INTERNATIONAL PRICES AND CONTINUING CONFLICT
THEORY AND EVIDENCE FROM SUB-SAHARAN AFRICA (1995-2006)

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December 2011

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 1995-2006. Results are not fully conclusive. However, there is robust evidence that prices of manufactures (interpreted as the uncontested ice-cream) are negatively associated with the likelihood of a civil war. Eventually, international price of manufactures is also associated with a higher GDP per capita growth rate. The concluding remark seems to be that an increase in world prices of manufactures would make civil wars less likely.

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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1. 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. This clearly does inform the pattern of interactions taking place. Thirdly, by 'external factors' I clearly mean 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 is 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. Rent-seeking is dissipative and unproductive. Yet, 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) [1].

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 form 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 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

[1]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).

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 1995-2006. 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[2].

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 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 (2007) 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

[2]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).

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 of small manufacturing sectors, for example, can dramatically affect the opportunity cost of conflict for individuals. Needless to say, the expected return 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[3].

The paper is structured as follows. In a first section a formal model is expounded. In a second section, in order to highlight some fundamental features of the analytical model a numerical example 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.

2. A BASIC MODEL OF CONFLICT AND PRODUCTION

There are two conflicting risk-neutral behaving units indexed by $i = 1,2$. These conflicting behaving units can be interpreted alternatively as countries, regions, 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 $R_i \epsilon (0, \infty), i = 1,2$. 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). In particular, it is also assumed that only one between the two goods produced (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:

[3] On the relation between commodity prices and economic development see Deaton (1999) and Deaton (2010).

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[4] (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[5]. 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 $q_i(G_i, 0) = 1, \forall G_i \epsilon (0,\infty)$. 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

[4]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).

[5] 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 γ is set to unity. Such assumption appears to be particularly fitting in our context.

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:

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

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:

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

where y_i denotes the level of resources devoted to the uncontested production by region i and $s\epsilon(0,1)$ 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 $\partial G^*/\partial p > 0, \partial G^*/\partial\partial p > 0$. Eventually, the level of butter is given by:

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

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

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 $x_1^* \neq x_2^* \Leftrightarrow R_1 \neq R_2$.

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At this point, the interlinking interaction of conflict and production determined the level of production for both tradable goods made of butter and ice-cream. The rest of the world purchases the total supply of butter and ice cream. Let me assume that the preferences of the rest of the world take the classical Cobb-Douglas form:

$$U^{ROW}(x_1, x_2, y_1, y_2) = (x_1 + x_2)^a (y_1 + y_2)^b = X^a Y^b$$

where $a\epsilon(0,1), b\epsilon(0,1), a + b = 1$. The rest of the world maximizes its utility under the constraint: $p_1 X + p_2 Y = m$, where $m\epsilon(0,\infty)$[6]. The demand for the different commodities is $D_i = km/p_i, i = 1,2, k = a, b$. The supply of the different commodities is nothing but the equilibrium quantities chosen in the first stage, namely $(x_1^*, x_2^*, y_1^*, y_2^*)$. The market clearing equations are given by:

$$\frac{am}{p_1} = (x_1^* + x_2^*) = X^* \quad \frac{bm}{p_2} = (y_1^* + y_2^*) = Y^*$$

Eventually the final prices of butter and ice-cream are respectively denoted by p_1 and p_2:

$$p_1 = \frac{2^{\frac{s}{s-1}} m s^{\frac{1}{s-1}}(b-1)}{2p^{1/(s-1)} - TR(2s)^{1/(s-1)}}$$

$$p_2 = 2^{(s-2)/(1-s)} bm \left(\frac{p}{s}\right)^{1/(1-s)}$$

Please note that $p_1 > 0 \Leftrightarrow 2p^{1/(s-1)} - TR(2s)^{1/(s-1)} < 0$, and $p_2 > 0$. The price of butter is decreasing in the initial relative price only in the presence of specific combinations of TR, p and s. That is, $\partial p_1/\partial p < 0$ if and only if $TR^2(2s)^{2/(s-1)} - 2^{(2s-1)/(s-1)} TR(ps)^{1/(s-1)} + 4p^{2/(s-1)} > 0$.

