Economics Bulletin

Volume 37, Issue 1

The effects on economic growth of natural resources in Sub-Saharan Africa: Does the quality of institutions matters?

Itchoko Motande Mondjeli Mwa Ndjokou
CEREG, University of Yaoundé II

Pierre Christian Tsopmo
CEREG, University of Yaoundé II

Abstract

The aim of the paper is to revisit the relation between quality of institutions, natural resources and economic growth in SSA's countries. The main contribution of the paper is the endogenous determination of the threshold for quality of institutions beyond and above which natural resources affect growth differently. The methodology focuses on the estimation of a Panel Smooth Transition Regression (PSTR) model inspired by González et al. (2005). The sample includes 18 countries within the period 1985- 2013 on annual frequency. From the empirical analysis, we derive the following conclusions. (i) The direct effect of natural resources on economic growth is negative, consolidating the natural resources curse's thesis in SSA's countries. (ii) The relation between natural resources and economic growth is based on quality of institutions. The growth effect of natural resources is negative for low quality of institutions and positive for a high quality of institutions. For robustness analysis, we conduct sensitive analysis and derive the GMM dynamic panel model. This further analysis confirms the result derived from the main specification of the PSTR model.

I am grateful to the anonymous referees and associate editor for excellent, helpful comments and suggestions. This article has benefited from discussions with Zamo Akono Marie.
Citation: Itchoko Motande Mondjeli Mwa Ndjokou and Pierre Christian Tsopmo, (2017) "The effects on economic growth of natural resources in Sub-Saharan Africa: Does the quality of institutions matters?", *Economics Bulletin*, Volume 37, Issue 1, pages 248-263
Contact: Itchoko Motande Mondjeli Mwa Ndjokou - motande@yahoo.fr, Pierre Christian Tsopmo - christiantsopmo@gmail.com.
Submitted: August 01, 2016. **Published:** January 26, 2017.

Economics Bulletin

Submission Number: EB-16-00550

The effects on economic growth of natural resources in Sub-Saharan Africa: Does the quality of institutions matters?

Itchoko motande Mondjeli mwa ndjokou
CEREG, University of Yaoundé II

Pierre christian Tsopmo
CEREG, University of Yaoundé II

Abstract

The aim of the paper is to revisit the relation between quality of institutions, natural resources and economic growth in SSA countries. The main contribution of the paper is to determine endogenously a threshold for quality of institutions beyond and above which natural resources affect growth differently. The methodology focuses on the estimation of PSTR model inspired by González et al. (2005). The sample includes 18 countries within the period 1985- 2013 on annual frequency. From the empirical analysis, we derive the following conclusions. (i) Results indicate that the direct effect of natural resources on economic growth is negative consolidating the thesis of curse of natural resources in SSA countries. (ii) The relation between natural resources and economic growth is based on quality of institutions. The growth effect of natural resources is negative for low quality of institutions and positive for a high quality of institutions. For robustness analysis, we derive the GMM dynamic panel model. The results confirm obtained by the PSTR model.

Submitted: August 01, 2016.

1- INTRODUCTION

Sub Saharan African (SSA) countries recorded since 2000 positive growth rates around 5% on average (Devarajan and Wolfgang, 2013). These positive growth rates are partly driven by exploitation of natural resources coupled with the increase of their prices in the international market. Natural resources can be therefore considered as a key factor for economic growth in SSA's countries. Statistics reveal that natural resources account for 65% of exports and their contribution to GDP is around 30% in SSA countries (IMF, 2012). Despite this importance, the growth rates are not sustainable[1] and mostly remain below the 7% level required by the Millennium Development Goals (MDGs). Moreover, these countries are among the poorest in the world and are ranked at the bottom especially when we refer to the human development index (HDI). For instance, fifteen over twenty countries with low human development are from Africa. Furthermore, natural resource-rich countries such as Democratic Republic of Congo, Sierra Leone, Chad, Angola and Nigeria exhibits the poorest economic growth, while natural resource-poor countries such as Singapore, South Korea, and Taiwan were among the fastest growing economies.

Empirical evidence on the growth effects of natural resources is still inconclusive. A recent paper by Havranek et *al.* (2016) shows that approximately 40% of empirical papers find a negative relation between natural resources and growth, 40% find no effect and 20% find a positive effect. The influential article by Sachs and Warner (1995) has argued the negative relationship between economic growth and natural resource abundance. This finding has been confirms by many empirical studies (Isham et *al*., 2005; Gyfalson and Zoega, 2006). According to Brunnschweiler and Bulte (2008), after distinguishing between natural resource dependence[2] and natural resource abundance[3], resource dependence does not affect growth. On the contrary, Smith (2015) finds that countries with large oil endowments exhibit higher income growth. The main argument put forward to explain the negative effect seems to be, beside the Dutch syndrome theory[4] and the curse of natural resources thesis, the poor quality of institutions. Weak institutions are certainly responsible for bad economic performances in Less Developed countries (LDCs) especially in SSA's countries. In fact, lower institutional quality is often associated with lower investment, slower productivity growth, lower per capita income and overall slower output growth (Jude and Levieuge, 2016).

