Revisiting natural resources-conflict nexus

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Abstract

This paper analyses the threshold effect of natural resources on internal conflict in 124 countries over the period 1984 -2017 using panel smooth transition regression approach. Data used in this study is obtained from International Country Risk Guide and World Development Indicator. The results suggest that the effect of natural resources on internal conflict is non-linear. Moreover, this study highlights the fact that natural resources fueling conflict is far from being conclusive. Nevertheless, the results indicate that the effect of GDP per capita, ethnic tension and population growth rate on internal conflict change as natural resource increases.

Keywords: Natural resources; Internal Conflict; Threshold panel; dynamic panel; GMM.

JEL classification: C23; C24; Q34

1 Introduction

Effort to identify the determinants of conflicts brings to mind some important questions. First, in which context do we observe conflict? Second, which variables or correlates determine conflict? Third, what are the possible transmission mechanisms? Finally, which econometric approaches resolve potential econometric limitations? These questions are perennial and difficult to tackle because they require appropriate model specification.

The notion of resources curse has gained considerable interest among social sciences scholars and policy makers. However, conflict in natural resources sectors seems to have been one of the main factor which explains the resources curse. Studies linking natural resources and conflicts have been conducted in a wide range of disciplines, such as: environmental studies, geography, sociology, anthropology, political sciences and economics. Despite significant studies conducted on this linkage, there is lack of scientific consensus on the effect of natural resources on the onset, duration and intensification of conflicts. The literature on natural resources-conflict nexus is broadly classified into two main groups.

The first group argue that natural resources abundance mostly non-renewable fuel violence, inequalities and conflict (Collier & Hoeffler 1998, Ross 2001, De Soysa 2002, Fearon 2005, Le Billon 2007, Collier et al. 2009). Whereas, the second group claim that it's scarcity rather than abundance that leads to conflicts and instability Percival & Homer-Dixon (1995), Homer-Dixon (1999), Klare (2001), Peters (2004), Humphreys (2012), Koubi et al. (2014). Yet, some studies posit that the results obtained by the first group and second groups are not robust and therefore argue for a non-significant effect of natural resources on conflicts(De Soysa 2002, Fearon & Laitin 2003, Price-Smith 2015, Stern 2016).

The first group offers different framework that is, greed Vs grievance, onset Vs duration, the resources curse, the rentier state, great Games and Aggressive state model. Bakeless (1921) argues that 14 out of 20 major wars were attributed to dispute over natural resources coupled with a rise of industrialisation. For instance, the war of the Pacific (1879–1884), Chile fought against a defensive alliance of Bolivia and Peru for the control of guano mineral deposits. Furthermore, Westing (1986) argues that many wars in the twentieth century had an important resource dimension. Examples include: The Algerian War of Independence (1954–1962), the Six Day War

(1967), the Chaco War (1932–1935), more recently, Saddam Hussein's invasion of Kuwait in 1990 was attributed to dispute over the Rumanian oil field. Collier also argues that fifty armed conflict active in 2001 were strongly related to natural resources exploitation in which either licit or illicit exploitation fostered, intensified or sustained violence.

The second group bases their analyses on the neo-Malthusians theory who argues that a wide gap between demographic growth rate and natural resources availability may leads to frustration, insurrection and conflict. Homer-Dixon (1999) main argument is that disequilibrium demand and supply lead to scarcity resulting to competition and eventually violence. In the same line, de Soysa et al. (2009) argue that competition between Great Power fighting for natural resources may be at the origin of resources-conflicts. Klare (2001) also supports the fact that resources scarcity may fuel conflict. Moreover, Klare shows that, scarcity of peak oil/gas linking specific natural resources to great powers competitions establishes a link between interstate conflict (example China, India and Russia).

Based on the mitigating results and lack of robust results obtained in the empirical literature of natural resources-conflict nexus, our result seems to argue that the effect of natural resources on conflict depends on: 1) the type of natural resources used, 2) the econometric specification and 3) the methodology of analyses. The main objective of this study is to revisit the nexus natural resources-conflict. Specifically 1) we evaluate the non-linear effect of natural resources on internal conflict. 2) Determine the threshold level of natural resources which mitigates the negative effect of natural resources on conflict and 3) Compute the individual elasticity of the effect of one percent increase of natural resources on conflict by country and by the type of natural resources used. The value addition of this paper is empiric. We use a panel threshold approach to determine the non-linear effect of natural resources on internal conflict in 124 countries. A perceived gap in the literature is the limited amount of studies analysing the non-linear effect of natural resources on internal conflict. Some studies analyse the linear effect of natural resources on conflict. The downside to these findings is that they lay emphases on the linear effect of natural resources on conflict considering that the countries are homogeneous and often neglect to investigate the threshold effect of natural resources on conflict in a heterogeneous environment. Our sample presents mixed characteristics. Some countries possess abundant nat-

ural resources and have experienced high levels of internal conflict, some possess few natural resources and have experienced high levels of internal conflict, whereas other possess abundant natural resources and have low levels of internal conflict and finally other have few resources and have low levels of internal conflict.

It's argued that, natural resources constitute a key sector for the development of a country. It is therefore important to understand which correlates observed and composite variables impede it from it positive contribution to economic development. This study attempts to link-up the concept of natural resources and conflict. The rest of the study is organised as follows: Section 2 deals with the literature review. Section 3 focuses on the methodology and data presentation. We present the main findings in section 4. Finally, we present the conclusion in section 5.

2 Literature Review

Although there is lack of consensus regarding the definition and measurement of scarcity of natural resources and abundance of natural resources, in this subsection, we briefly review the relationship between natural resources scarcity and conflict, followed by a review of the nexus natural resources abundance and conflict.

Resources scarcity and conflict

The neo-Malthusians laid more emphases on the environmental consequences of population growth. They suggest that a wide gap between demographic growth rate and natural resources' availability leads to competition, frustration, insurrection, and eventually conflict over means of existence. The most influential study on the relationship between natural resources scarcity and conflict started with the Canadian Environmental Change and Acute Conflict Project led by (Homer-Dixon 1999, 1994). His approach was in line with the neo-Malthusian perspective. The theoretical model of this project was based on sixteen case studies. The study assumes that three types of scarcity could generate a composite variable called environmental scarcity: 1)supply-induced scarcity representing the reduction in renewable resources' availability due to the fact that consumption, degradation and depletion of cropland, forests, water, and fish

stocks are being faster than regeneration. 2) demand-induced scarcity attributed to population growth and/or rising living standards, and 3) structural scarcity due to unequal distribution of resources. These three components result to what Homer-Dixon (1999) called resources *capture and ecological marginalisation*.

Resources capture which is similar to rent-seeking occurs when powerful elites use their power to grab resources that they think may become scarce in the future. Rent-seeking deprives scarce resources from weak groups. Ecological marginalisation refers to a situation where a particular group of people facing resources scarcity migrate to an area with a fragile ecosystem, this may thus create greater scarcity in that area resulting to conflict between the newcomers and the natives. resources capture and ecological marginalisation may thus be a vector of ethnic clashes, insurgency, banditry and military coup.

However, Homer-Dixon's and the neo-Malthusians theories were also subjected to some critics. For instance, Magnus Theisen (2008) argue that many non-environmental variables intervene to establish a direct link between population growth and scarcity-induced conflict. The cornucopians instead argue that though resources may be scarces, market and technological innovations can solve the issues of scarcity. As such, human ingenuity can easily handle the problem of scarcity (Simon & Bartlett 1985). Regarding Homer-Dixon study, Goldstone (2018) called for a better specification of the dependent variable conflict and the independent variables environment and population. Goldstone empirical results show that environmental variables such as long-term degradation alone did not cause large-scale violence conflict. Moreover, the results also suggest that it's not only population growth or density that fuel conflict they are coupled with other factors such as rapid urbanisation, education, a growing proportion of the youth in the total population and an unequal growth of ethnic groups via migration. In addition, the homogeneity nature of the dependent variable calls for concern, the study point out that not all resources conflicts are supposed to be violent. Several other studies fail to establish a clear causal relationship between population induced resources scarcity and conflict Collier & Hoeffler (1998, 2004), Urdal (2005)

Resources abundance and conflict

Whereas the notion of resources scarcity remains highly debatable, that of resources abundance have found strong support among conflict scholars. Since the end of 1990s and early 2000s many scholars focused their attention on the linkage between natural resources abundance and the onset of conflicts (Collier & Hoeffler 1998, Ross 2001, De Soysa 2002, Fearon 2005, Le Billon 2007). Concerning the relationship between abundance of natural resources and conflicts, the existing studies offer different framework. For instance, greed Vs grievance, onset Vs duration, resources curse, the rentier state, great games and aggressive state model. Each concept is being examined both qualitatively and quantitatively. What these studies have in common is the types of natural resources used. They all argue for non-renewable natural resources such as oil, diamonds, natural gas, gold and raw materials.