This is somehow counterintuitive. That is, since the quantity of butter is increasing in the initial relative price of butter in terms of ice-cream, it ought to be

[6]Reasonably, another assumption would be $m > TR$

expected that the price of butter would be decreasing in the initial relative price of butter in terms of ice-cream. The latter inequality shows that this is not always the case. There could be combinations of s, p and TR which make the price of butter increasing in the initial relative price of butter in terms of ice-cream. However, as the resources endowment increases, the inequality holds. In fact, this inequality unambiguously holds if $TR \to \infty$. In addition the price of butter is increasing in the degree of productivity.

Contrariwise, the final price of ice-cream is unambiguously increasing in the initial relative price $\partial p_2/\partial p > 0$, but it is decreasing in the degree of productivity $(\partial p_2/\partial s < 0)$if and only if $0 < p < 2se^{1/(s-1)}$. That is, the allocation of resources to ice-cream favours a larger supply of the uncontested commodity so inducing a decrease of price. However, whenever s and p are sufficiently high the price of ice cream is no longer decreasing in the degree of productivity. In particular, this confirms what found above, namely that when p is sufficiently high, even a superior productivity in the uncontested sector is 'dominated' by profitability if the contested sector. Eventually final incomes of both regions are given by:

$$W_1^* = W_2^* = W^* = (1 - s)\left(\frac{p}{2s}\right)^{\frac{s}{s-1}} + \frac{pTR}{4}$$

Final incomes are increasing in the aggregate positive endowment of resources. Eventually final income of both regions increases in the degree of productivity if and only if $0 < p < 2s$. That is, final income of both regions is increasing in the degree of productivity of uncontested production if and only if it dominates the incentive for fighting proxied by p.

3. 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 (proxied by the level of guns) undertaken by a rational actor. Broadly stated, the opportunity cost of conflict also depends on relative profitability of contested and uncontested production. Hereafter I try an empirical application focused on Sub-Saharan Africa for the period 1995-2006. 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 reflect 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. The figures below report the monthly indices for total commodity, nonfuel commodities and oil for the period 1994-2007. It is clear that since 2002 commodity markets have experienced an unprecedented boom.