Numerous papers have studied the effects on economic growth of natural resources in relation with institutions. This literature can be summarized in two main axes on the methodological point of view. The first axe uses a linear analysis. In this sense, the studies establish a relation in which the quality of institutions reinforces the effects of natural resources. Thus, Mehlum et *al.* (2006) explain that good quality of institutions leads to the creation of infrastructures conducive for productive activities. However, the presence of poor quality of institutions rather contributes to pervert this effect of natural resources. For instance, Omgba (2010) and Torres et *al.* (2013) demonstrate that in the absence of good quality of institutions, revenues generated by natural resources are largely monopolized by the dominant political elite. The search for private incomes will be accompanied by a move of economic agents from the most productive sectors of the economy towards the sectors of natural resource. In the same vein, Avom and Carmignani (2010) conclude that natural resources tend to accentuate economic inequality when the institutional framework is weak. Some studies describe the transmission channels of the negative effects of natural resources. Acemoglu et *al.*

[1] These last years, many oil-countries notably in SSA are facing economic crises due to the fall of oil prices in the international market.
[2] Natural resource dependence refers to the degree to which countries depend on natural resource exports.
[3] Natural resource abundance is a stock measure of resource wealth.
[4] The term "Dutch Disease" derives from the Netherlands 'experience of a declining manufacturing sector after the discovery of large natural gas reserves in 1950s.

(2012) as well as Collier and Hoeffler (2005) explain that countries endowed with natural resources are characterized by fragile political institutions which are counterproductive. According to Fearon and Laitin (2003), this feature is more pronounced in the petroleum countries. This fragility guarantees to leaders supplementary revenues at the expense of macroeconomic performance. The second axe of the literature indicates that the effect of natural resources on economic growth is conditioned by the level of natural resources dependence (Leite and Weidman, 1999), suggesting the use of non-linear approaches. Using this approach, Seghir and Damette (2013) find that beyond the 51% dependence threshold, and considering the poor quality of institutions, natural resources are counterproductive for economic growth. Yacine et *al.* (2015) find 69.8% to be the threshold above which natural resources are considered as a curse for the economy and this is amplified by inefficient institutions. In summary, it appears that quality of institutions is a key determinant in the relation between natural resources and economic growth. Indeed, the natural resource curse can be avoided if quality of institutions is sufficiently high. But, *what is the level of quality of institutions that ensure the positive effects of natural resource on economic growth*?

The paper revisits the relation between quality of institutions, natural resources and economic growth in SSA's countries by answering to the above question. This question is interesting in several aspects. By using the PSTR model, we highlight the heterogeneity of natural resources on economic growth depending on the quality of institutions in the double individual and temporal dimensions. Furthermore, the PSTR model allows to determine endogenously threshold for quality of institutions' variable associated with a shift in the natural resources-growth relationship. Previous studies (Damette, 2013; Yacine et *al.*, 2015) were mainly focused on the level of natural resources below and above which economic growth is differently affected. In this vein, they account only for natural resource dependence in the growth process leaving aside another important aspect i.e natural resource abundance. In our study, we evaluate the level of quality of a set of institutions which is likely more essential for policy recommendations rather than the optimum level of natural resources. Finally, by distinguishing several institutional variables, we can identify the effect and magnitude of each variable on the marginal effects of natural resources on economic growth.

The methodology of the paper is focused on the PSTR model developed by González et *al.* (2005). The dependent variable is economic growth and the main independent variables are natural resources and institutional indicators taken as threshold variables in the specification. For robustness check, we conduct sensitive analysis and rely on the generalized method of moments (GMM) estimator. Our empirical analysis shows that the direct effect of natural resources on economic growth is negative. In addition, we find that the quality of institutions modulates the effects of natural resources on economic growth. In this vein, the growth effects of natural resources is negative for low quality of institutions and positive for a high quality of institutions.

The rest of the paper is organized as follows. Section 2 describes the methodology. Section 3 exposes the results. Section 4 concludes and gives some policy implications.

2. METHODOLOGY

2.1. THEORETICAL SPECIFICATION AND DERIVATION OF THE ESTIMABLE FORM

To assess the relation between the quality of institutions, natural resources and economic growth, we use the model of Mankiw et *al.* (1992) which is a Solow (1956) growth model augmented by human capital. Like in the model of Lucas (1988), education result from capital accumulation. The model of Mankiw et *al.* (1992) considers that the marginal returns are decreasing both in physical capital and human capital. The model assumes a Cobb- Douglas production function where production depends on physical capital (K), labor force (L) and the level of technology (A). Thus, production at time t is given by:

$$Y(t) = A(t)K(t)^{\alpha} L(t)^{1-\alpha} \quad 0 \prec \alpha \prec 1 \qquad \text{“(1)”}$$

Transforming equation (1) in logs, the production function is rewritten as:

$$Log[Y(t)] = Log[A(t)] + \alpha Log[K(t)] + (1-\alpha)Log[L(t)] \qquad \text{“(2)”}$$

Following Mankiw et *al.* (1992), we assume that:

$$Log[A(t)] = a + u \qquad \text{“(3)”}$$

where a is a constant and u is a country specific shock. Substituting (3) into (2), equation (2) becomes:

$$y(t) = a + \alpha k(t) + (1-\alpha)l(t) + u \qquad \text{“(4)”}$$

Since our study is focused in a sample of 18 countries, equation 4 is specified in panel as follows:

$$y_{it} = a + \alpha k_{it} + (1-\alpha)l_{it} + u_i \qquad \text{“(5)”}$$

where $i = 1,....,N$ denotes the number of countries and $t = 1,....,T$ determines the time dimension.

