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NATURAL RESOURCES AND VIOLENT CONFLICTS: QUANTITATIVE ANALYSIS FOR AFRICAN COUNTRIES

Peace, security, development and human wellbeing are the values and goals important for all nations in the world. The existence of violent conflicts is still creating an obstacle to reach these goals. These conflicts are partly caused by the contest for important natural resources in different regions of the world and of individual countries. Africa belongs to those regions where the violent conflicts linked to natural resources are evident. The authors of this paper have tried to prove whether this explanation can be also supported with statistical analyses. The analysis in the paper has shown that some of the reasons of the violent conflicts suggested by qualitative methodology are also relevant from the statistical point of view.

Keywords: Africa, natural resources, environment, international security, conflicts.

JEL: D74, F59, O55, Q01, Q59.

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ПРИРОДНІ РЕСУРСИ І ЗБРОЙНІ КОНФЛІКТИ: КІЛЬКІСНИЙ АНАЛІЗ ЗА ДАНИМИ АФРИКАНСЬКИХ КРАЇН

У статті показано, що мир, безпека, економічний розвиток і добробут людини пріоритетні для всіх країн у світі. Виникнення збройних конфліктів перешкоджає досягненню цих цілей. Ці конфлікти частково обумовлені боротьбою за важливі природні ресурси в різних регіонах світу та окремих країнах. Африка належить до тих регіонів, де відбуваються збройні конфлікти, пов'язані з природними ресурсами. Це доведено за допомогою статистичного аналізу. Деякі з причин збройних конфліктів дійсно підтверджуються статистичними методами.

Ключові слова: Африка, природні ресурси, навколишнє середовище, міжнародна безпека, конфлікти.

Таб. 5. Літ. 39.

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ЕСТЕСТВЕННЫЕ РЕСУРСЫ И ВООРУЖЕННЫЕ КОНФЛИКТЫ: КОЛИЧЕСТВЕННЫЙ АНАЛИЗ ПО ДАННЫМ АФРИКАНСКИХ СТРАН

В статье показано, что мир, безопасность, экономическое развитие и благополучие человека приоритетны для всех стран в мире. Возникновение вооруженных конфликтов по-прежнему препятствует достижению этих целей. Эти конфликты частично обусловлены борьбой за важные естественные ресурсы в различных регионах мира и отдельных странах. Африка принадлежит к тем регионам, где происходят вооруженные конфликты, связанные с естественными ресурсами. Это доказано при помощи статистического анализа. Некоторые из причин вооруженных конфликтов действительно подтверждаются статистическими методами.

Ключевые слова: Африка, естественные ресурсы, окружающая среда, международная безопасность, конфликты.

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1. Introduction. Many places of the world are still confronted with violent conflicts. As stressed by Waisova (2005), learning about the causes is one of the most important parts of complex solutions of international and internal conflicts. Africa is regarded as a major laboratory for theory building in the field conflicts (Osaghae and Robinson, 2005).

While political and military issues remain critical, conceptions of conflict and security have broadened: economic and social threats including poverty, infectious diseases and environmental degradation are also seen as significant contributing factors. This new understanding of the contemporary challenges to peace is now being reflected in high-level policy debates and statements.

From conflict prevention and early warning to peacemaking, peacekeeping and peace building, the potential role of natural resources and the environment must be taken into consideration (UN ECOSOC, 2006).

The other causes which can be understood as reasons of violent conflicts are as follows: difficult economic conditions combined e.g. with financial, energy and food crises and linked with critical balance of involvement in international trade, ethnic, cultural and religious diversity, impact of conflicts in neighbouring countries. The patterns of governance and economic policy, both of which have much to do how natural resources are shared, lead to internal conflicts (Mwagiru, 2001).

Therefore, conflicts can also be caused by the presence of important, rich (water resources, pastures, minerals) as well as scarce natural resources (water, fertile land, pastures) in countries. Climate change with interlinked issues (drought, desertification, deforestation, natural disasters and floods) also can be a source for conflicts and unstability (Thiombano and Tourino-Soto, 2007). In fact, natural resources have been acknowledged as a factor influencing or prolonging some conflicts in Africa (UN, 2010). The scale of many originally regional or local environmental problems, such as extensive urban development degradation, deforestation, desertification, salination, denudation, or water or fuel wood scarcity or other natural resources scarcity or the access to resources now threatens broader international repercussions: by undermining the economic base and social fabric of weak and poor states, by generating or exacerbating intra- or inter-state tensions and conflicts (Hurell, 1995).