FIGURE 1 – COMMODITY PRICE INDEX – MONTHLY PRICE – SOURCE: IMF

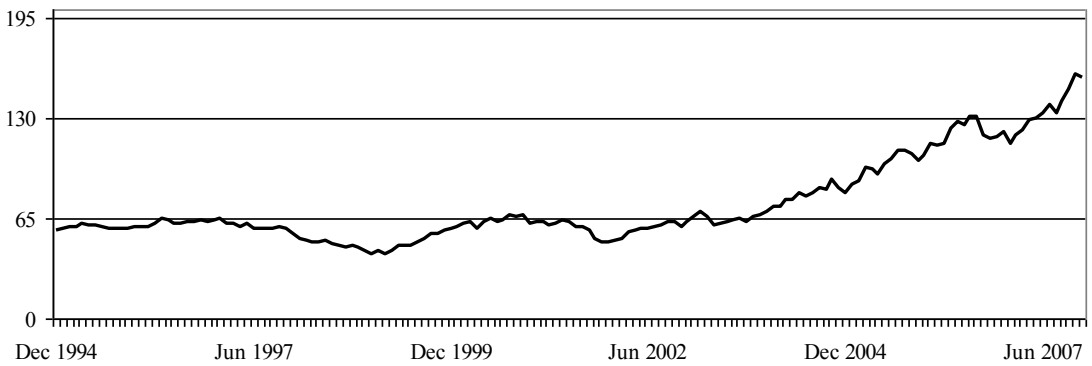


FIGURE 2 – CRUDE OIL PRICE INDEX – MONTHLY PRICE – SOURCE: IMF

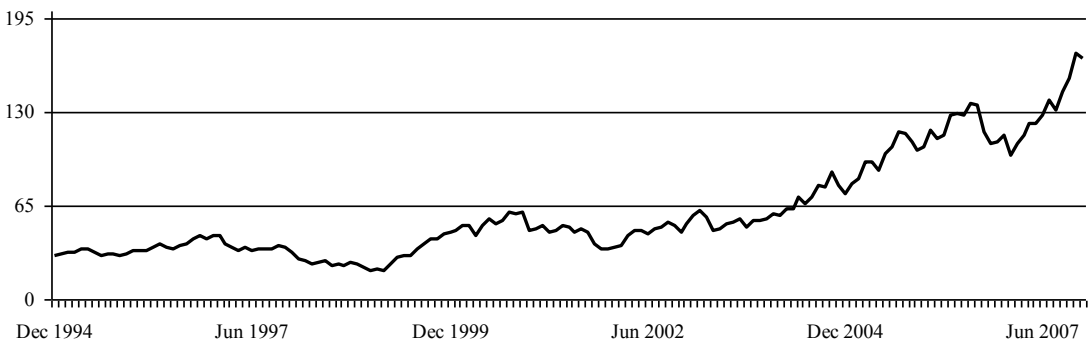


FIGURE 3 – COMMODITY NONFUEL PRICE INDEX – MONTHLY PRICE – SOURCE: IMF

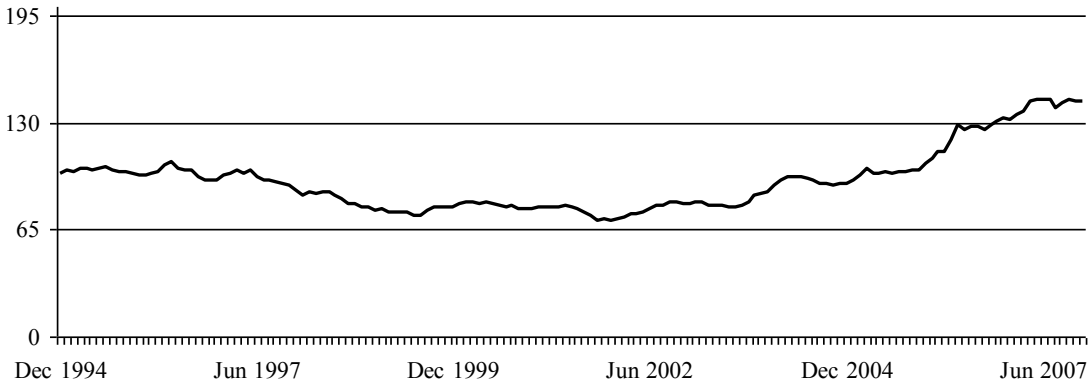
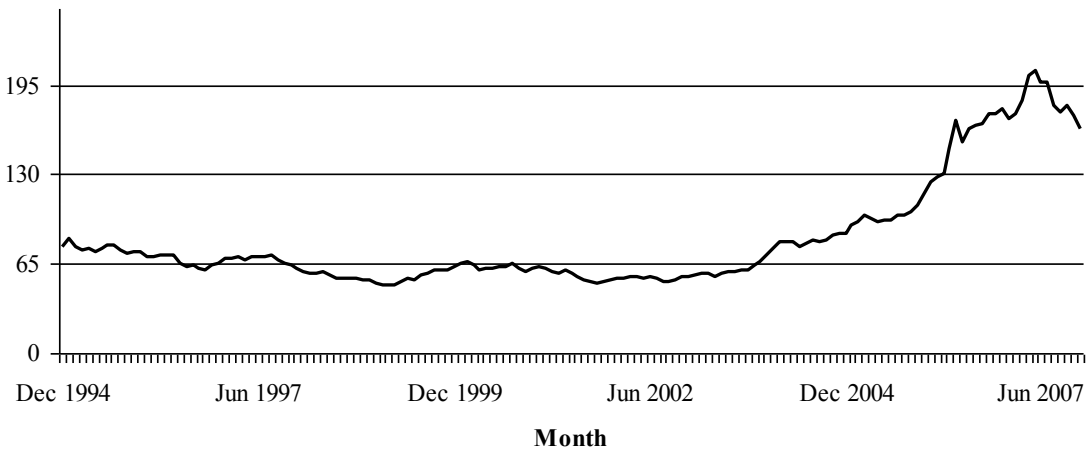