In many empirical studies, equation (5) is not often estimated in this form. The model of Mankiw et *al.* (1992) gives therefore the possibility to include control variables and variables of interest in order to capture some specific effects. Following the aim of our study, we include natural resources (NR) as the main independent variable. We can therefore rewrite equation (5) as:

$$y_{it} = a + \alpha k_{it} + (1-\alpha)l_{it} + \delta NR_{it} + u_i \qquad \text{“(6)”}$$

It's theoretically admitted that natural resources can influence economic growth through many channels. One of the channels is the quality of institutions. In this vein, good quality of institutions reinforce the positive relation between natural resources and growth while poor quality of institutions leads to a negative relation (Melhum et *al.*, 2006). We can therefore assume that the relation between natural resources and growth can be non-linear depending on the level of quality of institutions. To account for this assumption, threshold models have been widely used in the literature among them the PSTR model. The PSTR model is suitable for the purpose of this study. In fact, Villavicencio and Mignon (2011) highlight several interesting features. First, the coefficient can take different values, depending on the "regimes". Second, since the transition from one regime to another is smooth, the coefficients are allowed to change gradually. Finally, individuals are allowed to change between groups over time according to changes in the "threshold variable".The PSTR model, developed by González et *al.* (2005), is an extension of PTR model of Hansen (1999). From equation (6), the simplified form of the PSTR model, in vector form, is given by the relation (7).

$$y_{it} = u_i + \beta_0^{'} x_{it} + \beta_1^{'} x_{it} g(q_{it}, \gamma, c) + \varepsilon_{it} \qquad \text{"(7)"}$$

ε_{it} is the residual term, $x_{it} = (x_{it}^1, \ldots, x_{it}^k)$ is a k-dimensional vector of time-varying exogenous variables including control variables. $\beta_0^{'}$ and $\beta_1^{'}$ indicate respectively the vector of parameters of the linear and non-linear model. $g(q_{it}, \gamma, c)$ is the transition function. As suggested by Granger and Teräsvirta (1993), Teräsvirta (1994) and Jansen and Teräsvirta (1996), the functional form of transition function takes the logistic form as formulated in equation (8).

$$g(q_{it}, \gamma, c) = \left[1 + \exp\left(-\gamma \prod_{j=1}^{m} (q_{it} - c_j) \right) \right]^{-1} \qquad \text{"(8)"}$$

The transition function is continuous and derivable and is normalized to be bounded between 0 and 1. It allows the system to move progressively from one regime to other regimes. The arguments of the transition function are the transition variable (q_{it}), the threshold parameter (c) and the smoothness parameter (γ) with $\gamma > 0$. $c_1 < \ldots < c_m$ where $c = (c_1 \ldots c_m)$ is a m-dimensional vector of threshold parameters. The value of the parameter γ describes the smoothness of the transition from one regime to another. As $\gamma \to \infty$, the transition function approaches an indicator function that takes the value of 1 if $q_{it} > c_j$. If $\gamma \to 0$, it becomes a linear panel regression model with fixed effects. If γ is sufficiently high, then the PSTR model reduces to a threshold model with two regimes. In such case, the direct effect of the main independent variable on dependent variable will be given by $\beta_0^{'}$ for the individuals with independent variable below the threshold and by $\beta_0^{'} + \beta_1^{'}$ for those individuals where the independent variable is above the threshold. By considering the equation expressing the transition function, equation (7) becomes:

$$y_{it} = u_i + \beta_0^{'} x_{it} + \sum_{j=1}^{m} \beta_j^{'} x_{it} g_j(s_{it}^j, \gamma_j, c_j) + \varepsilon_{it} \qquad \text{"(9)"}$$

Recall that the dependent variable is economic growth(y). As we have mentioned earlier, natural resources can be counterproductive or not depending on the quality of institutions. Indeed, the economic intuition is that, for poor quality of institutions, natural resources destroy growth and for good quality of institutions, natural resource foster growth. Therefore, quality of institutions (*Q*), is taken as threshold variable. We consider the following institutional variables: political stability, quality of bureaucracy and the rule of law. Two reasons justify the choice of these measures. First, as documented by Havranek et *al.* (2016), the measures of economic institutions are more commonly used than the political institutions; and as regards economic institutions, studies use measures for World Bank and less frequently they use measures reported by the International Country Risk Guide. These limits were overcome in our study. Second, facts reveal that almost all natural resource-rich countries in SSA have been at least once subject to problem of political stability and consequently have experienced the periods of non-compliance of rule of law. National resource wealth is generally linked to violence and conflict (Collier and Hoefler, 2005). In addition, they are among the most corrupt countries in the world; and according to public choice theories corruption generally alters the quality of bureaucracy.

The other variables include: initial production variable, private investment (I*nv*), trade openness (*Open*), inflation (*Inf*), government spending (*Gov*) and population (*Pop*). The initial level of real GDP is used to control the conditional convergence in the spirit of the Neoclassical growth theory (Barro and Sala-i-Martin, 1995). The initial level of real GDP is the one period lagged value of real GDP in log. Private investment permits to analyze the effect of private sector on growth. Private investment is captured by private gross fixed capital formation as ratio of GDP. The theory predicts that private initiative generally boosts economy growth and the expected sign is therefore positive. The influence of external sector is also important and openness is a significative variable in many growth econometric regressions. This variable is obtained by dividing the sum of exports and imports to GDP. Considering the liberal theories of international trade and the endogenous growth theory, openness is growth-enhancing in a country; the expected sign is therefore positive. It's generally agreed that very high inflation has distortional effects on long-term economic growth; but at a low level, the inflation growth nexus can be positive. Thus, the expected sign can be either negative or positive. To account for differences in the variability of inflation within countries, inflation is captured by the standard deviation of consumer price index. Regarding the variable government spending, many studies have evaluated its relation with growth. This variable is taken as the ratio of GDP. There is no consensus in the literature concerning the sign of the relationship between public spending and economic growth. Indeed, empirical researches show that public spending can influence negatively or positively economic growth depending on the nature and quality of public spending (Gupta et *al.*, 2005) or on the public spending threshold (Mondjeli, 2015). According to Neoclassical growth model, population can influence growth which is modeled as a growth rate and the expected sign of the population growth rate is negative.