The leading article of Paul Collier and Anke Hoeffler [1] sparked the interest of most scholars to investigate the effect of natural resources on civil conflicts Ross (2001, 2004a, 2012), De Soysa (2002), Humphreys (2005), Fearon (2005), Le Billon (2007), Brunnschweiler & Bulte (2009) . Empirical literature on natural resources-conflict nexus suggests mixed evidence and lack of consensus on the nexus. In this section, without being exhaustive, we review some empirical studies on the relationship between natural resources and conflict (Onset and Duration).

The first empirical study conducted by Collier & Hoeffler (1998) investigates the economic causes of civil war using a sample of 98 countries of which 27 countries experienced civil war of varying duration over the period 1960-1992. The authors used a threshold of 1000 battle-related deaths to characterise the presence of conflict and no conflict for battle-related deaths less than 1000 and the share of primary commodity to GDP to capture natural resources. Using a probit (to analyse the effect of resources on the onset of conflict) and tobit (to analyse the effect of resources on the duration of conflict) model. The theoretical framework of this study relies on the argument that natural resources offer financial opportunities to rebel which then use it to fuel conflict. The results suggest that primary export has a positive effect on the probability of occurrence of conflict and the duration of conflict. Moreover, the squared of primary exports

[1] Published in 1998 on the Causes of Civil War establishes the link between natural resources and intrastate conflict

has a negative and significant effect on conflict indicating the possibility of non-linear effect of natural resources on the probability of conflict occurrence. Similar results were obtained by Collier & Hoeffler (2004) who used a logit model on a broader sample instead of probit and tobit model. The study argues that primary commodities offer financial capaties to rebel for which they use them to finance conflict.

Fearon & Laitin (2003) analysed the effect of ethnicity and insurgency on civil war. They used 3 criteria to characterise the occurrence of conflict. 1) Fight between agent of state and organised or non-state group seeking to take control over the government or use violence to change government policies. 2) At least 1000 battle-related deaths recorded during the conflict with an average of 100 death per year. Finally 3) at least 100 people killed on both sides of the conflict including civilians attacked by rebels. Based on this criteria, the authors coded onset "1" for years in which civil conflict started otherwise "0." Fearon & Laitin (2003) used the same measure of natural resources as Collier & Hoeffler (1998) and found little evidence of the effect of primary export on the onset of conflict.

De Soysa (2002) analyses the determinants of civil war over the period 1989-1999 using Correlates of War data. He uses a lower threshold of 25 battle-related death to capture civil conflict. He argues that, this lower threshold captures societal conflict reflecting better the nature of economic violence or criminalised violence as suggests the literature[2]. This study uses maximum likelihood probit analyses to gauge the likelihood that a positive outcome of conflict will be obtained for a given independent variable. The results argue that there is no effect between total natural resources and conflict as well as no effect when taking the squared value. However, when considering only mineral resources, the results suggest a positive effect of squared mineral resources on conflict. Moreover, the dummy which captures oil exporting countries shows a positive effect on conflict.

Lujala et al. (2005) used a different natural resources (diamond production) to analyse the relationship between diamond and armed conflict. The authors use a new dataset, diamond deposit and production (DIADATA) (Gilmore et al. 2005)[3] which include secondary and primary

[2]Conflict usually provoked by ecological factors. However, the measurements of these factors are not clearly defined

[3]The dataset contains all known existing diamond discovery in the world with the dates of discovery, location, and dates of first year of production

diamond.[4] This study posits that, 1) secondary diamond production induces a higher risk of conflict onset. 2) Primary diamond production has no affect on the risk of conflict onset. 3) Secondary diamond production has a higher incidence of conflict and 4) primary diamond production induces lower incidence of conflict. The study uses the same measure of conflict used by Fearon & Laitin (2003) on a sample of 53 countries over the period 1945-1999. Using a bivariate analysis, the results argue for a strong bivariate relationship between secondary diamond and onset of conflict. Moreover, the study found a positive and significant effect of secondary diamond on the onset of conflict but no effect of the former on incidence of conflict.

Another key contribution to the empirical literature of natural resources-conflict nexus is attributed to Weinstein (2005). The author investigates the effect of primary commodity rent on the composition of rebel recruitment. Collier and Hoefller acknowledged the importance of Weinstein's point of view because it is extremely important to understand the internal mechanisms of rebels' organization when studying the causes and the resolution of conflict. This is because the existence of these organisations defines the feature of civil war. The key results obtained by Weinstein show that when resources are accessible, opportunistic rebel leaders crowd out ideological leaders. In addition to the lack of consensus as indicates the empirical literature, a perceived gap in the literature is the limited amount of studies investigating the threshold effect of natural resources on internal conflict. Some studies such as Collier & Hoeffler (1998), Collier & Hoeffler (2004) and Buhaug (2010) use the squared of natural resources to capture the non-linear effect of natural resources on conflict. The downside to these studies is that the fail to adequately capture the threshold effect of natural resources on conflict. Their findings mainly indicate either a U-shaped relationship or an inverted U-shaped relationship of natural resources on conflict. This study attempts to empirically fill this gap by analysing the threshold effect of natural resources on internal conflict in 124 countries using a panel threshold specification.

[4]Primary diamond also called kimberlite diamond requires skilled labour and high investment for its extraction because they occur in underground rock formation. However, they also occur in lamproite rock formation. By contrast, secondary diamond can be easily found and are exploited by artisanal tools

3 Methodology and data presentation

Methodology

We retain in this study the formulations of models which will abide with the objective of our study. The theoretical specification of our empirical model is based on greed and grievance model suggested by Collier & Hoeffler (1998). We respectively use difference-GMM dynamic panel-data estimation and panel smooth transition regression approach for our estimations.

Difference-GMM dynamic panel-data estimation

The main advantage of the dynamic panel model is that it takes into account endogenous variables found in the model. Moreover, it also enables us to capture the persistent effect of conflict. We perform dynamic panel data using difference GMM estimation (Arellano & Bond 1991) to account for the potential endogeneity of lagged dependent variable, GDP per capita and democratic accountability. Moreover we determine if there is either a U-shaped or inverted U-shaped relationship between natural resources and internal conflict. The structural equation is given as:

$$\begin{aligned} CONFL_{it} = \beta_1 CONFL_{i,t-1} + \beta_2 ETHF_{i,t} + \beta_3 RET_{i,t} + \beta_4 DEMO_{i,t} + \beta_5 \ln(PERCA_{i,t}) + \\ \beta_6 (POPG_{i,t}) + \beta_7 (POPY_{i,t}) + \beta_8 (NR_{i,t}) + \beta_9 (NR_{i,t})^2 + \varepsilon_{i,t} \end{aligned} \quad (1)$$

Where, $CONFL_{i,t}$ represents internal conflict for individual i at time t, $CONFL_{i,t-1}$represents the first lagged of the dependent variable capturing the persistent effect of conflict, $ETHF_{i,t}$, stands for ethnic tension, $RET_{i,t}$ represents religion tension, $DEMO_{i,t}$, represents democracy accountability, $ln(PERCA_{it})$, represents the log of GDP per capita, $POPY_{i,t}$,represents the share youth population, aged between 15 and 42 over total population, $POPG_{i,t}$ represents population growth rate, $NR_{i,t}$ stands for natural resources [5], term $(NR_{i,t})^2$ captures the squared of natural resources and $\varepsilon_{i,t}$ represents the error term. Following Ciccone (2011) we use annual rainfall (average precipitation in depth , mm per year) as instrument for GDP per capita. We also follow

[5]They include: total natural resources rent to GDP, oil rent to GDP, forest rent to GDP, mineral rent to GDP, natural gas rent to GDP, fuel exports to total merchandise exports, share of ores and metal export on total merchandise export and Value added of agricultural productivity growth

Eicher & Leukert (2009) who used trade and crop production index as instrumental variable of institution on a sample of OECD countries.

Panel Smooth transition regression

We suggest using the panel smooth transition regression (PSTR) model. This approach presents both advantages and disadvantages. Concerning the advantages, the PSTR specifications allow the natural resources-conflicts coefficient to vary between countries, between different regimes and also overtime. This provides a simple way to appraise the heterogeneous nature of the relationship between natural resources and conflict overtime and by countries. Another advantage associated to the PSTR approach is that it permits a smooth and/or a brutal change in country-specific correlation depending on the threshold variables. In this paper, our threshold variables is natural resources. Nonetheless, the PSTR also has some disadvantages. The PSTR does not solve the problem of endogenous variables found among the explanatory variables and assumes a unique threshold for all the countries.