FIGURE 4 – COMMODITY METALS PRICE INDEX – MONTHLY PRICE – SOURCE: IMF

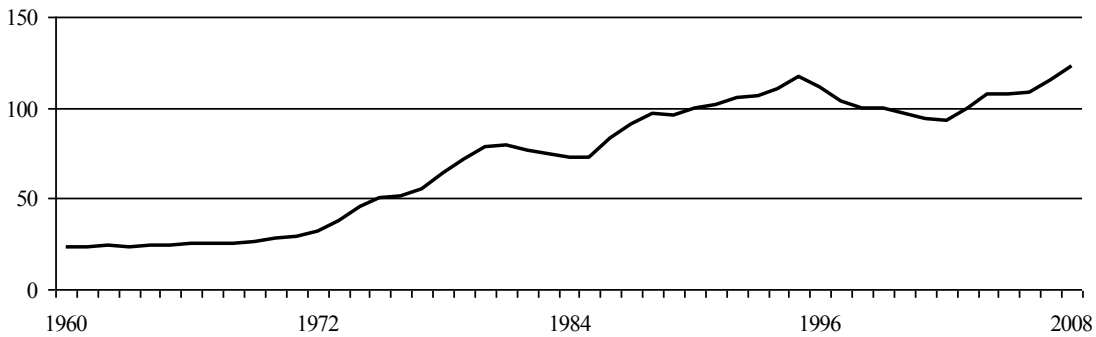


There are no available data on prices of manufactures of Africa countries. Therefore, the manufactures price index adopted is the Manufactures Unit Value Index (henceforth MUV). It is a trade-weighted index of the five major developed countries' (France, Germany, Japan, United Kingdom, and United States) 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. Figure 5 reports the MUV from 1960 to 2008. The increase of MUV in the latest years is explained by means of dollar depreciation.

FIGURE 5 – MANUFACTURES UNIT VALUE INDEX (MUV), 1990=100. U.S. DOLLAR TERMS



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Hence, I created a panel dataset for the occurrence of civil wars in Sub-Saharan Africa which spans from 1995 to 2006. 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 Armed Conflict Database[7].The commodities indexes considered are alternatively: (i) an aggregate commodity index; (ii) an Oil price index; (iii) the Commodity Nonfuel Price Index; (iv) a metals price index. Source of these indexes is the IMF database. In particular, annual averages have been computed on the basis of monthly averages. The

[7] 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)

MUV index is available on the World Bank website[8]. I use lagged values for all indexes mentioned above. The expected signs for the coefficients of commodity prices and MUV are positive and negative respectively.

First, parsimonious models have been estimated. In further estimations a set of control variables has 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 Montalvo and Reynal Queirol (2005) [9]. 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 order to evaluate the social well-being I use the Human Development Index (henceforth HDI for sake of brevity) produced by United Nations Development Programme (UNDP) since 1990. The HDI combines three basic dimensions of human life: (1) life expectancy at birth; (2) education; (3) standard of living measured by GDP per capita. Given its nature, it could be considered a good approximation of a broader socio-economic environment. In particular, I use only the HDI computed in 1995. This would capture the initial conditions at the beginning of the period considered. Needless to say, since the HDI index depends also upon literacy, they have not been included in the same regressions.

TABLE 1. DESCRIPTIVE STATISTICS

Variable	Source	Obs	Mean	St. Dev.	Min	Max
War (dummy)	**PRIO/UCDP**	480	0.28	0.44	0	1
Commodity Price Index (logged)	**IMF**	480	4.13	.19	37.8	4.61
Oil Price Index (logged)	**IMF**	480	3.89	.45	3.20	4.79
Nonfuel commodity index	**IMF**	480	4.48	.11	4.33	4.61
MUV (logged)	**World Bank**	480	4.63	0.07	4.53	4.76
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
HDI1995	**UNDP**	408	.47	.11	.30	.75
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

The results as presented in table 2 are somehow puzzled. First, the most interesting and robust result is that the MUV index is statistically significant in all specifications (with the exception of column 12 specification). Most coefficients are significant at either the

[8] The MUV is available at http://go.worldbank.org/VDQ5AA3VP0 [accessed on december 2009].
[9] Data on ethnic and religious fractionalization and polarization are available at http://www.econ.upf.edu/~reynal/data_web.htm [accessed on december 2009].