Prevention, peaceful solving of violent conflicts and recovery from conflict are important parts of good and efficient global, regional and national governance (Lehmanova et al., 2010). Governance should be understood as performance the delivery of high quality political goods including security and safety, rule of law, participation and human rights, sustainable economic opportunity including access to natural resources, human development to citizens by government of all kinds. That applies also to Africa (Rotberg, 2009).

The authors of this paper have tried to prove the hypothesis that presence and depletion of natural resources in countries can be one of important reasons for violent conflicts, comparing it to other factors. They have applied a cross-sectional estimation for statistical analyses. There are several examples how this (i.e. statistical) type of cross-country analyses has been successfully applied for answering various questions. For instance, M. Saleth and A. Dinar (2008) used it for examining the important factors for good water sector performance. P. Sauer et al. (2008) performed similar analysis for learning which institutions can explain different environmental

performance in different countries. Concerning the methodology of this paper – the panel data were collected and 2 statistical models were developed. The first model covers economical, political and institutional variables; the second relates to resource depletion and response to climate changes. The goal was to compare the effectiveness of institutional variables related to good governance and ethnicity in the explanation of violent conflicts in comparison with natural resource abundance.

2. Conflicts over natural resources in Africa and its factors. The exploitation of natural resources and related environmental stresses are supposed to become significant drivers of violence because as the global population continues to rise and the demand for resources continue to grow. Therefore, there is a potential for conflicts over natural resources to intensify.

Many countries currently face development challenges related to the unsustainable use of natural resources and the allocation of natural wealth which leads to tensions related to their supply, in particular minerals. Population growth fostered the demands of raw materials and energy consumptions. For instance metals, industrial and construction minerals, fossil fuels, biomass has increased almost eightfold, the extraction of iron ore, bauxite, copper and nickel is now rising faster than the world GDP (Krausmann et al., 2009). Although the GDP per capita increased 5.5-fold, income distribution is a major problem as well as the culture of "consumerism" developed in high income countries.

Africa's exports of raw materials like oil and strategic raw materials have been growing but regional manufacturing capacities and consumption have been stagnating (more details: in OPEC, 2007). Similar occurs with the agricultural export commodities like coffee, cocoa beans, cotton, tea, cashew nuts, flowers, tropical timber which adds stress to land and water use (Peters and Kambewa, 2007). The variation on prices has a close link to natural resources exploitation, since the exports of those commodities represent a significant share of GDP, similar to the share of foreign aid supply (Okonjo-Iweala, 2009).

Therefore, African countries, their institutions, interests groups, from highest political representation/elite to local communities, are pending on revenues from the exploitation of natural resources and their legal or illegal use and transfer mainly to regional or international markets. In some cases, when governance fails to resolve tensions and distribute equitably the profits from the use of natural resources, leading to generate disadvantages specific groups and ultimately to conflict (Huggins and Clover, 2005; Ochola, 2007; Bates, 2008). Illegal exploitation of resources contribute to the creation of violent conflicts as well, e.g. in mining sector, fisheries, timber logging (Hilson and Clifford, 2010; van Donge, 2009).

Regarding natural resources, their local abundance combined with acute poverty or the lack of opportunity for other forms of income and low quality institutions, creates an incentive for groups to control them by rent-seeking and violent actions (Maathai, 2009). The potential consequences of climate change which affects water availability, food security, the prevalence of disease, coastal boundaries are aggravating existing tensions and potentially generating new conflicts too (Brown and Crawford, 2008). The UNEP (2008b) study brings a table with examples where civil wars, internal or regional conflicts, were affected by natural resources (see Table 1).

The 10 cases of this sort from Africa are shortly described in the study and in regular quarterly progress reports on the relevant UNEP conflicts programmes.

Table 1. Recent civil wars and internal unrest fuelled by natural resources

Country	Duration	Resources
Angola	1975-2002	Oil, diamonds
Congo, Democratic Republic of	1996-1998, 1998-2003, 2003-2008	Cooper, coltan, diamonds, gold, cobalt, timber, tin
Congo, Republic of	1997-	Oil
Cote d'Ivoire	2002-2007	Diamonds, cocoa, cotton
Liberia	1989-2003	Timber, diamonds, iron, palm oil, cocoa, coffee, rubber, gold
Nigeria	1967-1970, 1990-	Oil
Senegal — Cadamance	1982-	Timber, cashew nuts
Sierra Leone	1991-2000	Diamonds, cocoa, coffee
Somalia	1991-	Fish, coal
Sudan	1983-2005	Oil

Source: Adapted from UNEP (2008b); where it was adapted and updated from Ross (2003); modified for Africa by the authors of this paper.

