.53, n.2, pp. 424-434.
- Buhaug, H., and Gates S.**, 2002, The Geography of Civil War, *Journal of Peace Research*, vol. 39, n.4, pp. 417-432.
- Bruckner M., Ciccone A.**, (2010), International Commodity Prices, Growth, and Civil War in Sub-Saharan Africa, *The Economic Journal*, vol. 120, n. 544, pp. 519-534.
- Caruso R.**, (2010a), On the Nature of Peace Economics, *Peace Economics, Peace Science and Public Policy*, vol. 16, n.2, art.1
- Caruso R.**, (2010b), Butter, Guns and Ice-Cream, Theory and evidence from Sub-Saharan Africa. *Defence and Peace Economics*, vol. 21, n.3, pp. 269-283
- Caruso, R.**, (2007), Continuing Conflict and Stalemate: A note, *Economics Bulletin*, vol. 4, n.17, pp. 1-8.
- Caruso, R.**, (2006), A Trade Institution as a Peaceful Institution? A Contribution to Integrative Theory, *Conflict Management and Peace Science*, 23 (1), 53-72.
- Chen J., Stocker H.**, (1997), Composite Commodities and the Prebisch-Singer Thesis, *World Development*, vol. 25, n.11, pp. 1863-1871.
- Collier, P., and Hoeffler A.**, (1998), On Economic Causes of Civil War, *Oxford Economic Papers*, vol. 50, n. 4, pp. 563-573.

- Collier P., Goderis B.**, (2008), Commodity Prices, Growth and the Natural Resource Curse: Reconciling a Conundrum, CSAE WPS/2007-15
- Deaton A.**, (2010), Understanding the Mechanisms of Economic Development, *The Journal of Economic Perspectives*, vol. 24, n.3, pp. 3-16
- Deaton A.**, (1999), Commodity Prices and Growth in Africa, *Journal of Economic Perspectives*, vol. 13, n.3, pp.23-40
- De Luca G., Sekeris P.**, (2011), Land Inequality and conflict intensity, *Public Choice*, forthcoming.
- De Soysa I., Neumayer E.**, (2007), Resource Wealth and the Risk of civil war Onset: Results from a new dataset of Natural Resource Rents, 1970-1999, *Conflict Management and Peace Science*, vol. 24, n.1, pp.201-218.
- Djankov S., Reynal-Querol M.**, (2010), The Causes of Civil War, working paper.
- Dube O., Vargas J.F.**, (2007), Commodity Price Shocks and Civil Conflict: Evidence from Colombia. Working paper. CERAC - Centro de Recursos para el Análisis de Conflictos
- Fearon J.**, (2005), Primary Commodity Exports and Civil War, *Journal of Conflict Resolution*, 49 (4), 483-507.
- Fearon, J.D., Laitin D.D.**, (2003), Ethnicity, Insurgency and Civil War, *American Political Science Review*, vol. 97, n.1, 75-90.
- Ferreira M.E.**, (2006), Angola: Conflict and Development, 1961-2002, *The Economics of Peace and Security Journal*, 1, (1), 25-29.
- Fu X., Kaplinsky R., Zhang J.** (2009), The impact of China's export on Global Manufactures Prices, Oxford Department of International Development, SLPTMD working paper n. 32.
- Garfinkel, M. R., Skaperdas S.**, (2007), Economics of Conflict: An Overview, in *Handbook of Defense Economics* edited by Sandler T., Hartley K., Elsevier.
- Garfinkel, Skaperdas and Syropoulos** (2008), Globalization and Domestic Conflict, *Journal of International Economics*, vol.76, n.2, pp.296-308.
- Grossman, H.I.**, (1991), A General Equilibrium Model of Insurrections.", *The American Economic Review*, vol. 81, n.4, pp. 912-921.
- Grossman, H. I., and Kim M.**, (1995), Swords or Plowshares? A Theory of the Security of Claims to Property, *The Journal of Political Economy*, vol. 103, n. 6, pp. 1275-1288.
- Hausken, K.**, (2004), Mutual Raiding of Production and the Emergence of Exchange.", *Economic Inquiry*, vol. 42, n. 4, pp. 572-586.
- Hausken, K.**, (2006) The Stability of Anarchy and Breakdown of Production, *Defence and Peace Economics*, vol. 17, n.6, pp.589-603.
- Humphreys M.**, (2005), Natural resources, conflict and Conflict Resolution, *Journal of Conflict Resolution*, vol. 49, n.4, pp. 508- 537.
- Hicks M.J., Smith J.**, (2009), Warfare, Civil Conflict and the Spatial Impacts on Domestic Investments: Evidence from South America,