1% or 5%. Namely a higher international price index for manufactures is associated with a lower probability of a civil war. In all specifications this finding is robust. By contrast there is no robust evidence about an association between commodity prices and the probability of a civil war. For example, the Oil index only appears to be significantly associated with the incidence of a civil war. However, such association appears to be only weakly significant in only two specifications. The general commodity price index is highly significant only in column (6). The metal price and the nonfuel commodities index are never statistically significant. In the meantime, the coefficients of covariates have the expected signs and precisely: (a) literacy, Polity and HDI are negatively associated with the likelihood of a civil war; (b) density of population, being landlocked and the size of forested territory are positively associated with the incidence of a civil war.

Table 2 - Probit Analysis for the incidence of Civil War

	(1)	(2)	(3)	(4)	(5)	(6)	7	8	9	10	11	12	13	14
Commodity Price Index (t-1)					.32	**1.94*** **	.41							
					(.55)	(.76)	(.56)							
OIL price index (t-1)	-.01	**.54***	.32	**.45***										
	(.22)	(.31)	(.25)	(.27)										
nonfuel price index (t-1)											1.58	.27	.76	1.79
											(1.77)	(1.36)	(1.41)	(1.32)
metals price index (t-1)								.95	.92	1.32				
								(.75)	(.76)	(.89)				
MUV (t-1)	**-2.98****	**-5.09*****	**-3.84****	**-4.54**	**-3.32****	**-7.04*****	**-3.55****	**-4.85*****	**-4.91*****	**-6.99*****	**-6.37****	-3.29	**-4.08***	**-5.37*****
	(1.50)	(2.18)	(1.76)	(1.80)	(1.59)	(2.38)	(1.65)	(2.11)	(2.12)	(2.65)	(3.07)	(2.35)	(2.42)	(2.31)
HDI1995		**-10.99*****				**-20.52*****				**-10.14*****	**-15.01****			
		(3.40)				(4.26)				(2.33)	(3.33)			
Literacy			**-1.23*****	-.24										
			(.29)	(.24)										
Polity		**-0.09****	**-.11*****	**-.16*****		**-0.08*****	**-.11*****		**-.10**	**-0.07*****	**-.07**	**-10*****	**-0.05***	
		(0.05)	(0.03)	(0.03)		(0.04)	(0.03)		(0.03)	(.03)	(0.04)	(.03)	(0.03)	
Density of Population		.20	**.61**	-.08		-.24	**.57*****		-0.07	**.25****	**.84*****		-.20	
		(.24)	(.13)	(.11)		(.23)	(.13)		(.11)	(.12)	(.23)		(.13)	
Ethpol		-1.20	-1.50			**-6.02*****					2.21		**-1.84***	
		(2.18)	(1.09)			(2.50)					(1.59)		(1.08)	
Ethfrac		.99		1.62		-.90					**-2.71***		-.56	
		(1.87)		(1.00)		(1.45)					(1.54)		(.79)	
Forest area		.002	**.57*****	**-.21***		**.33****			.02	0.08	**.52*****		**.26*****	
		(.20)	(.11)	(.12)		(.15)			(.07)	(0.09)	(.18)		(.11)	
Landlocked		.05				**-.73**			.25	-.19	.33		**.89****	
		(.74)				(.58)			(.25)	(.44)	(.58)		(.30)	

Const	**12.51****	**25.21****	**14.25***	**19.09*****	**12.7****	**35.46*****	**12.14***	**17.15****	17.05	**27.55**	**19.90****	**13.74**	**15.46****
	6.87	(10.73)	(8.17)	(8.19)	(6.88)	11.31	(7.08)	(7.83)	(7.94)	(10.30)	(10.20)	(7.61)	(7.24)
Obs.	480	360	408	408	480	360	480	480	480	408	360	432	480
Groups	41	30	34	34	41	30	41	41	41	35	30	36	41
Log Likelihood	-149.68	-89.92	-119.73	-118.93	-149.51	-86.47	-148.25	-148.88	-145.33	-99.38	-88.34	-134.76	-148.75
Wald	4.08	42.12	49.61	26.25	4.39	49.79	41.79	5.58	19.56	41.00	48.03	22.36	5.83
LR	265.83	94.83	187.54	186.20	266.17	100.57	244.00	267.08	224.64	135.13	100.67	205.95	267.18

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.

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 crude oil price index performs better than other indexes.