Given the previous information, the question to be answered is which a set of variables provides a better explanation of violent conflicts occurrence — a set of institutional variables or the abundance and administration of natural resources.

3. Statistical models: Literature review of the about violent conflicts outbreak.

Several studies have been conducted to study the causes of violent conflicts. For example, Murshed (2004) analyzed the sample of 91 developing countries, where for each country the first two major export items (commodities) were identified based on the UNCTAD (2002). The export commodities were then characterized as originating from one of the following 4 sources: (i) point-source natural resources; (ii) diffuse-source natural resources; (iii) coffee/cocoa or; (iv) manufacturing. The data spans the period 1970-2000, the index of democracy was included as well in order to measure the effects of institutions and he found that the countries rich in natural resources perform worse in economic terms and that natural resources could retard institutional development.

Collier & Hoeffler (1998, 2002a) reported that primary commodity exports tend to increase the danger of civil war. Their work covers up to 52 civil wars between 1960 and 1999, and suggests that a state's dependence on natural resources — measured as the ratio of primary commodity exports to GDP — has a significant influence on the likelihood that a civil war will begin over the next 5 years.

Fearon and Laitin (2003) adopted a state-centric perspective and considered per capita income as a measure of financial and bureaucratic strength of government, instead of the cost of recruitment for rebel, also they considered the share of resource exports on GDP constituted a measure of the weakness of national economy, and the attention to natural wealth as financing means to rebels was restricted to mineral resources.

The literature review reveals that natural richness and a poor designed institutional framework are the causes for the outbreak of violent conflicts; the objective of the following analyses is to study separately the effects of a mix of institutional, economical and ethnical factors in comparison to the natural resources abundance and their preservation over the incidence of violent conflicts on the African continent.

Methodology. The methodology of analyses presented in the paper is based on the study of Murshed (2004) who used the crossed-sectional estimates to calculate 2 regression models regarding the effects of natural resources endowments over the degree of democracy, which involved rent seeking and institutional issues, and over the variations of economic growth. Using the information from sections 2 and 3, the authors developed 2 regression models to test which set of variables provides a better explanation for violent conflicts outbreak.

Table 2. Political, economical and institutional variables

Variable	Description
Dependent variable	
<i>Y_{CON}</i> Government involvement in armed conflict (2007) <i>Source: Index of African Governance Results and Ranking 2009</i>	The indicator measures the number of armed conflicts in which a government was involved during a given year and in which there are at least 25 battle-related deaths.
Independent variables	
<i>COR</i> Public sector corruption (2007) <i>Source: Index of African Governance Results and Ranking 2009</i>	Public sector corruption refers to a system that does not function according to general laws, but through particularistic favours and arrangements. It scores countries on the scale from 0 to 10, where "0" indicates high levels of perceived corruption. Due to its nature it difficult to measure objectively.
<i>NARET</i> Exports of natural resources (2007) <i>Source: The Economic Report on Africa 2012. Economic Commission for Africa, African Union, 2012. African Economic Outlook. 2012. Economic Commission for Africa, African Union, OECD, African Development Bank, 2012.</i>	% of natural resources' share in exports. Includes the share of minerals and agricultural raw materials in export in 2010. Number of countries having this share between 91 and 100% = 24 countries, between 81 and 90% = 9 countries, between 51 and 80% = 13 countries, between 21 and 50% = 6 countries, between 11 and 20% = 1 country, between 0 and 10% = 1 country.
<i>GDP</i> GDP per capita growth (2007) <i>Source: Index of African Governance Results and Ranking 2009</i>	Gross Domestic Product (GDP) per capita based on purchasing power parity (PPP) (constant 2005 international dollars) is included as a measure of wealth creation.
<i>GOV</i> Index of African governance (2007) <i>Source: Index of African Governance Results and Ranking 2009</i>	The 2009 Index of African governance is composed by 5 general categories: (I) safety and security, (II) rule of law, transparency and corruption, (III) participation and human rights, (IV) sustainable economic opportunity, and (V) human development performance. It is a summary of each country institutional factors, measuring how responsible were the nation-states on the delivery of essential political goods to their inhabitants. It takes values from 0 to 100.
Cultural mix (<i>CUM</i>) <i>Source: Atlas of the World's Languages (2007)</i>	This is included as a dummy variable, where 0 if cultural mix is absent and 1 if present (mix of ethnics, languages, religions, cultural – customary diversity).