We use a non-linear panel (PSTR) approach developed by Gonzalez et al. (2005), which is a generalisation of the Hansen (1999) Panel Threshold Regression model. Let the basic panel smooth transition regression model with two regimes be expressed as:

$$y_{it} = \mu_i + \beta_0^{'} x_{it} + \beta_1^{'} z_{it} g(q_{it}; \gamma, c) + \varepsilon_{it} \tag{2}$$

where *i=1,...,N* and *t=1,...,T* with N and T denoting the cross section and time dimensions of the panel, y_{it} the dependent variable, x_{it} a $k-dimensional$ vector of time varying exogenous variables in the linear part and can be different from the explanatory variables found in the non-linear part, z_{it} contains explanatory variables in the non-linear part, μ_i is the fixed individual effect, c is a threshold parameter, q_{it} is the threshold variable, ε_{it} are the error term and are $iid(0, \delta^2)$. Re-writing equation 2 in the form of the empirical model adopted for the PSTR in this paper, we obtain:

$$CONFL_{it} = \mu_i + \beta_{01} ETHF_{i,t} + \beta_{02} RET_{i,t} + \beta_{03} DEMO_{i,t} + \beta_{04} \ln(PERCA_{i,t}) + \beta_{05}(POPG_{i,t}) + \beta_{06}(POPY_{i,t}) + \beta_{07}(NR_{i,t}) + [\beta_{11} ETHF + \beta_{14} \ln(PERCA_{i,t}) + \beta_{15} POPG_{i,t} + \beta_{16} POPY_{i,t} + \beta_{17} NR_{i,t}] g(q_{it}; \gamma, c) + \varepsilon_{i,t} \quad (3)$$

where the different variables are similar to those found in equation 1. Following Collier & Hoeffler (1998) and Fearon & Laitin (2003) we used lagged explanatory varibles because it's argued that using lagged explanatory variables solve endogeneity issues.

The transition function in equation 4 is a continuous function depending on the threshold variable q_{it} and is normalised to be bounded between zero and one. These two values are respectively associated with the regression coefficient β_0 and $\beta_0 + \beta_1$. Teräsvirta & Granger (1993) provide a logistic specification of the transition function with c_i denoting an m-dimensional vector[6] of location parameters, γ determines the smoothness or slope of the transition and q_{it} the threshold variable. $\beta_0^{'}$ are the parameters estimated without the transition, $\beta_1^{'}$, are the parameters on which the transition variable interact with. In this case, the transition function is given as:

$$g_j(q_{it}; \gamma, c) = [1 + \exp(-\gamma \prod_{j=1}^{m} (q_{it} - c_j)]^{-1} \quad (4)$$

The choice of transition variables depends on the studied economic phenomenon, and therefore are statistically significant to account for structural breaks in the model. In this study, "natural resources" are used threshold variables q_{it} . Our choice is justified by the fundamental character of this variable in understanding the economic resources dependence for the rentier States. Collier & Hoeffler (1998) suggest that the possession of natural resources initially increases the risk and duration of civil war but then reduces it. He posit that the maximum occurs at 27% for the risk of civil war and 24% for its duration. This basically means that, below the threshold we observe a positive effect of natural resources on conflict and above we observe negative effect of natural resources on conflict. Rather than considering an arbitral level like

[6] In practice it's generally sufficient to allow m=1 or m=2

Collier & Hoeffler (1998) we propose to use a PSTR specification which estimates the optimal threshold level of natural resources.

Specification Test: Testing for Linearity

Testing for linearity of the PSTR model indicated by equation 2 can be undertaken either by testing $H_0 : \beta_1 = 0$ or $H_0^{'} : \gamma = 0$. In both cases, the test will be non-standard because under the null hypothesis, the PSTR model contains unidentified nuisance parameters. To circumvent the identification problem, we replace the transition function $g(q_{it};\gamma,c)$ by its first order Taylor expansion around $\gamma = 0$ see Luukkonen et al. (1988). Consequently, testing $H_0 : \gamma = 0$ is equivalent in testing $H_0 : \beta_1^* = ... = \beta_m^* = 0$ in equation 2. This null hypothesis may be conveniently tested by a Wald test (LM), the Pseudo likelihood ratio test (LRT) and the Lagrange Multiplier of Fisher (LMF).

The linearity tests can be used for two purposes. Firstly, the test can be used for selecting the appropriate transition variables q_{it} in the PSTR model. And Secondly, the linearity test can also be used to determine the appropriate order of the logistic function (m).

Estimations

Estimating the parameters $\psi = (\beta_0^{'}, \beta_1^*, \gamma, c^{'})$ in the PSTR model equation 2 is a relatively straight forward application of the fixed effect estimator and non-linear least squares estimator (NLS).We first eliminate the individual effects μ_i by removing individual-specific means and then apply NLS to the transformed data.

Individual effect or Marginal effect

The PSTR model has the advantage of allowing parameters to vary between countries. They provide a parametric approach to bring out the heterogeneity between countries via the calculation of marginal effects. Specifically, these models are used to observe the estimated parameters changes following the variation of threshold variable q_{it}. When the regime dependent variable (x_{it}) is different from the transition variable (q_{it}) The marginal effect or the elasticity of a variable x_{it} for individual i at time t is given as:

$$e_{it} = \frac{\partial y_{it}}{\partial x_{it}} = \beta_0 + \beta_1[1 + \exp(-\gamma \prod_{j=1}^{m}(q_{it} - c_i)]^{-1} \quad (5)$$

It's seen that $\{\beta_0, \beta_0 + \beta_1\} \leq max\{\beta_0, \beta_0 + \beta_1\}$ since $0 \leq g(q_{it}; \gamma, c) \leq 1$, $\forall q_{it}$ .The estimated parameters vary between the two regimes (or their extreme values) following the values taken by the threshold function $g(.)$ the parameter β_0 corresponds to the extreme regime where the transition function $g(q_{it}; \gamma, c)$ tends to 0 and $\beta_0 + \beta_1$ corresponds to the extreme regime where the transition function tends to 1. Between these two extreme regimes, the marginal effect is defined as a weighted average of the parameters β_0 and β_1.

However, the expression of the elasticity is slightly different when the threshold variable is equal to the regime dependent variable or a function of the regime dependent variable as suggests this study, let's consider that g_{it} is a function of the transition variable q_{it}, the elasticity will be given as follows.

$$e_{it}^{g} = \frac{\partial y_{it}}{\partial g_{it}} = \beta_0 + \beta_1[1 + \exp(-\gamma \prod_{j=1}^{m}(q_{it} - c_i)]^{-1} + \beta_1 \frac{\partial [1 + \exp(-\gamma \prod_{j=1}^{m}(q_{it} - c_i)]^{-1}}{\partial g_{it}} g_{it} \quad (6)$$

Data Presentation

Data used here is obtained from two distinct sources namely, International Country Risk Guide(Group 2012) and World Development indicator of the World Bank (Group 2019).

ICRG of the PRC group provides both monthly and annual data on political risk (12 components and 15 sub-components), financial risk (5 components) and economic risk (5 components) from 1984 to date. The ICRG risk is assesses on the basis of political, financial and economic information collected in each country and converted into "risk points" for each variable on the basis of consistent pattern of evaluation. Political risk are calculated based on subjective data whereas financial and economic risk are based on objectives data.

In this study, we focus on political risk component which aims to provide a way of evaluating the political stability of a country on comparable basis. As such, it provides risk points to

a pre-group of factors, called political risk components. For consistency raisons, both between countries and overtime, points are computed by the editor based on a series of pre-set questions for each risk component. We use ICRG rather than other datasets frequently used in the literature[7] because: it accounts for a broader dimension of internal conflict than raw data on terrorism and civil war.

The components of political risk used here are; internal conflicts, religions tension, e thnic tension and democratic accountability.

Internal conflict (dependent variable) assesses political violence and it actual or potential impact on government in a given country. The highest rating (4) is assigned to countries where there is no armed or civil opposition to the government and the government does not contribute in arbitrary violence, either direct or indirect against its own people. The lowest rating (0) is attributed to countries engaged in an on going war. Finally, the risk assigned is the sum of three sub-components Civil war/Coup threat, Terrorism/Political Violence and Civil Disorder. A score of 4 represents a low risk whereas a score of 0 is for high risk. In other to ease interpretation, we restructure the variable by subtracting all the variables from 12 such that the lower risk has a score of 0 and the higher risk has a score of 12.