By contrast, evidence about MUV is very robust 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 particular, this also recalls and complements the evidence presented in Caruso (2010b) that shows a robust negative correlation between the size of manufacturing sector and the incidence of a civil war. Namely the higher is the ratio of manufacturing activities in GDP the lower is the probability of occurrence of a civil conflict. Table 3 reports the results of further regressions which focus on the relationship between civil war, MUV and size of manufacturing sector.

As explanatory variables I added the size of manufacturing sector expressed as percentage of GDP and eventually an interaction term between the manufacturing sector and MUV. Results are as expected. First, 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. Interestingly, the size of manufacturing sector is positively related to the incidence of civil wars. This would mean perhaps that only the manufacturing which is tradable to the rest of the world have a detrimental effect on conflicts.

Table 3 - Probit and Logit Analysis for the incidence of Civil War

	Probit		**Logit**	
	(1)	**(2)**	**(3)**	**(4)**
Manufacturing	**23.49****	**26.33***	**42.77****	**45.665***
	(11.41)	(15.91)	(19.915)	(28.24)
MUV	6.427	7.836	12.195	13.132
	(4.878)	(7.052)	(8.34)	(12.73)
Manufacturing*MUV	**-5.175****	**-6.03***	**-9.41****	**-10.53***
	(2.461)	(3.44)	(4.30)	(6.111)
Literacy		-.29		**-2.47*****
		(.280)		(.581)
Polity		**-.121*****		**-.236*****
		(.031)		(.061)
Density of Population		**1.028*****		**1.539*****
		(.187)		(.329)
Ethpol		.444		-1.557
		(1.036)		(2.071)
Forest area		**.149***		**.334****
		(.089)		(.168)
Landlocked		**.788*****		2.60
		(.348)		(58.89)
Const	-30.53	-38.19	-57.76	-54.33
	(22.64)	(.32.62)	(38.73)	(58.89)
Obs.	480	408	480	408
Groups	41	34	41	34
Log Likelihood	-143.546	-109.154	-143.593	-107.787
Wald	15.78	65.13	14.03	51.44

LR	256.67	148.87	257.19	148.86

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.# To increase accuracy the number of points for Gauss-Hermite quadrature has been set to 24.

Eventually, it is possible to test directly the impact of both commodities prices and manufactures prices on GDP per capita growth. The GDP per capita growth rate has been extracted from Unctad dataset. The expected signs for the coefficients of commodity prices and MUV are negative and positive respectively.

Table 4 - GDP growth and MUV - OLS fixed effects - Dependent variable GDP growth

	FE	FE	FE	FE	FE	FE	FE
Commodity Price Index (t-1)	.002				.005		
	(.003)				(.005)		
OIL price index (t-1)		-.0000				.202	
		(.098)				(.220)	
nonfuel price index (t-1)			.630				
			(.591)				
metals price index (t-1)				.110			.178
				(.330)			(.357)
MUV (t-1)	**2.01*** **	**2.13*** **	1.32	**1.919** **	**1.676** **	**1.742** **	**1.893** **
	(.721)	(.687)	(1.018)	(.931)	(.875)	(.900)	(1.021)
Literacy					.009	.010	.010
					(.025)	(.025)	(.0251)
Polity					-.007	-.008	-.007
					(.022)	(.0217)	(.022)
Density of Population					-.971	-1.266	-.466
					(.795)	(1.140)	(.615)
Forest area					-.221	-.199	-.211
					(.228)	(.228)	(.229)
Const	**-7.98*** **	**-8.44*** **	**-7.49*** **	**-7.192** **	-2.023	-1.994	-5.24
	(3.27)	(3.14)	(3.249)	(3.507)	(6.089)	(6.752)	(5.27)
Obs.	424	424	424	424	393	393	393
Groups	41	41	41	41	38	38	38
Rsquared within	.0261	.0255	.0284	.0258	.0393	.0382	.0366
Rsquared within	.0214	.0177	.0410	.0196	.0001	.0008	.0041
Rsquared within	.0115	.0110	.0118	.0112	.0012	.0016	.002

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

Even in this case, the results are not fully conclusive. First and foremost, there is a clear positive association between the MUV (one year lagged) and the gdp per capita growth rate. More in detail, *ceteris paribus*, a 1% increase in MUV is associated with an increase in GDP per capita growth rate of 2% approximately. Instead, there is no significant association between the GDP per capita growth rate and commodities prices indexes. This is in line with the previous results.