The empirical model to be estimated is presented as follow:

$$y_{it} = u_i + \alpha y_{it-1} + \beta_1^0 NR_{it} + \beta_2^0 Open_{it} + \beta_3^0 Gov_{it} + \beta_4^0 Inf_{it} + \beta_5^0 Inv_{it} + \beta_6^0 Pop_{it} + \left[\beta_1^1 NR_{it} + \beta_2^1 Open_{it} + \beta_3^1 Gov_{it} + \beta_4^1 Inf_{it} + \beta_5^1 Inv_{it} + \beta_6^1 Pop_{it}\right] g_j\left(s_{it}^j, \gamma_j, Q_j\right) + \varepsilon_{it} \quad \text{“(10)”}$$

2.2. PROCEDURE OF ESTIMATION

Equation (9) is estimated by non-linear least squares. But before the estimation, two preliminary tests are required: the linearity and the number of regimes tests.

2.2.1. THE LINEARITY TEST

The aim is to demonstrate that the relation between quality of institutions, natural resources and growth is non-linear through the linearity test. The null hypothesis is $H_0 : \beta^1 = 0$ against the alternative $H_1 : \beta^1 \neq 0$. However, this test is not standard since under the null hypothesis, the PSTR model contains nuisance unidentified parameters (Hansen, 1996). As suggested by Luukkonen et *al.* (1988), we replace the transition function by its first-order Taylor around $\gamma = 0$. The null hypothesis becomes $H_0 : \gamma = 0$. After rewriting, we obtain the following regression:

$$y_{it} = u_i + \alpha y_{it-1} + \beta^{*0}_1 NR_{it} + \beta^{*0}_2 Open_{it} + \beta^{*0}_3 Gov_{it} + \beta^{*0}_4 Inf_{it} + \beta^{*0}_5 Inv_{it} + \beta^{*0}_6 Pop_{it} + \left[\beta^{*1}_1 NR_{it} + \beta^{*1}_2 Open_{it} + \beta^{*1}_3 Gov_{it} + \beta^{*1}_4 Inf_{it} + \beta^{*1}_5 Inv_{it} + \beta^{*1}_6 Pop_{it}\right] g_j\left(s^j_{it}, \gamma_j, Q_j\right) + \varepsilon_{it} \quad \text{“(11)”}$$

where the vectors of parameter $\beta^{'*1},..., \beta^{'*m}$ are multiples of γ and ε^*_{it} is ε_{it} plus the residue of Taylor's development. The null hypothesis of the linearity test becomes $H_0 : \beta^{'*1} = ... = \beta^{'*1} = 0$. The linearity is tested with standard tests. We use Wald test expressed as follows:

$$LM_w = \frac{NT(SSR_0 - SSR_1)}{SSR_0} \quad \text{“(12)”}$$

where SSR_0 and SSR_1 are the panel sum of square residuals under H_0 (linear panel model with individual effects) and the panel sum of square residual under H_1 (PSTR model with m regimes) respectively. For small sample, González et al. (2005) suggest to use the Fisher test defined as:

$$LM_F = \frac{NT(SSR_0 - SSR_1)/nk}{SSR_0 / TN - N - nk} \quad \text{“(13)”}$$

with k the number of explanatory variables. LM_F follows a Fisher distribution with mk and $TN - N - mk$ degrees of freedom ($F(mk, TN - N - mk)$). All these linearity tests are distributed $\chi^2(k)$ under the null hypothesis.

2.2.2. THE NUMBER OF REGIMES TEST

The test consists to verify the null hypothesis for which the PSTR model has a single transition function ($m = 1$) against the alternative hypothesis that the PSTR model has at least two transition functions ($m = 2$). The decision of the test relies on the statistics of LM_w and LM_F. If the coefficients are statistically significant at the critical level of 5%, we reject the null hypothesis and we conclude that there exist at least two transition functions. Otherwise, we do not reject the null hypothesis and we conclude that the model has two regimes and therefore has one threshold.

2.3. DATA

The table A.1 in appendix gives the description of variables over the period 1985-2013 in a panel of 18 SSA countries which exportations of natural resources account for at least 15% of GDP. The traditional growth variables used and the natural resource variable are taken from the World Development indicators (WDI) of the World Bank. Institutional variables are extracted from the database of the International Country Risk Guide (ICRG). Descriptive statistics of the variables are reported in table A.2 in appendix. Before proceeding to the econometric analysis, it seems appropriate to determine the series integration properties to avoid spurious regression problem. For this purpose, we run Im, Pesaran and Shin (IPS) test (2003) and Pesaran test (2007). The IPS (2003) and Pesaran (2007) tests give two main results. First, the gross domestic product, private investment, inflation and government spending are all stationary at the critical level of 1%. Second, natural resources and trade openness are stationary in difference from the IPS test. But following the Pesaran test, these variables are stationary in level. The Pesaran test is more robust since it assumes that individual in the panel are cross-sectionally dependently distributed.

Table 1: Unit root tests

Variables	IPS Test		Pesaran Test		Conclusion
	Level	Difference	Level	Difference	
Natural Resources	-0,788 (0,216)	-12,36*** (0,000)	-5,27** (0,010)		I(0)
Gross Domestic Product	-8,50*** (0,000)		-6,21** (0,010)		I(0)
openness	1,219 (0,888)	-12,32*** (0,000)	-5,77** (0,010)		I(0)
Government spending	-2,056** (0,019)		-6,22** (0,010)		I(0)
Private investment	-1,60** (0,040)		-5,25** (0,010)		I(0)
Inflation	-7,91*** (0,000)		-6,21** (0,010)		I(0)
Population	- 6,32*** (0,000)		-5,25** (0,010)		I(0)

Note: The values in parentheses are probabilities. Significance level: (***) 1%; (**) 5%.