Religious tension is when the rules and regulation of a country is strictly dominated by a single religion group seeking to replace the civil and excluding other religions from political and or social decision. A high risk assigned a value of 0 whereas a low risk has score of 6 for interpretation purposes, we restructure it in such that low risk has a score of 0 and high risk a score of 6.

Ethnic tension measures the degree of tension is a country attributed to racial, nationality, language division and region of origin. Unlike religious tension, a high risk assigned a value of 0 whereas a low risk has score of 6 for interpretation purposes, we restructure it in such that low risk has a score of 0 and high risk a score of 6.

Democratic accountability refers to the degree of sensitivity of the government to it people. ICRG differentiates five types of democracy namely, alternating democracy, dominated democracy, de facto one-party state, de jury one-party state and autarchy. The best form being al-

[7]COW, ACLED, ACD, UCDP/PRIO among others

ternating and the worst being autarchy. The highest score (6) of risk is attributed to alternating democracy and lowest score (0) to autarchies.

Natural resources rents percentage of GDP (Variable of interest) are defined in this study as the difference obtained from the total revenue that can be generated from the extraction of the natural resource minus the cost of extracting these resources (plus normal return on investment reported by extractive enterprises). This is the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents.

We also use Oil rent, ores and metal export percantage of total merchandise export, forest rent, agriculture, forestry, and fishing, value added (annual % growth), fuel export percentage of total export. Other explanatory variables obtained from World Development Indicator (WDI) include; GDP per capita, population growth rate, the share of young men population to total population (aged between 15 and 44), crop production index and rain fall (average precipitation in depth, mm per year). Descriptive statistics are presented in table 3 found in the appendix. An overview of the descriptive statistics indicates that over the period 1984-2017: the score of internal conflict over the scale of zero to twelve averaged 3.245, total natural resources 8.247% of GDP, oil rent 4.492% of GDP, mineral rent 1.184% of GDP, forest rent 2.071% of GDP, natural gas rent 0.367% of GDP, ores and metal export percentage of total merchandise export 8.103%, fuel export percentage of total merchandise export 18.556% and agricultural value added growth rate 2.550%.

4 Empirical Results

In this section, we comment sequentially on the results obtained from the unit root test, the dynamic panel model, the panel smooth transition regression (PSTR) as well as marginal effects constructed from the PSTR. In a step wise manner, we first present the results gotten from the unit root test. Second, we comment the results obtained from the dynamic panel model. Third, we comment the results obtained from the PSTR as well as the marginal effects.

Results for stationarity

Recent development on macro-panels data also focuses on studying the asymptotic properties of the data. Therefore, they may require that the specification of equation 3 relies on the assumption that all variables are I(0). Using the second generation unit root test proposed by Pesaran (2007), table 4 in the appendix shows that all the variables are stationary except the test for natural gas percentage of GDP.

Difference dynamic panel data estimation

Table 1 presents the result of the model outlined in equation 1 using defference GMM estimator proposed by Arellano & Bond (1991) for all the 8 proxies capturing natural resources. In addition to the control variables, we include the squared of natural resources variables. Column 1 reports the results when we consider total natural resources rents as a percentage of GDP. Column 2 shows results for oil rent % of GDP. Column 3 reports results when we consider mineral rent % of GDP. Column 4 indicates the results for natural gas rent % of GDP. Column 5 presents the result when we consider Forest rent % of GDP. Column 7 presents the results for ores and metal export as percentage of total export. Finally column 8 reports the result when considering agricultural value added growth rate.

Table 1. Dynamic panel data instrumental variable estimation of natural resources on conflict

Variables	Column 1 Total resources rent	Column1 2 Oil Rent	Column 3 Mineral rent	Column 4 Natural gas	Column 5 Forest rent	Column 6 Ores-metal export	Column 7 Fuel Export	Column 8 Agriculture growth
$Past\_conflict_{(t-1)}$	0.646^{***}	0.642^{***}	0.629^{***}	0.645^{***}	0.624^{***}	0.681^{***}	0.648^{***}	0.607^{***}
	(0.005)	(0.009)	(0.005)	(0.007)	(0.009)	(0.0003)	(0.010)	(0.007)
GDP per capita	-0.312^{***}	0.557^{***}	0.103	0.319^{***}	0.298^{***}	0.234	0.056	0.375^{***}
	(0.065)	(0.144)	(0.102)	(0.111)	(0.134)	(0.006)	(0.148)	(0.114)
Ethnic tension	0.303^{***}	0.305^{***}	0.301^{***}	0.286^{***}	0.293^{***}	0.209^{***}	0.212^{***}	0.249^{***}
	(0.018)	(0.028)	(0.022)	(0.024)	(0.016)	(0.001)	(0.028)	(0.019)
Democratic	-0.156^{***}	-0.130^{***}	-0.095^{***}	-0.067^{***}	-0.077^{***}	-0.086^{***}	-0.104^{***}	-0.075^{***}
Accountability	(0.015)	(0.020)	(0.010)	(0.020)	(0.014)	(0.003)	(0.024)	(0.019)
Religion tension	0.296^{***}	0.248	0.038	0.089^{***}	0.084^{***}	0.099^{***}	0.127^{***}	0.249^{***}
	(0.02)	(0.036)	(0.035)	(0.024)	(0.017)	(0.001)	(0.036)	(0.019)
Young men Pop	-0.041^{***}	-0.08^{***}	-0.044^{**}	-0.041^{***}	-0.049^{***}	-0.034^{**}	-0.026^{**}	-0.066^{**}
(% of total population)	(0.009)	(0.008)	(0.006)	(0.012)	(0.007)	(0.0005)	(0.006)	(0.014)
Population growth	-0.115^{***}	-0.121^{**}	-0.047^{***}	-0.099^{**}	-0.070^{***}	-0.063^{**}	-0.069^{**}	-0.084^{***}
	(0.015)	(0.024)	(0.035)	(0.048)	(0.021)	(0.0008)	(0.025)	(0.027)
Total natural resources	0.004							
rent (% of GDP)	(0.003)							
(Total Natural resources	-0.0003^{***}							
rent % of GDP)^2	(0.00005)							
Oil rent % of GDP		0.020^{***}						
		(0.001)						
(Oil rent %		-0.0003^{***}						
o f GDP)^2		(0.00004)						
Mineral rent %			0.068^{***}					
of GDP			(0.006)					
(Mineral rent %			-0.001^{***}					
of GDP)^2			(0.0001)					

Table 1 continued

Variables	Column 1 Total resources rent	Column1 2 Oil Rent	Column 3 Mineral rent	Column 4 Natural gas	Column 5 Forest rent	Column 6 Ores-metal export	Column 7 Fuel Export	Column 8 Agriculture growth
Natural gas rent				0.031				
% of GDP				(0.027)				
(Natural gas rent				0.001				
% of GDP)^2				(0.002)				
Forest rent % of GDP					-0.012			
					(0.008)			
(Forest rent %					-0.002^{***}			
of GDP)^2					(0.0002)			
Ores and metal export						-0.009^{***}		
% of total export						(9.15e-5)		
Ores and metal export)^2						0.0001^{***}		
						(1.12e-6)		
Fuel export % of							0.004^{***}	
total export							(0.001)	
(Fuel export % of							-0.00004^{**}	
total export)^2							(0.00001)	
Agricultural Produc-								0.0009^{***}
tivity growth								(0.0001)
(Agricultural produc-								-0.00007^{***}
tivity growth)^2								(0.00001)
Constant	-0.115	-2.006^{***}	-0.001	-1.246^{**}	-0.243	-0.923^{***}	-0.385	-0.328
	(0.496)	(0.495)	(0.432)	(0.547)	(0.622)	(0.032)	(0.586)	(0.629)
AR(1) test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0001
AR(2) test	0.247	0.12	0.220	0.160	0.231	0.47	0.52	0.34
P-value Sargan test	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Source: Computed by authors from WDI 2018 and ICRG. Note: $(***), (**)(*)$ denote significance at $1\%, 5\% and 10\%$, respectively. Standard errors are reported in parentheses. Diagnostic tests (Sargan and second order autocorrelations) reveal that the instruments used by the difference-GMM estimator are valid

The results reported in table 1 indicate that the direct effect of total natural resources rent on internal conflict is non-significant whereas it squared value is negative and significant. When considering each resource separately, the results show that oil rents % of GDP, mineral rent % of GDP, ores and metal export % of total merchandise, fuel % of total export and agricultural value added growth rate increase the risk of internal conflict. However, their squared values reduce the risk of internal conflict. These results indicate that there is an inverted U-shaped relationship between oil rents % of GDP, mineral rent % of GDP, ores and metal export % of total merchandise, fuel % of total export and agricultural value added growth rate and internal conflict. For natural gas rent, the results suggest non-significant effects of natural gas and it squared value on internal conflict. The latter results are similar to those obtained by Fearon (2005) who finds no evidence of natural resources on conflict. Concerning forest rent, the direct effect is non-significant whereas it squared value has a negative and significant effect on internal conflict.