- Peace Economics, Peace Science and Public Policy*, vol. 15, n.1, article 6.
- Hirshleifer, J., 1988. "The Analytics of Continuing Conflict.", *Synthese*, 76 (2), 201-233. reprinted by Center for International and Strategic Affairs, CISA, University of California.
- Hirshleifer, J.**, (1989). Conflict and Rent-Seeking Success Functions, Ratio vs. Difference Models of Relative Success, *Public Choice*, vol. 63, pp. 101-112.
- Kaplinsky R.**, (2006) Revisiting the Terms of Trade Revisited: What Difference does China Make?, *World Development*, vol. 34, n. 6, pp. 981-995.
- Lujala P., Gleditsch N.P., Gilmore E.**, (2005), A diamond Curse? Civil War and a Lootable Resource, *Journal of Conflict Resolution*, 49 (4), 538-562.
- Maxwell J.W., Reuveny R.**, (2005), Continuing conflict, *Journal of Economic Behavior and Organization*, vol.58, n.1, pp. 30-52
- Miguel E., Satyanath S., Sergenti E.**, (2004), Economic Shocks and Civil Conflict: An Instrumental variables approach, *Journal of Political Economy*, 112 (4), 725- 753.
- Montalvo J. G., Reynal- Querol M.**, (2005), Ethnic Polarization, Potential Conflict, and Civil Wars, *The American Economic Review*, 95 (3), 796-816.
- Muenster J.**, (2007), Simultaneous Inter- and Intra-Group Conflicts, *Economic Theory*, vol. 32, n.2, pp. 333-352.
- Muenster J., Staal K.**, (2011), War with Outsiders Makes Peace Inside, *Conflict Management and Peace Science*, vol. 28, n.2, pp. 91-110.
- Noh, S. J.** (1999), A General Equilibrium model of two-group conflict with endogenous intra-group sharing rules, *Public Choice*, vol. 98, pp. 251-267
- Polachek S.**, (1999). Conflict and Trade: An Economics Approach to Political International Interactions, *Peace Economics, Peace Science and Public Policy*, vol.5, n.2.
- Sambanis, N.** (2001). Do Ethnic and Non-ethnic Civil Wars Have the Same Causes? A Theoretical and Empirical Inquiry (part I), *Journal of Conflict Resolution*, 45(3), 259-282.
- Sambanis N.**, (2002), A review of recent Advances and Future Directions in the quantitative Literature on Civil War, *Defence and Peace Economics*, 13(3), 215-243.
- Seigle C., Liu, P.C.**, (2002) Arms races in the developing world: some policy implications, *Journal of Policy Modeling*, vol.24, n. 7-8, pp. 693-705
- Skaperdas, S.** 1992, Cooperation, Conflict, and Power in the Absence of Property Rights, *The American Economic Review*, vol. 82, n.4, pp.720-739.
- Skaperdas, S.** 1996, Contest Success Functions, *Economic Theory*, 7 (2), 283-290.

- Skaperdas S., Syropoulos C.**, (1996), Can the Shadow of Future harm Cooperation?, *Journal of Economic Behavior and Organization*, vol. 29, n.3, pp. 355-372.
- Torvik, R.** 2002. "Natural Resources, Rent Seeking and Welfare.", *Journal of Development Economics*, 67 (2), 455-470.
- Tullock, G.** 1980. "Efficient Rent Seeking," in *Toward a Theory of the Rent-seeking Society*, edited by Buchanan, J. M., Tollison R., D., Tullock G. Texas A&M University, College Station, 97-112.
- Verbeek M.**, (2000), *A guide to Modern Econometrics*, John Wiley & Sons.
- Villoria N.B.**, (2009), China and the manufacturing Terms of Trade of African Exporters. *Journal of African Economies*, vol. 18, n.5, pp.781-823