3. RESULTS

The results of linearity and of the number of regimes tests are reported in tables 2 and 3 respectively. From table 2, it notices that the hypothesis of linearity of the model is rejected for all institutional variables. This result shows that the effect of natural resources on economic growth depends on political stability, the quality of bureaucracy and the rule of law. The PSTR model is therefore appropriate. The result for the test for no remaining non-linearity (see table 3) indicates that the null hypothesis cannot be rejected, indicating that one threshold properly captures the non-linearity in the different models.

Table 2: Linearity test

Threshold variables	Wald Test (LM_W)	Fisher Test (LM_F)	LRT Tests (LRT)
Political stability	0.000***	0.000*	0.000***
Quality of bureaucracy	0.071***	0.082***	0.000***
Rule of law	0.000***	0.000***	0.000***

Note: H_0: Linear Model. H_1: PSTR model with at least one threshold. Significances Level: (***) 1%

Table 3: Test of the number of regimes

Threshold Variables	Wald Test	Fisher Test	LRT Tests	Number of transition functions
Political Stability	0.055***	0.072***	0.051***	1
Quality of bureaucracy	0.277	0.321	0.271	1
Rule of law	0.524	0.571	0.520	1

Note: H_0: PSTR with one transition function. H_1: PSTR with at least two transition functions. Significances Level: (***) 1%

The results of the estimation of the PSTR model are reported in Table 4. In that table, the second, third and fourth column describes respectively the results when political stability (model 1), quality of bureaucracy (model 2) and rule of law (model 3) are used as institutional indicators. The results deserve several comments. First, many control variables have the expected signs and are significant irrespective of the model used. The initial income coefficient is positive in models 2 and 3. The rationale of this result is that the convergence within SSA's countries is not established: holding constant other growth determinants, countries with lower GDP do not grow faster. Private investment influences negatively growth (see model 2). This result is contrary to what theory predicts and is justified by the poor quality of bureaucracy in African context which tend to discourage private initiative, by increasing for instance transaction costs. As documented by previous studies, public expenditures destroy economic growth since it's well established that a large proportion of public expenditures is unproductive in SSA's countries. Finally, trade openness positively fosters growth. This result confirms the predictions of international trade theories.

Second, the direct effect of natural resources on economic growth, measured by β_0 is negative and significant. This result confirms the natural resources curse thesis in the SSA's countries reported by many studies. The magnitude of the effect of natural resources depend on the model used, with the parameter estimates being -0.482, -0.174 and -0.054 respectively when the institutional indicator is political stability, quality of bureaucracy and rule of law. These coefficients reveal that the curse of natural resources is amplified by political instability, a result that is widely documented in previous studies (Bannon and Collier, 2003; Collier and Hoefler, 2005). Natural resources-rich countries of SSA usually find themselves in a vicious circle. In fact, Sala-i-Martin and Subramaniam (2013) research indicates that there is an increase in the probability of civil conflict when countries possess resource wealth. In return, civil conflicts explain natural resource curse.

Third, table 4 shows that the nonlinear component of the effect of natural resources on economic growth is positive and significant at the conventional level for the three institutional variables. The values of the estimated coefficients are 0.579, 0.291 and 0.0603 respectively for political stability, quality of bureaucracy and the rule of law. Thus, our results show that the sensitivity of growth to natural resources is negative for low quality of institutions and positive for a high quality of institutions. The shift between these two regimes occurs around the threshold of 2.55 for political stability, 0.55 for the quality of bureaucracy and 1.34 for the rule of law. Furthermore, the values of the smoothing parameter are low reflecting the smoothness of the transition. Definitively, it appears that the relation between natural resources and economic growth depends on the quality of institutions. As well as the studies of Omgba (2010) and Seghir and Damette (2013), we confirm the idea that the quality of institutions can explain the thesis of curse of natural resources in the SSA countries. Like Kolstad and Soreide (2009), we can assert that deteriorating institutions is the development problem in resource abundant countries rather than just one of the problems.

Table 4: Estimated coefficient of the PSTR model

Variables	Model 1	Model 2	Model 3
	Political Stability	**Quality of bureaucracy**	**Rule of law**
Natural Resources (β_0)	- 0.482*** (-2.462)	-0.170*** (-3.812)	-0.054*** (-2.103)
Natural Resources (β_1)	0.579*** (2.446)	0.291*** (3.924)	0.0603** (1.912)
Initial income	3.363 (0.741)	9.733*** (4.945)	9.912*** (4.544)
Private investment	0.101 (0.232)	-0.024*** (-3.924)	0.068 (0.431)
Inflation	0.067 (0.071)	-0.821 (-0.357)	-0.512** (-2.065)
Population	3.767 (1.178)	1.560** (2.000)	4.323*** (2.880)
Public expenditures	0.055 (0.141)	-0.390*** (-2.656)	-0.438*** (-2.392)
Trade openness	0.273*** (1.765)	0.105*** (4.085)	0.134*** (3.142)
γ	1.131	6.277	2.194
c	2.556	0.577	1.348
Number of observations	522	522	522

Note: The dependent variable is the growth rate of real GDP. Significance level: (***) 1%; (**) 5%.

For robustness purpose, we conduct sensitive analysis and derive the GMM dynamic panel model of Blundell and Bond (2000). To analyze the sensitivity of our results, we consider the following assumption: natural resources can influence economic growth through at least two control variables in our specification i.e public expenditures and trade openness. As regards public expenditures, the theory predicts that, by financing public investments in infrastructure and human capital, natural resources revenues may help foster growth. Concerning trade openness, the mechanisms by which natural resources affect growth can be explained by the Baghwati (1958)'s immiserizing growth theory and the Dutch Disease theory. Therefore, we run estimations in three cases: first we exclude to the specification public expenditures, then trade openness and finally the two variables. The results of these three specifications, reported on tables 5, 6 and 7, give strong insight to our previous findings.