Regarding other covariates, the results suggest there is a persistent effect of internal conflict over time for all the indicators of natural resources as indicates the positive and significant effect of past conflict on present conflict. The results also indicate that ethnic tension and religious tension have a positive and significant effect on conflict for all the indicators of natural resources. Moreover, the results suggest that democratic accountability has a negative and significant effect on internal conflict for all the indicators of natural resources. This may indicate that sound democratic accountability reduces the risk of internal conflict. The effect of the proportion of young men over total population and population growth rate on internal conflict are negative and significant for all the indicators of natural resources. Although the effect of population growth and young men's proportion on internal conflict are counter intuitive, similar results were also obtained by Collier & Hoeffler (2004), Humphreys (2005) and Weinstein (2005).

Furthermore, the results suggest that, the effect of GDP per capita on internal conflict is negative and significant when considering total natural resources rent. However, the effect of GDP per capita on internal conflict becomes positive and significant when considering oil rent % of GDP, natural gas rent, forest rent and agricultural value added growth rate. In addition, the

results also indicate that for mineral rents, ores and metal export percentage of total merchandise export and fuel export percentage of total export, the effect of GDP per capita is non-significant.

The counter intuitive effect of population growth rate and young men population indicate that their effect on internal conflict could be contingent by the level of resources or rents generated from natural resources. Moreover, the conflicting effect of GDP per capita may also be explained by the level of rent generated from natural resources. In addition, experience has shown that ethnic tension, conflict between two ethic groups and dispute between regions were also attributed to fertile soils or resources found at the boundaries (Lecours & Béland 2009). In this regard, in the next subsection, the study proposes to use threshold analyses to determine if the effect of GDP per capita, population growth rate, young men population and ethnic tension on internal conflict are dependent on the level of natural resources.

Panel Smooth Transition Regression estimation results of natural resources on internal conflict

Number of threshold and non-linearity test

The first step of the PSTR model consist of testing for linearity. This test can be used for two main purposes. First, it can be used to select the appropriate transition variable (q_{it}) among a group of potential transition variables. Second, the linearity test can also be used to determine the appropriate order of the logistic function (m). In that vein, we test for homogeneity for choosing the number of threshold (m) and linearity. Following Teräsvirta & Granger (1993) the model selects $m = 2$ if $H0^*2$ shows the strongest rejection otherwise the model selects $M = 1$. Table 5 shows that the model selects $m = 1$ for all the variables capturing natural resources indicating that we have one threshold or inflection point with two extreme regimes. Table 6 shows the linearity vs PSTR with $m^* = 1$. The test posits that, if the null hypothesis is rejected, the model is non-linear and confirms that $m = 1$. This test relies on the Wald, Lagrange Multiplier and Pseudo likelihood tests.

PSTR estimation results

Results from the previous subsection suggest the presence of inverted U-shaped between natural resources indicators and internal conflict. This may purports the presence of a non-linear relationship between natural resources indicators and internal conflict. Table 2 presents the results of the empirical model outlined in equation 3 for two scenarios regarding all the indicators of natural resources. In the first scenario, the coefficients associated with $\beta_0^{'}$ indicate estimated results of the lower extreme regime. That is, when the transition function is zero indicating that the results presented are those of the linear model. In the second scenario, the coefficients associated with $\beta_1^{'}$ indicate the estimated results when the threshold variable (natural resources) increases gradually over the transition function. That is, the situation when the transition function tends to 1. We also report the values of the estimated threshold variables ($\widehat{c}$) and values of the estimated slope parameters ($\widehat{\gamma}$) in table 2.

Table 2. Panel Smooth Transition Regression estimation results

Variables	Column 1 Total resources rent	Column1 2 Oil Rent	Column 3 Mineral rent	Column 4 Natural gas	Column 5 Forest rent	Column 6 Ores-metal export	Column 7 Fuel Export	Column 8 Agriculture growth
GDP per capita(β_0)	-0.773^{***}	0.638^{*}	-1.168	-0.675^{***}	-1.36^{***}	-0.608^{**}	-0.341	-0.774^{***}
	(0.235)	(0.352)	(1.002)	(0.228)	(0.623)	(0.272)	(0.242)	(0.243)
GDP per capita(β_1)	-0.958^{***}	-1.098^{***}	$0.946.^{*}$	-0.156	0.9	0.440^{**}	-0.889^{***}	-0.812^{***}
	(0.234)	(0.303)	(0.495)	(0.128)	(2.165)	(0.144)	(0.252)	(0.397)
Ethnic tension(β_0)	0.431^{***}	0.244^{***}	1.011^{***}	1.001^{**}	0.667^{***}	0.920^{***}	0.811^{***}	0.910^{***}
	(0.035)	(0.066)	(0.020)	(0.04)	(0.130)	(0.046)	(0.038)	(0.038)
Ethnic tension(β_1)	-0.154^{***}	-0.205^{**}	-0.351^{***}	-0.351^{***}	0.82	-0.247^{***}	-0.221^{***}	1.319^{***}
	(0.046)	(0.085)	(0.102)	(0.047)	(0.461)	(0.044)	(0.077)	(0.092)
Democratic	-0.931^{***}	-0.125^{***}	-0.227^{***}	-0.373^{***}	-0.371^{***}	-0.43^{***}	-0.425^{***}	-0.102^{***}
Accountability(β_0)	(0.027)	(0.042)	(0.121)	(0.027)	(0.027)	(0.032)	(0.033)	(0.027)
Religion tension (β_0)	$0.0.382^{***}$	0.117^{***}	1.739^{***}	0.116^{***}	0.365^{***}	0.415^{***}	0.392^{***}	0.468^{***}
	(0.039)	(0.034)	(0.302)	(0.034)	(0.039)	(0.046)	(0.047)	(0.043)
Young men Population	-0.098^{***}	-0.113^{**}	0.027	-0.11^{***}	0.0219^{***}	-0.071^{**}	-0.111^{***}	-0.071^{**}
(% of total population)(β_0)	(0.010)	(0.0115)	(0.065)	(0.011)	(0.066)	(0.014)	(0.011)	(0.010)
Young men Population	0.076^{***}	0.161^{***}	-0.041	0.085^{***}	-1.166^{***}	0.005	0.113^{***}	-0.153^{***}
(% of total population)(β_1)	(0.012)	(0.021)	(0.051)	(0.014)	(0.261)	(0.014)	(0.016)	(0.064)
Population growth(β_0)	0.225^{***}	-0.116^{**}	-0.12	0.009	1.222^{***}	0.143^{**}	0.278^{***}	0.054
	(0.042)	(0.048)	(0.3)	(0.057)	(0.197)	(0.034)	(0.043)	(0.030)
Population growth(β_1)	-0.231^{***}	0.244	-0.06	-0.057	-4.399^{***}	0.054	-0.221^{**}	-1.854^{***}
	(0.55)	(0.053)	(0.199)	(0.061)	(0.775)	(0.050)	(0.077)	(0.151)
Total natural resources	0.038							
rent % of GDP(β_0)	(0.027)							
Total natural resources	-0.55^{***}							
rent % of GDP(β_1)	(0.027)							
Oil rent % of GDP(β_0)		0.067^{*}						
		(0.038)						
Oil rent % of GDP(β_1)		-0.098^{**}						
		(0.046)						
Mineral rent % of GDP(β_0)			0.133					
			(0.126)					
Mineral rent % of GDP(β_1)			0.170					
			(0.127)					