4. 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 1995-2006. 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, a higher international price index for manufactures is associated with a lower probability of a civil war. In all specifications this finding is robust. By contrast there is no robust evidence about an association between commodity prices and the probability of a civil war. Eventually, there is a clear positive association between the MUV index and the GDP per capita growth rate.The resulting conclusion seems to be that an increase in world prices of manufactures would make civil wars less likely. This 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.

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COUNTRIES	EXPORT COMMODITIES*	CIVIL WAR
Angola	**crude oil**, diamonds, refined petroleum products, coffee, sisal, fish and fish products, timber, cotton	1974-1989, 1995-1997, 1998-2002, 1075-2006.
Benin	cotton, cashews, shea butter, textiles, palm products, seafood	
Botswana	diamonds, copper, nickel, soda ash, meat, textiles	
Burkina Faso	cotton, livestock, gold	
Burundi	coffee, tea, sugar, cotton, hides	1988-1991, 1993-2005
Cameroon	**crude oil** and petroleum products, lumber, cocoa beans, aluminum, coffee, cotton	
Central African Republic	diamonds, timber, cotton, coffee, tobacco	
Chad	**oil**, cattle, cotton, gum arabic	
Congo	petroleum, lumber, plywood, sugar, cocoa,	

	coffee, diamonds	
Dem.Rep.Congo	diamonds, gold, copper, cobalt, wood products, **crude oil,** coffee	1996-1997, 1998-2003
Equatorial Guinea	**petroleum**, methanol, timber, cocoa	
Eritrea	livestock, sorghum, textiles, food, small manufactures	2008-ongoing
Ethiopia	coffee, qat, gold, leather products, live animals, oilseeds	1974-91
Gabon	crude oil,, timber, manganese, uranium	
Gambia	peanut products, fish, cotton lint, palm kernels, re-exports	
Ghana	gold, cocoa, timber, tuna, bauxite, aluminum, manganese ore, diamonds, horticulture	
Guinea	bauxite, alumina, gold, diamonds, coffee, fish, agricultural products	
Ivory Coast	cocoa, coffee, timber, petroleum, cotton, bananas, pineapples, palm oil, fish	1999-2000, 2002-2007
Kenya	tea, horticultural products, coffee, petroleum products, fish, cement	
Lesohto	wool and mohair, food and live animals	
Liberia	rubber, timber, iron, diamonds, cocoa, coffee	1989-1996, 1999-2003
Malawi	tobacco , tea, sugar, cotton, coffee, peanuts, wood products, appare	
Mali	cotton, gold, livestock	
Mauritiana	iron ore, fish and fish products, gold, copper, petroleum	
Mozambique	aluminum, prawns, cashews, cotton, sugar, citrus, timber; bulk electricity	1976-1992
Namibia	diamonds, copper, gold, zinc, lead, uranium; cattle, processed fish, karakul skins	
Niger	uranium ore, livestock, cowpeas, onions	
Nigeria	petroleum and petroleum products 95%, cocoa, rubbe	
Rwanda	coffee, tea, hides, tin ore	1990-1994
Senegal	fish, groundnuts (peanuts), petroleum products, phosphates, cotton	
Sierra Leone	diamonds, rutile, cocoa, coffee, fish	1991-2002
Somalia	livestock, bananas, hides, fish, charcoal, scrap metal	1991-present
South Africa	gold, diamonds, platinum, other metals and minerals, machinery and equipment	
Sudan	oil and petroleum products; cotton, sesame, livestock, groundnuts, gum arabic, sugar	1983-2005, 2003-present
Swaziland	soft drink concentrates, sugar, wood pulp, cotton yarn, refrigerators, citrus and canned fruit	
Tanzania	gold, coffee, cashew nuts, cotton	
Togo	reexports, cotton, phosphates, coffee, cocoa	
Uganda	coffee, fish and fish products, tea, cotton, flowers, horticultural products; gold	1987-2009
Zambia	petroleum products, fertilizer; foodstuffs, clothing	
Zimbabwe	platinum, cotton, tobacco, gold, ferroalloys, textiles/clothing	

Source: *CIA World Fact book [accessed December 2009],