Table 5: Estimated coefficient of the PSTR model, trade openness excluded

Variables	Model 1	Model 2	Model 3
	Political Stability	**Quality of bureaucracy**	**Rule of law**
Natural Resources (β_0)	-0.246*** (-2.372)	-0.042*** (-5.508)	-0.036*** (-2.283)
Natural Resources (β_1)	0.259*** (2.389)	0.048*** (6.171)	0.040*** (2.410)
Initial income	-3.527 (-0.869)	3.211 (1.252)	3.642 (1.416)
Private investment	-0.118 (-0.301)	0.152*** (2.638)	0.273*** (2.345)
Inflation	-0.0007 (-0.400)	-0.003*** (-3.164)	-0.003*** (-2.521)
Population	1.899 (0.457)	1.128*** (2.313)	-0.274 (-0.358)
Public expenditures	-0.047 (-0.105)	-1.163* (-1.592)	0.017 (0.182)
Trade openness	-	-	-
γ	0.822	6.443	10.68
c	2.268	0.942	1.395
Number of observations	522	522	522

Note: The dependent variable is the growth rate of real GDP. Significance level: (***) 1%; (*) 10%.

Table 6: Estimated coefficient of the PSTR model, public expenditures excluded

Variables	Model 1	Model 2	Model 3
	Political Stability	**Quality of bureaucracy**	**Rule of law**
Natural Resources (β_0)	-0.343*** (-2.823)	-0.042*** (-5.313)	-0.018*** (-2.103)
Natural Resources (β_1)	0.357*** (2.847)	0.047*** (5.655)	0.023** (1.912)
Initial income	-6.990 (-1.483)	2.680 (1.132)	1.559 (0.631)
Private investment	-0.356 (-0.739)	0.134*** (2.288)	0.376*** (2.819)
Inflation	0.0003 (0.149)	-0.002*** (-3.441)	-0.003*** (-2.424)
Population	2.759 (0.656)	1.048*** (2.087)	0.270 (0.372)
Public expenditures	-	-	-
Trade openness	0.2645* (1.765)	-0.005 (-0.205)	-0.002 (-0.077)
γ	0.845	7.688	13.36
c	2.216	0.960	1.402
Number of observations	522	522	522

Note: The dependent variable is the growth rate of real GDP. Significance level: (***) 1%; (**) 5%.

Table 7: Estimated coefficient of the PSTR model, trade openness and public expenditures excluded

Variables	Model 1	Model 2	Model 3
	Political Stability	**Quality of bureaucracy**	**Rule of law**
Natural Resources (β_0)	-0.362*** (-2.475)	-0.044*** (-5.568)	-0.023*** (-2.103)
Natural Resources (β_1)	0.376*** (2.493)	0.048*** (5.800)	0.052** (1.912)
Initial income	-5.457 (-0.979)	2.949 (1.202)	2.978*** (4.544)
Private investment	-0.180 (-0.328)	0.107*** (2.062)	0.345 (0.431)
Inflation	-0.0001 (-0.025)	-0.003*** (-3.710)	-0.003*** (-2.065)
Population	2.533 (0.745)	0.942** (2.037)	4.323*** (2.880)
Public expenditures	-	-	-
Trade openness	-	-	-
γ	0.786	7.152	8.631
c	1.681	0.953	1.405
Number of observations	522	522	522

Note: The dependent variable is the growth rate of real GDP. Significance level: (***) 1%; (**) 5%, (*) 10%.

Now, we derive the GMM analysis upon the estimation of equation (13).

$$y_{it} = u_i + \beta_0 RN_{it} + \beta_1 (RN_{it} * Q_{it})^2 + \beta_2 ouv_{it} + \beta_3 dep_{it} + \beta_4 \pi_{it} + \beta_5 invest_{it} + \beta_6 pop_{it} + \varepsilon_{it} \quad \text{“(13)”}$$

where Q_{it} captures the quality of institutions; the term $\beta_1 (RN_{it} * Q_{it})^2$ reflects both the combined effect of quality of institutions and natural resources and the non-linearity in the relation. The results of the GMM estimation are reported in Table 8 and are similar to those obtained through the different estimations of PSTR model. Indeed, table 8 shows that natural resources have a direct negative effect on economic growth. For political stability and quality of bureaucracy, the relation between natural resources and growth is significative respectively at 5% and 1% level of significance. The combined effect is positive and significative for all the institutional variables, meaning that the influence on growth of natural resources depends on the quality of institutions and the relation is non-linear.

Table 8: Estimated coefficient of the GMM model

Variables	Model 1	Model 2	Model 3
	Political Stability	**Quality of bureaucracy**	**Rule of law**
Natural Resources	-5,918*** (2,24)	-3,963** (-1,840)	-6,49* (-1,10)
$(RN_{it} * Q_{it})^2$	3,622*** (2,87))	0,015** (1,810)	7,035*** (2,27)
Initial income	2,319* (1,56)	1,830 (0,730)	0,81 (0,23)
Private investment	0,376*** (2,76)	-0,141 (-0,960)	-0,200 (-0,67)
Inflation	1,17* (1,68)	-0,0005** (-1,710)	2,98** (1,75)
Population	6,66*** (2,12)	11,890 (0,740)	13,17** (1,75)
Public expenditures	-0,143 (-0,53)	-0,221 (-0,54)	0,287* (1,29)
Trade openness	0,021 (0,36)	0,345*** (2,91)	0,059* (1,17)
AR2 (p-value)	0,548	0,100	0,650
Sargan Test(p-value)	0,561	0,280	0,523
Number of observations	522	522	522

Note: The dependent variable is the growth rate of real GDP. Significance level: (***) 1%; (**) 5%, (*) 10%.