4. First model — Data and variables. The sample consists of 53 African countries taken from "Strengthening African Governance, Index of African Governance: Results and Rankings" (Rotberg and Gisselquist, 2009). The climate change data and related information were derived from ADB (2010), Toulmin (2009) and the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC, 2010) and submitted national communications from African countries.

The data on the percentage of natural resources share in exports were adopted from ADB/OECD (2007). The institutional, economical and ethnical variables used for this model are described in Table 2.

Results of estimations. The results are show in Table 3. The model shown above explains 26% of the variation of government involvement in armed conflicts. All results, excluding cultural mix, are statistically significant at 0.01. The problems of heteroskedasticity and multicollinearity seem to be absent in this model and the specification seems to be correct as well, the autocorrelation problem wasn't detected.

Table 3. Regression of political, economic and sociocultural variables

Predictor	Coefficient
Public sector corruption (<i>COR</i>)	0.341072 ***
Exports of natural resources (<i>NARET</i>)	0.014314***
GDP per capita growth (<i>GDP</i>)	0.149869***
Index of African governance (<i>GOV</i>)	-0.092673***
Cultural Mix (<i>CUM</i>)	0.366460**
F-Statistics	50.38917***
Adjusted R ²	.269
*** = $p < .001$, ** = $p < .01$	

5. Second model: Data and variables. The data was collected from the World Bank Green Accounting (WBGA, 2007) about the depletion of mineral, forestall, energy and water resources for 48 African countries (UNEP, 2006; UNEP, 2008a).The variables (natural resources and their preservation) used for this model are described in Table 4.

Table 4. Resource depletion variables and climate change response

Variable	Description
Dependent variable	
<i>Y_{CON}</i> Government involvement in armed conflict (2007) <i>Source: Index of African Governance Results and Ranking 2009</i>	The indicator measures the number of armed conflicts in which a government was involved during a given year and in which there are at least 25 battle-related deaths.
Independent variables	
<i>ENERGY</i> Energy depletion (% of GNI) (2007) <i>Source: World Bank Green Accounting</i>	Energy depletion is the ratio of the value of the stock of energy resources to the remaining reserve lifetime (capped at 25 years). It covers coal, crude oil and natural gas.
<i>FOREST</i> Net forest depletion (% of GNI) (2007) <i>Source: World Bank Green Accounting</i>	Net forest depletion is calculated as the product of unit resource rents and the excess of roundwood harvest over natural growth.
<i>MINERAL</i> Mineral depletion (% of GNI) (2007) <i>Source: World Bank Green Accounting</i>	Mineral depletion is the ratio of the value of the stock of mineral resources to the remaining reserve lifetime (capped at 25 years). It covers tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite and phosphate.
<i>WATER</i> Annual freshwater withdrawals (% of internal resources) (2007) <i>Source: World Bank Green Accounting</i>	Annual freshwater withdrawals refer to total water withdrawals, not counting evaporation losses from storage basins. Withdrawals also include water from desalination plants in the countries where they are a significant source. Withdrawals can exceed 100% of the total renewable resources where extraction from non-renewable aquifers or desalination plants is considerable or where there is significant water reuse. Withdrawals for agriculture are total withdrawals for irrigation and livestock production. Data are for the most recent year available for 1987-2002.

The End of Table 4

Variable	Description
CLIRE Climate change response <i>Source:</i> Author evaluation of national climate change strategies of all African countries in 2011–2012	A dummy variable captures the effect of climate change strategies. If a country has formal strategies regarding climate change and at the same time an efficient integrated implementation, it takes the value of 1, if not –0.

Estimations results. The results are shown in Table 5. The model explains 13% of the variation of government involvement in armed conflicts. All the results are statistically significant at 0.01, only the forest depletion (FOREST) is not statistically significant but it is relevant for the model. The problems of heteroskedasticity and multicollinearity problems seem to be absent in this model also and the specification seems to be correct as well, autocorrelation wasn't detected.