Table 2 continued

Variables	Column 1 Total resources rent	Column1 2 Oil Rent	Column 3 Mineral rent	Column 4 Natural gas	Column 5 Forest rent	Column 6 Ores-metal export	Column 7 Fuel Export	Column 8 Agriculture growth
Natural gas rent				-8.928^{***}				
% of GDP(β_0)				(2.552)				
Natural gas rent				8.973^{***}				
% of GDP(β_1)				(2.549)				
Forest rent % of GDP(β_0)					0.246			
					(0.157)			
Forest rent %					$.302^{***}$			
of GDP(β_1)					(0.085)			
Ores and metal export						-0.068		
% of total export(β_0)						(0.126)		
Ores and metal export(β_1)						0.077		
						(0.126)		
Fuel export % of							0.015^{**}	
total export(β_0)							(0.007)	
Fuel export % of							-0.001	
total export(β_1)							(0.007)	
Agricultural Produc-								0.001
tivity growth(β_0)								(0.002)
Agricultural produc-								-0.032^{*}
tivity growth(β_1)								(0.017)
$\widehat{c}$	7.219^{***}	3.395^{***}	7.169^{***}	0.078^{***}	17.111^{***}	1.74^{***}	41.111^{***}	49.595^{***}
	(0.154)	(0.699)	(0.003)	(0.008)	(0.214)	(0.046)	(0.396)	(2.058)
$\widehat{\gamma}$	2.629^{***}	1.193^{**}	223.731^{***}	47.087^{***}	0.065^{***}	21.094^{***}	0.095^{**}	2.133
	(0.349)	(0.940)	(60.98)	(11.509)	(0.011)	(0.188)	(0.030)	(6.022)
R^2	0.702	0.763	0.719	0.706	0.710	0.709	0.710	0.710

Source: Computed by authors from WDI 2018 and ICRG. Note: $(***), (**)(*)$ denote significance at $1\%, 5\% and 10\%$, respectively. Standard errors are reported in parentheses

Considering the first scenario for total natural resources rent % of GDP, that is the results of the linear panel model associated with the lower extreme regime of natural resources, the results presented in table 2 (column 1) indicate that total natural resources rent has a non-significant effect on internal conflict. Furthermore, the effect of GDP per capita and the proportion of young men over total population on internal conflict appear to be negative and significant whereas, the effect of ethnic tension and population growth rate on internal conflict are positive and significant. However, in the second scenario, as the level of total natural resources rent % of GDP gradually increases over the transition function, the results show that the effect of total natural resource rent on internal conflict becomes negative and significant. The effect of GDP per capita on internal conflict remains negative and significant in the second scenario. Moreover, in the second scenario the effect of ethnic tension and population growth rate on internal conflict become negative and significant as total natural resources rent % of GDP increases. The effect of the proportion of youth over total population on internal conflict switches sign and becomes positive and significant as total natural resources rent % of GDP increases.

Regarding oil rent, the results reported in table 2 (column 2) show that, the first scenario associated with the lower extreme regime of oil rent % of GDP (corresponding to the linear model) indicates that oil rent has a week positive effect on internal conflict. The effect of the share of young men over total population and population growth on internal conflict are negative and significant in the linear model. Moreover, in the first scenario, the results also suggest a positive and significant effect of ethnic tension on internal conflict. For the second scenario associated with the coefficients $\beta_1^{'}$, the results show that, the effect of oil rent % of GDP on internal conflict becomes negative and significant. For GDP per capita and ethnic tension the result indicate that their effect on internal conflict initially positive have become negative and significant as oil rent percentage of GDP gradually increases. As the oil rent % of GDP increase, the effect of young men population on internal conflict becomes positive and significant.

For mineral rent, the results reported in table 2 (column 3) suggest no effect of mineral rent % of GDP on internal conflict for the first and second scenario associated to the coefficient $\beta_0^{'}$ and $\beta_1^{'}$ respectively. However, the results indicate a positive effect of ethnic tension on internal conflict. In the second scenario, as the level of mineral rent % of GDP gradually increases the

effect of ethnic tension becomes negative and significant. Beside, when we do not consider the transition function, democratic accountability has a negative and significant effect on internal conflict, whereas the effect of religion tension on internal conflict is positive and significant.

Considering natural gas rent for the first scenario, the results presented in 2 (column 4) show that natural gas rent has a negative and significant effect on internal conflict. The effect of GDP per capita and the proportion of young men over total population on internal conflict when we do not include the transition function are negative and significant whereas the effect of ethnic tension is positive and significant. In the second scenario, as natural gas rent % of GDP increases, the effect of natural gas rent switches sign an becomes positive. In addition, the effect of GDP per capita remains negative but non-significant whereas the effects of ethnic tension and young men population over total population switch sign and are significant.

Concerning forest rent, the results reported in column 5 of table 2 show that in the lower extreme regime of forest rent (when the transition function equals zero), the effect of forest rent on internal conflict is non-significant. However, in the second scenario when the level of forest rent gradually increases over the transition function, we observe a positive and significant effect of forest rent on internal conflict. The effect of GDP per capita associated with the first scenario is negative and significant whereas the results suggest a positive and significant effect for ethnic tension, young men population and population growth rate. Additionally, when the level of forest rent increases, the effects of population growth rate and young men population over total population become positive.

For ores and metal export regarding its lower extreme regime (for the linear model when the transition function equals zero), the results reported in table 2 (column 6) show that, increasing GDP per capita and young men population over total population reduces the risk of internal conflict. Moreover, increasing ethnic tension and population growth rate increase the risk of internal conflict. However, for the second scenario associated to the coefficients β_0^*, as ores and metal over total export increases, the effect of GDP per capita and population growth rate on internal conflict become positive and significant whereas, the coefficients of ethnic tension initially positive in the first scenario becomes negative and significant. Furthermore, the results indicate that ores and metal export has no effect on internal conflict for both linear model and

the model which include the transition function.

Regarding fuel export as percentage of total export, in the lower extreme regime, the results in table 2 (column 7) indicate that, the effect of fuel on internal conflict is positive and significant. However, as fuel export % of total export gradually increases the results suggest a non-significant effect of fuel export % of total export on internal conflict. The coefficient of the other covariates associated with the lower extreme regime of fuel export % of total export indicate that ethnic tension and population growth have positive and significant effect on internal conflict. Besides, the share of young men over total population has a negative and significant effect on internal conflict. For the second scenario, as fuel export % of total export gradually increases, the coefficients of GDP per capita, ethnic tension and population growth rate initially positive in the lower extreme regime of fuel export become negative and significant. Moreover, young men population has a positive and significant effect on internal conflict as fuel export % of total export increases gradually over the transition function.

Concerning agricultural productivity growth rate, the results in table 2 (column 8) indicate that in the lower extreme regime of agricultural productivity growth rate, the effect of agricultural productivity growth rate on internal conflict is non-significant. However we register a weak negative effect of agricultural growth rate on internal conflict as agricultural value added growth rate increases gradually. Besides, the effects of GDP per capita and young men population over total population are negative and significant regardless the regime of agricultural productivity growth rate. Furthermore, the results also indicate that ethnic tension has a positive and significant effect on internal conflict no matter the regime of agricultural productivity growth rate. The effect of population growth rate is contingent by the level of agricultural productivity growth rate. We observe no effect of population growth rate on internal conflict in the lower extreme regime of agricultural productivity and a negative and significant effect of population growth rate on internal conflict as agricultural value added growth rate increases.

The results presented in table 2 indicate that for all the indicators of natural resources, democratic accountability has a negative and significant effect on internal conflict. Moreover, an increase in religious tension increases the risk of internal conflict. The results also indicate estimated slope values of transition functions as well as those of the estimated threshold levels.

The latter indicates the level of natural resources which mitigates the effect of each indicator of natural resources and other covariates on internal conflict. Regarding the slope of the transition function, the results show low values of the slopes for all the indicators. These low values indicate smooth transition functions[8] except the slope of mineral rents which has a high value of 223.731 indicating a brutal change. This stipulates that, the estimated parameters for our sample over the period 1984-2017 having smooth transition function are distributed over a "continuum" of values. This kind of results could be attributed to the heterogeneity of our sample. This also indicates that estimating the effect of natural effect on internal conflict by considering that the countries are homogenous may yield unsatisfactory results.

The observation that natural resources often fuel conflict is far from being conclusive in this study. Our results seems to suggest that for most indicators of natural resources, when the level of natural resources increases gradually over the transition function the effect of natural resources on internal conflict is either negative and significant or non-significant.

Average marginal effects

The average marginal effect [9] for total natural resources rent as % of GDP are presented in figure 1. Appraising the marginal effect for total natural resources rent suggests that their values ranged from -0.0172 to 0.0383. Figure shows that out of 124 countries of our sample, 35 countries reported negative marginal effects. This indicates that for these countries, 1% increase of total natural resources rent reduces the risk of internal conflict. Whereas those countries registering positive marginal effects suggest that 1% increase of total natural resources increases the risk of internal conflict.