4. CONCLUSION

The paper revisits the relationship between quality of institutions, natural resources and economic growth in SSA's countries by answering to question of the level of quality of institutions that ensures natural resources blessing. The sample includes 18 countries which exportations of natural resources account for at least 15% of GDP within the period 1985-2013. The methodology is mainly relied upon the estimation of smooth transition model for panel data. Before the estimation of PSTR model, we have run two preliminary tests. The test for non-linearity provides evidence that the effect of natural resources on economic growth is non-linear. It depends on political stability, the quality of bureaucracy and the rule of law. According to the test used to estimate the number of regimes, we notice one threshold that properly captures the non- linearity in the different models. Results indicate that the direct effect of natural resources on economic growth is negative and significant at the conventional level. The relation between natural resources and economic growth is based on quality of institutions. Indeed, the growth effect of natural resources is negative for low quality of institutions and positive for a high quality of institutions. For robustness purpose, we conduct sensitive analysis and derive the GMM dynamic panel model. The two analyses confirm the result derived from the main specification of the PSTR model. At the end of the day, it appears that natural resources and economic growth nexus depends on the quality of institutions.

Three policy recommendations can be derived from our results. The first recommendation is the necessity to improve the quality of institutions to benefit from natural resources. But it's important to bear in mind that institutions are usually endogenous in the context of resource abundant notably in SSA's countries. Abundant natural resources usually imply weak institutions (violence, conflicts etc.). This is exacerbated within a non-democratic political regimes context. Indeed, a move toward democratization regimes is a key issue in SSA's countries to improve the overall quality of institutions, and a pre-requisite to avoid natural resources curse. In this vein, the second recommendation is to reduce the dependency to natural resources by promoting diversification of the structure of the economy through investment in non-traditional sectors such as secondary and tertiary sectors. As highlighted by Avom and Carmignani (2010), diversification requires a number of pre-requisites among them the availability of resources to finance investments in non-traditional sectors and the efficient infrastructures to strengthen the competitiveness of the industrial and service sector. The third recommendation is to put in place an explicit tool of economic policy i.e resource funds. The argument underlying this proposition is the volatility of the commodity prices which can cause the instability of resources revenues. In addition, the purpose of resource funds is to sterilize the over-injection of revenues from natural resources and/or for saving a part of the wealth for future generations. Tsani (2013) observes that countries which have established resource funds perform well in term of governance and quality of institutions.

This study is not without its limits relatively to the approach used. The main critic addressed is that we have a unique threshold for each institutional variable in the entire sample. Since each country is specific in term of economic and institutional characteristics, the threshold level of each institutional indicator may be country-specific. But the PSTR model eliminates at the first step fixed effects and thus implying a unique threshold for all the countries. Another limitation of our study is to consider natural resources in their entirety. However, there are several natural resources such as coal, forest, mineral, gas and oil etc. And to the extent that countries are differently endowed, it will be interesting, in future researches, to see whether a clear distinction of natural resource will give different conclusions.

REFERENCES

Acemoglu, D. S., Johnson and J. A. Rombison (2012) “The colonial origin of comparative development: an empirical investigation: a reply”, *The American Economic Review* 102, 3077-3110.

Avom, D. and F. Carmignani (2010) “L’Afrique Centrale peut-elle éviter le piège de la malédiction des produits de base ? ”, *Revue d'économie du développement* 18*,* 47-72.

Bhagwati, J. (1958) “Immiserizing growth: a geometrical note”, *Review of Economics Studies* 25, 201–205.

Bannon, I and P. Collier (2003) Natural Resource and violent conflict, The World Bank, Washington.

Barro, R. J. (1990) “Government spending in a simple model of endogenous growth”, *Journal of Political Economy* 98, 103-117.

Barro, R. J. and X. Sala-i-Martin (1995) Economic Growth, Mc Graw- Hill.

Blundell, R. and S. Bond (2000) “GMM estimation with persistent panel data: an application to production fonctions”, *Econometric Reviews* 19, 321- 340.

Brunnschweiler, C.N., and E.H. Bulte (2008) “The resource curse revised and revised: A tale of paradoxes and red herrings”, *Journal of Environmental Economics and Management* 55, 248–264.

Collier, P. and A. Hoeffler (2005) “Resource rents, governance, and conflict”, *The Journal of Conflit Resolution* 49, 625- 633.

Devarajan, S. and F. Wolfgang (2013) “L’essor économique de l’Afrique: motifs d’optimisme et de pessimisme”, *Revue d’Economie du Développement* 21, 97-113.

Fearon, J. D. and D. Laitin (2003) “Ethnicity, Insurgency, and Civil War”, *American Political Science Review* 97, 75–90.

Gonzalez, A., T. Teräsvirta and V. D. Dijk (2005) “Panel smooth transmission regression models”, *Working Paper Series in Economics and Finance: Stockholm School of Economics*.

Granger, C. and T. Teräsvirta (1993) Modelling non-linear economic relationships, Oxford University Press.

Gupta, S. Clements, B. Baldacci, E. and C. Mulas- Granados (2005) “Fiscal policy, expenditure consumption and growth in low-income countries”, *Journal of International Money and Finance* 24, 441- 463.

Gylfason,T. and G. Zoega (2006) “Natural resources and economic growth: The role of investment”, *The World Economy* 29, 1091–1115.

Hansen, B. E. (1996) “Inference when a nuisance parameter is not identified under the null hypothesis”, *Journal of Econometrics* 64, 413- 430.