Table 5. Regression with natural resources depletion and climate change response on violent conflicts

Predictors	Coefficient
Intercept	0.458276***
Energy depletion (ENERGY)	0.027765***
Net forest depletion (FOREST)	0.056941
Mineral depletion (MINERAL)	0.097867***
Annual freshwater withdrawals (WATER)	– 0.003993***
Climate change response (CLIRE)	– 0.427184***
F-statistics	10.75806
Adjusted R ²	0.132658
*** = $p < .001$, ** = $p < .01$	

6. Interpretation and models'conclusions. In general, the statistical analyses has shown that the outbreaks of violent conflicts are caused mainly by institutional and sociocultural factors used in the first model: it fits with the hypothesis on rent seeking factors, the international trade also matches with the reviewed information which considers that trade could increase the probability of starting conflicts, and in the case of governance fits as well due to the fact that better governance reduce the possibilities of illegal activities that could lead to conflicts.

The first model relates to income distribution and the corruption linked to certain elites, with certain ethnical and cultural profile (Murshed, 2004) which tends to gather profits from extractive activities. It is not surprising that good governance reduces the outbreak of violent conflicts since better institutional framework reduces the levels of corruption. GDP per capita growth and the share of natural resources on the exports level increase the possibilities of having conflicts, and they are also linked as well to rent-seeking phenomenon. In Africa, corruption is linked to intensive legal and illegal exports of natural resources in particular of energy and mineral resources and primary agriculture export commodities and also involves granting licences for extraction activities, for timber logging, for new agricultural sectors (e.g., horticulture) using African natural resources (forests, water, fertile lands, biodiversity) in unsustainable way. Africa loses around US\$ 148 bln annually due to corrupt practices, almost 25% of the continent GDP according to the African Union reports (ADB/OECD, 2007). Therefore, good governance represents a possible solution to

abate rent-seeking activities, for developing countries with certain endowment of natural resources and guarantees peace.

The second model which considers the natural resources depletion and climate change as exogenous variables provided interesting results: natural resources and in particular mineral and forest resources depletion have the strongest impact on African countries; followed by energy depletion resources, although is small, which means they are more likely to cause local and regional conflicts for their control. The relevant issue is, that climate change respond reduces considerably the probabilities of violent conflict outbreaks, since the adoption of strategies to protect natural resources improves the institutional framework. Water depletion was confusing, but it can be assumed that ensuring water access reduces the chances of conflicts, therefore if more water is withdraw the probabilities of conflicts will decrease. In Africa, crude petroleum, natural gas etc. – energy products account for more than 60% of the total exports of goods from Africa (in many cases – up to 99%) and for about 20% of the world trade in energy products. Africa holds approximately 30% of the Earth's minerals reserves with the growing share of mining in GDP and in respective international trade. 4 of Africa's worst conflicts of recent years took place in Angola, Sierra Leone, Liberia and the Democratic Republic of the Congo (DRC) motivated, inter alia, by the competition for access to natural resources and for monopoly to trade them and the related incomes. The national arm conflicts were even financed by the exploitation of natural resources (legal or illegal) – diamonds and timber in Sierra Leone and Liberia, oil in Angola and a wide range of mineral resources in DRC. Access to water, although it hadn't a large effect, is important since Africa is the world's second driest continent after Australia. About 75% of the population relies on groundwater as the major source of drinking water; however, groundwater represents only about 15% of the continent's total renewable water resources (UNEP, 2011).

The results of the second model which evaluated the richness in natural resources also fits with the results of a qualitative research conducted by Hlavacek (2009, 2013). His observation reflects experience of this region that extractive industries of any scale if not controlled and regulated by efficient national and global governance system can destabilize economies, increase poverty and fuel conflicts. The international community and national governments should prevent the potential conflicts over the resources. The instruments of the intervention should include national legislation and policies (e.g., New Mining and Minerals Law of 2000 and Mineral Policy of Liberia of 2010) as well as international prevention measures (e.g., Kimberley Process Certification Scheme, OECD Guidelines for Multinational Enterprises, Extractive Industries Transparency Initiative). The climate change response strategies belong to these instruments. These strategies should concern both climate change mitigation and adaptation approaches (Cihelkova, 2011).

Concerning the methodological questions, it is possible to say that the reasons for conflicts expressed in the qualitative literature could be confirmed to some extent. We believe that both quantitative and qualitative analyses can contribute to more detailed understanding of the reasons and the dynamics of the conflicts outbreak with natural resources abundance. Still an improvement on the statistical models studying this relation is necessary in order to increase their explicative power. Meanwhile, it

seems that institutional, ethnical and economical variables provide a better explanation of these phenomena.

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