5 Conclusion

This paper analyses the threshold effect of natural resources on internal conflict using panel data from 124 countries over the period 1984-2017. We consider 8 different indicators of natural resources namely: Total natural resources rent as percentage of GDP, oil rent as percentage of

[8] See figure 2 in the appendix for the various transition functions

[9] the marginal effect for other indicators are provided upon request

GDP, Mineral rent as percentage of GDP, forest rent as percentage of GDP, natural gas rent as percentage of GDP, ores and metal export as percentage of total merchandise export, fuel export as percentage of total merchandise export, and agricultural productivity growth rate. Regarding internal conflict, the risk assigned is the sum of three sub-components civil war/coup threat, terrorism/political violence and civil disorder.

In a stepwise manner, we undertake dynamic panel data instrumental variables regression to account for the endogeneity of past conflict, GDP per capita and democratic accountability. Additionally, we also use a panel smooth transition regression (PSTR) approach to test the non-linear relationship between natural resources and internal conflict as well as the non-linear relationship between GDP per capita, ethnic tension population growth rate and the proportion of young men over total population on internal conflict. The PSTR also indicates issues associated with heterogeneity. The results from the dynamic panel model indicate that there is an inverted U-shaped relationship between between oil rents % of GDP, mineral rent % of GDP, ores and metal export % of total merchandise, fuel % of total export and agricultural value added growth rate and internal conflict. Estimates for the PSTR model suggest strong evidence of non-linear effects of all the indicators of natural resources on internal conflict. Furthermore, the results suggest that the effects of GDP per capita, ethnic tension, population growth rate and young men population over total population on internal conflict are also contingent by the threshold level of natural resources.

In closing, the results appear to indicate that it's difficult to generalise the effect of natural resources on conflict. This study shows that the conclusion that natural resources fuel conflict is far from being conclusive. This is because the extent to which natural resources affect internal conflict vary for the different indicators of natural resources as well as from one country to another.

Appendix

Table 3. Descriptive Statistics 1984-2017

Variables	Observations	Mean	Standard Deviation	Minimum	Maximum
Internal Conflict	4352	3.245	2.450	0.000	12
Natural resources rent to GDP	4163	8.247	11.269	0.00	68.778
Oil rent to GDP	4157	4.492	10.155	0	67.527
Forest rent to GDP	4167	2.071	4.249	0	36.068
Mineral rent to GDP	4169	1.184	3.478	0.000	46.624
Natural gas rent to GDP	4152	0.367	1.021	0.000	11.179
Ores and metal export to total export	3423	8.103	14.376	0	88.812
Fuel export to total export	3398	18.556	28.761	0.000	99.98
Agriculture value added growth rate	3632	2.550	8.825	-45.851	91.606
Ethnic tension	4352	3.934	1.415	0.000	6
Democratic Accountability	4350	3.770	1.663	0.000	6
Religion Tension	4352	3.934	1.353	0.000	6
ln GDP Per capita	4127	3.699	0.683	2.215	5.049
Young men Population to total pop	4532	36.502	6.042	0	75.235
Population growth	4341	1.732	1.474	-4.536	17.510
Trade to GDP	3963	78.75	54.742	0.020	442.62
Rain fall	4318	1154.967	792.126	51	3240
Crop production index	4130	94.448	30.426	10	322.48

Source:Computed by the author using data from WDI and ICRG

Table 4. Peseran 2007 second generation panel unit root test

Variables	$Z[t-bar]$	$P-value$
Natural resources rent to GDPF	-8.985	0.000
Oil rent to GDP	-4.374	0.000
Forest rent to GDP	-2.574	0.005
Mineral rent to GDP	-17.493	0.000
Natural gas rent to GDP	0.308	0.621
Ores and metal export to total export	-	-
Fuel export to total export	-	-
Agriculture value added growth rate	-23.745	0.000
Population growth rate	-19.724	0.000
Young men population over total population	-4.340	0.000
GDP per capita	-3.119	0.001

Source:Computed by the author using data from WDI and ICRG

Table 5. Sequence of tests for choosing between m=1 and m=2

Hypothesis	Test	Value	Significance level
Total natural resources rent % of GDP			
$H0^*: \beta^*(1) = \beta^*(2) = \beta^*(3)$=0	F(15,3789)	7.187	0.000
$H0^*3: \beta^*(3) = 0$	F(5,3789)	1.639	0.146
$H0^*2: \beta^*(2) = 0 \vert \beta^*(3) = 0$	F(5,3794)	9.392	0.000
$H0^*1: \beta^*(1) = 0 \vert \beta^*(2) = \beta^*(3) = 0$	F(5,3799)	10.398	0.000
Oil Rent rent % of GDP			
$H0^*: \beta^*(1) = \beta^*(2) = \beta^*(3)$=0	F(15,2076)	8.138	0.000
$H0^*3: \beta^*(3) = 0$	F(5,2076)	8.017	0.000
$H0^*2: \beta^*(2) = 0 \vert \beta^*(3) = 0$	F(5,2081)	2.111	0.061
$H0^*1: \beta^*(1) = 0 \vert \beta^*(2) = \beta^*(3) = 0$	F(5,2086)	13.978	0.000
Mineral Rent rent % of GDP			
$H0^*: \beta^*(1) = \beta^*(2) = \beta^*(3)$=0	F(15,3789)	3.862	0.000
$H0^*3: \beta^*(3) = 0$	F(5,3789)	2.326	0.040
$H0^*2: \beta^*(2) = 0 \vert \beta^*(3) = 0$	F(5,3794)	1.849	0.099
$H0^*1: \beta^*(1) = 0 \vert \beta^*(2) = \beta^*(3) = 0$	F(5,3799)	7.387	0.000
Natural gas rent % of GDP			
$H0^*: \beta^*(1) = \beta^*(2) = \beta^*(3)$=0	F(15,3778)	5.768	0.000
$H0^*3: \beta^*(3) = 0$	F(5,3778)	3.230	0.006
$H0^*2: \beta^*(2) = 0 \vert \beta^*(3) = 0$	F(5,3783)	5.217	0.000
$H0^*1: \beta^*(1) = 0 \vert \beta^*(2) = \beta^*(3) = 0$	F(5,3788)	8.766	0.000
Forest rent % of GDP			
$H0^*: \beta^*(1) = \beta^*(2) = \beta^*(3)$=0	F(15,3792)	9.636	0.000
$H0^*3: \beta^*(3) = 0$	F(5,3792)	6.175	0.000
$H0^*2: \beta^*(2) = 0 \vert \beta^*(3) = 0$	F(5,3797)	2.336	0.039
$H0^*1: \beta^*(1) = 0 \vert \beta^*(2) = \beta^*(3) = 0$	F(5,3802)	20.208	0.000
Ores and metal export % of Total export			
$H0^*: \beta^*(1) = \beta^*(2) = \beta^*(3)$=0	F(15,3122)	3.639	0.000
$H0^*3: \beta^*(3) = 0$	F(5,3122)	4.643	0.000
$H0^*2: \beta^*(2) = 0 \vert \beta^*(3) = 0$	F(5,3127)	0.861	0.506
$H0^*1: \beta^*(1) = 0 \vert \beta^*(2) = \beta^*(3) = 0$	F(5,3132)	5.377	0.000
Fuel export % of Total export			
$H0^*: \beta^*(1) = \beta^*(2) = \beta^*(3)$=0	F(15,3094)	5.443	0.000
$H0^*3: \beta^*(3) = 0$	F(5,3094)	1.842	0.101
$H0^*2: \beta^*(2) = 0 \vert \beta^*(3) = 0$	F(5,3099)	3.915	0.001
$H0^*1: \beta^*(1) = 0 \vert \beta^*(2) = \beta^*(3) = 0$	F(5,3104)	10.502	0.000
Agriculture value added growth rate			
$H0^*: \beta^*(1) = \beta^*(2) = \beta^*(3)$=0	F(15,3311)	3.410	0.000
$H0^*3: \beta^*(3) = 0$	F(5,3311)	5.455	0.000
$H0^*2: \beta^*(2) = 0 \vert \beta^*(3) = 0$	F(5,3316)	1.724	0.125
$H0^*1: \beta^*(1) = 0 \vert \beta^*(2) = \beta^*(3) = 0$	F(5,3321)	3.0175	0.010