Hansen, B. E. (1999) “Threshold effects in non-dynamic panels: estimation, testing, and inference”, *Journal of Econometrics* 93, 345–368.

Havranek, T. , R. Horvath, and A. Zeynalov (2016) “Natural resources and economic growth: a meta-analysis”, *World Developmen,t* http://dx.doi.org/10.1016/j.worlddev.2016.07.016.

Im, K., M. H.Pesaran, and Y. Shin (2003) “Testing for unit roots in heterogeneous panel”, *Journal of Econometrics* 115, 53-74.

IMF (2012), Sub-Saharan Africa: Sustaining Growth amid Global Uncertainty, Regional Economic Outlook.

Isham, J., M. Woolcock, L. Pritchett, and G. Busby (2005) “The varieties of resource experience: Natural resource export structures and the political economy of economic growth”, *World Bank Economic Review* 19, 141–174.

Jansen, E. and T. Teräsvirta (1996) “Testing parameter constancy and super exogeneity in econometric equations”, *Oxford Bulletin of Economics and Statistics* 58, 735–763.

Jude, C. and G. Levieuge (2016), “The growth effect of foreign direct investment in Developing countries: the role of institutional quality”, The World Economy, doi: 10.1111/twec.12402.

Kolstad, I and T. Soreide (2009) “Corruption in natural resource management: Implications for policy makers”, *Resources Policy 34*, 214-226.

Leite, C. A. and J. Weidmann (1999) “Does Mother Nature Corrupt? Natural Resources, Corruption, and Economic Growth”, *IMF Working Paper* n° 85, Washington, D.C.

Lucas, R. (1988) “On the Mechanism of Economic Development”, *Journal of Monetary Economics*, 22, 2-42.

Luukkonen, R., P. Saikokonen and T. Terävirta (1988) “Testing linearity against smooth transition autoregressive models”, *Biometrica* 75, 491- 499.

Mankiw, N. G., D. Romer, and D. N. Weil (1992) “A Contribution to the Empirics of Economics Growth”, *The Quarterly Journal of Economics* 107, 407-437.

Mehlum, H. K. Moeneb and R. Torvik (2006) “Cursed By Resources or Institutions?”, *The World Economy* 29, 1117-1131.

Mondjeli M. N. (2015) “Too much public expenditures, less economic growth?”, *Economics Bulletin* 35,1985-1991.

Omgba, D. (2010) *Trois essais sur l'économie politique de la rente pétrolière dans les Etats Africains*, Thèse de Doctorat Université d'Auvergne - Clermont-Ferrand I.

Pesaran, M. (2007) “A Simple Panel Unit Root Test in the Presence of Cross Section Dependence”, *Journal of Applied Econometrics* 22, 265-312.

Sala-i-Martin, X. and A. Subramanian (2013) “Addressing the natural resource curse: An illustration from Nigeria”, *Journal of African Economies* 22, 570–615.

Seghir, M. and O. Damette (2013) “Natural resource curse: a nonlinear approach in a panel of oil exporting countries”, *Munich Personal RePEc Archive.*

Smith, B. (2015) “The resource curse exorcised: Evidence from a panel of countries”, *Journal of Development Economics* 116, 57–73.

Solow, R. M. (1956) “A contribution to the theory of economic growth”, *Quarterly Journal of Economics* 71, 65–94.

Teräsvirta, T. (1994) “Specification estimation and evaluation of smooth transition autoregressive models”, *Journal of the American Statistical Association* 89, 208- 218.

Torres, N., O. Afonso and I. Soares (2013) "Oil abundance and economic growth: a panel data analysis". *Energy Journal* 33, 119-148.
Tsani, S. (2013) "Natural resource, governance and institutional quality: the role of resource funds", *Resource Policy* 38, 181-195.
Villavicencio, A. and V. Mignon, (2011) "On the impact of inflation on output growth: does the level of inflation matter?", *Journal of Macroeconomics* 33, 455–464.
Yacine, B., L. Sami and S. Said (2015) "Effects of institutions and natural resources in a Multiple growth Regime", *The Economic Research Forum, Working Papers.*

Appendices

Table A1**:** Description of variables

Variables	**Description**	**Source**
Natural Resources	Ratio between natural resources rent and GDP. The rent of natural resources is the difference between the selling price and the exploitation costs.	WDI
Economic growth	Growth rate of real gross domestic product	WDI
Initial income	One period lagged value of real GDP	WDI
Private investment	Private gross fixed capital formation as ratio of GDP	WDI
Inflation	Standard deviation of consumption price index	WDI
Population	Growth rate of population	WDI
Public expenditures	Public final consumption as a percentage of real GDP.	WDI
Trade openness	Ratio between the sum of exportations and importation and real GDP	WDI
Political stability	Capacity of government to respect their engagement. This index include: government unity, legislative power and popular support.	ICRG
Rule of law	The strength of the impartiality of the judicial authority.	ICRG
Quality of bureaucracy	The institutional force and the quality of bureaucracy in terms of minimization of the capacity to revise national policies with a new political power.	ICRG

Table A2**:** Descriptive statistics of variables

Variables	**Obs.**	**Mean**	**Standard deviation**	**Min**	**Max**
Natural Resources	522	56,62	178,65	3,33	1563,30
Economic Growth	522	4,24	6,25	-41,89	36,94
Private investment	522	13,23	8,70	-4,08	72,37
Inflation	522	5,65	2,81	4,23	35,03
Population	522	2,70	1,27	-7,32	10,80
Public expenditures	522	16,81	7,70	4,36	48,58
Trade openness	522	65,60	31,01	10,95	178,99
Political stability	522	1,28	0,87	0	3,5
Rule of law	522	7,43	2,33	1	11,58
Quality of bureaucracy	522	2,68	1,13	0	6