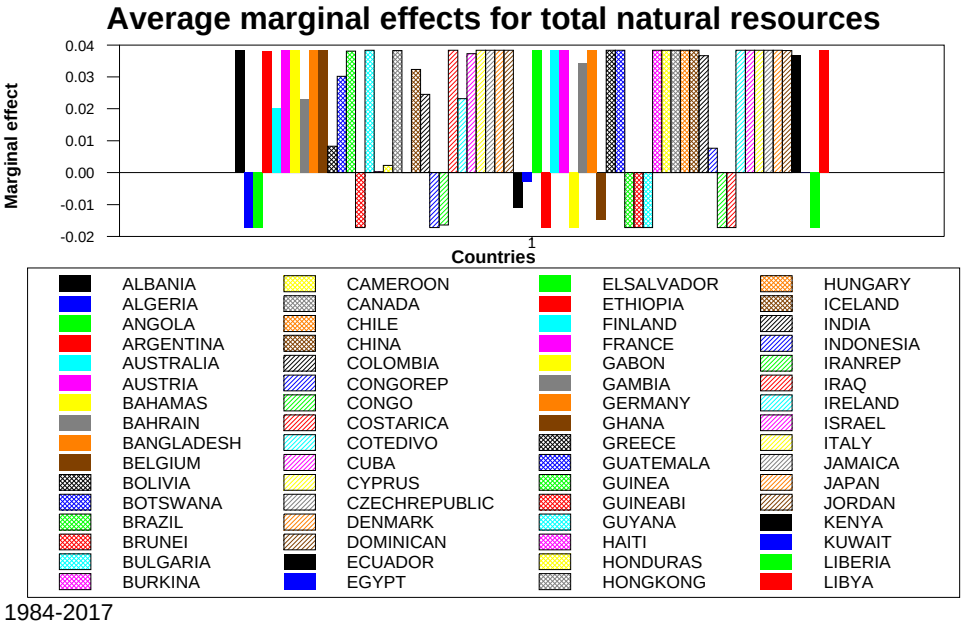
Source: author's estimates using data from World Bank and ICRG

Table 6. Test of Linearity vs PSTR with m^* = 1 Hypothesis, $H0^* : \beta^*(1) = 0$

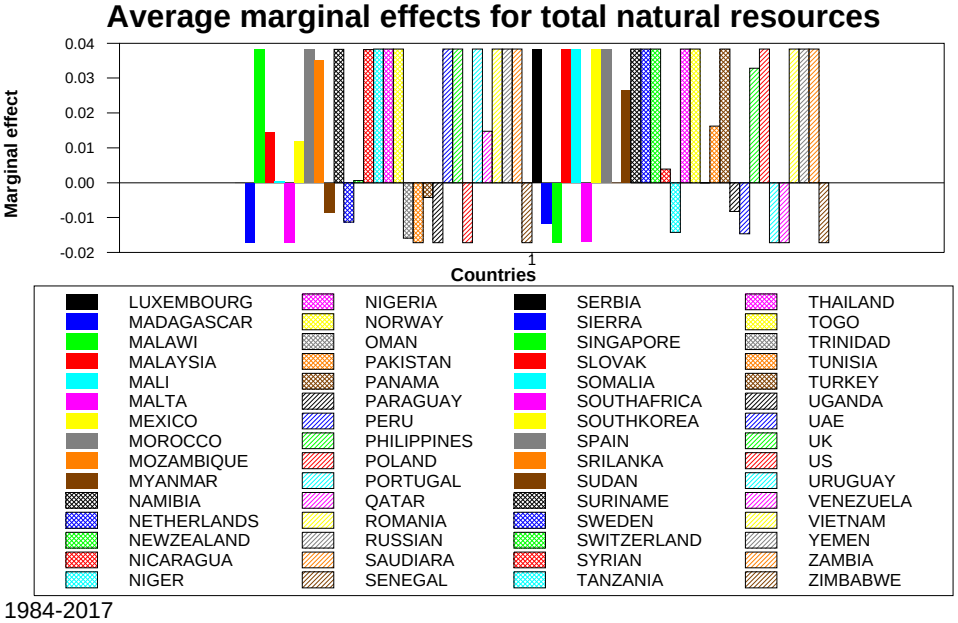
Variables	Test	Value	Significance level
Natural resources rent to GDPF	(5,3799)	10.398	0.000
Oil rent to GDP	F(5,2086)	13.978	0.000
Forest rent to GDP	F(5,3802)	20.208	0.000
Mineral rent to GDP	F(5,3799)	7.387	0.000
Natural gas rent to GDP	F(5,3788)	8.766	0.000
Ores and metal export to total export	F(5,3132)	5.377	0.000
Fuel export to total export	F(5,3104)	10.502	0.000
Agriculture value added growth rate	F(5,3321)	3.017	0.010

Source:Computed by the author using data from WDI and ICRG

Figure 1. Average maginal effects

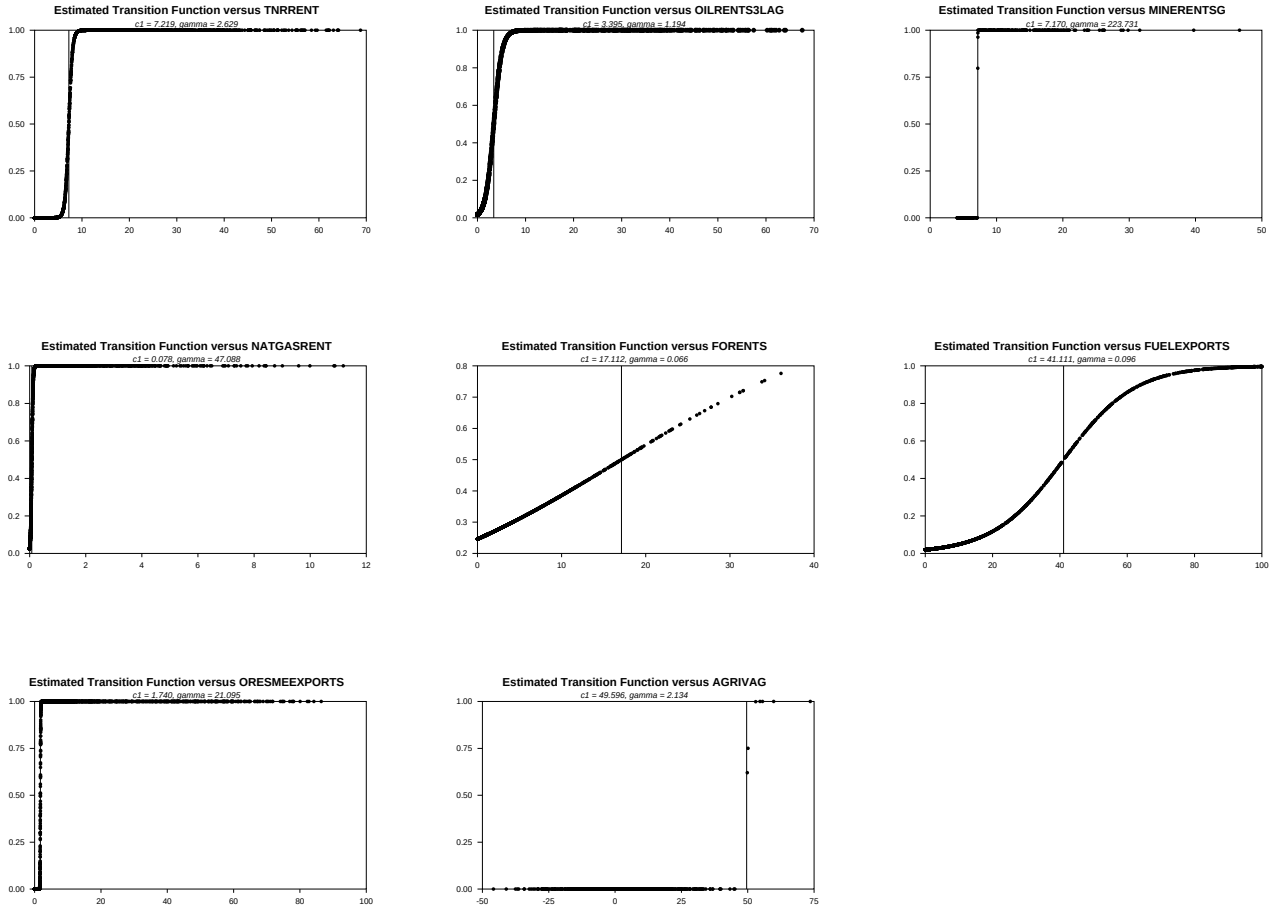


1984-2017



1984-2017

Figure 2. Transition functions for all the indicators of natural resources



TNRRENT; Total natural resources rent, OILRENTLAG; Oil rent, MINERENTSG; Mineral rent, NATGASRENT; Natural gas rent, FORENT; Forest rent, FUELEXPORT: Fuel export percentage of total export, ORESMEEXPORT; Ores and metal export percentage of total export, AGRIVA; Agricultural productivity value added growth rate

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