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Natural resources, Institutional Quality and Economic growth: An African Tale

Boniface Ngah Epo and Dief Reagen Nochi Faha

Abstract

This study investigates the role of institutions in the relationship between natural resources and economic growth using a panel data of 44 African countries over the period 1996-2016. We use natural resource rents as a percentage of GDP and the share of ores and metals in total merchandise exports as variables for natural resources and six indicators of institutional quality. To check for endogeneity, heterogeneity and non-linearity we undertake a cross-sectional instrumental variable analysis, a system dynamic panel-data instrumental variable regression and panel smooth transition regression. The relationship between natural resources on economic growth vary for indicators of institutional quality and the measure for natural resources. The non-linear relationship between natural resources and economic growth is significantly ameliorate when we consider the variables rule of law and regulations and quality for both natural resource rents as a percentage of GDP and the share of ores and metals to total export.

Keywords: Natural resources, economic growth, institutions, panel threshold and Africa

I. Introduction

The 2013 African Development Bank (ADB) report questions' the importance of natural resource exploitation in the process of economic development (ADB, 2014). Rents from resources can serve as productive assets and help finance promising sectors of the economy (Joya, 2015). Overall and over time, most African countries have largely been dependent on natural resources, with very little diversification. Failure to diversify their economies prevent resource rich countries from having sustained growth and reducing the effect of growth volatility associated with resource dependence.

Natural resources constitute an important source of national wealth for most African countries (Diaw and Lessoua, 2013). Yet, rents from natural resources are solely not sufficient to bring about economic prosperity and progress. Over the last two centuries, the relationship between natural resources and economic growth reveals mixed results. In the nineteenth century and end of the first half of the twentieth century, countries like Australia, Scandinavia and United State recorded positive development experiences in which natural resources played a significant role in stirring economic growth. However, it is hard to find such successful experiences in the second half of the twentieth century because countries that largely depend on natural resources, have been associated with the "Natural resource curse¹" thesis (Atkison and Hamilton, 2003; Sachs and Warner, 1995).

¹ Natural resource curse refers to the seemingly counterintuitive observation that resource-abundant countries often appear to grow more slowly than those with fewer resources.

Countries with poor economic governance or weak institutions adopt inadequate industrialization programs that do not structurally change their economies (Matti, 2009). This observation may be heightened during periods of abundant natural resource exploitation. Other studies find negative effects of resources, via institutional decay, to economic growth (Gylfason and Zoega, 2001; and Murshed, 2003). In this regard, it is important for African countries that rely heavily on rents from natural resources to drive their development towards understanding how robust institutions could positively impact on the relationship between natural resources and economic growth.

Economic theory argues that institutions influence how natural resources are managed. This influence is perceived in terms of competing or complimentary interests between institutions and production in the natural resource sector. According to Mehlum et al. (2006a), production and rent-seeking are competing if the most effective rent-seeking activities are located outside the productive part of the economy. This competing scenario encourages rent seeking behavior and vested interest that may bias the management of gains from natural resources through bad institutions. This in turn may negatively affect economic growth and potential shared prosperity.

Recent empirical studies show that institutions play an important role in development and consolidating economic growth (Mehlum et al., 2006b; Mavrotas et al., 2011; Sala-i-Martin and Subramanian, 2013). Good institutional quality is a prerequisite for economic growth (Boschini et al., 2013). Therefore, how institutions are governed should significantly affect natural resource sectors. According to Collier and Hoeffler (2005), natural resource is likely to increase the chances of political instability, which should probably be negative for growth. Likewise, Omgba (2010) argues that with increasing wealth from resources, the payoff from staying in power grows and politicians tend to avoid adopting good governance practices that should lead to poor growth performance.

Researchers find mixed results when studying the relationship between natural resources and economic growth. Some authors find a positive relationship (Haber and Menaldo, 2011; Arezki and van der Ploeg, 2007), other authors find a negative relationship (Auty, 1993; Sachs and Warner, 2001), whereas some authors find that this relationship is contingent with the level of institutional quality (Sala-i-Martin and Subramanian 2013). The different results obtained by these researchers may be attributed to the nature of the relationship between natural resources and growth which is non-linear.

This study empirically contributes to the very limited number of studies that assesses the role institutions play in ameliorating the relationship between natural resource and economic growth in Africa. This study differs from Ndjokou and Tsopmo (2017), Belarbi et al. (2015) and Damette and Seghir (2018) in the following manner. First, we focus on 44 African countries (see annex for list of countries) unlike Ndjokou and Tsopmo (2017) which consider only 18 countries in SSA. Second, we use two different measures of natural resources. They include natural resource rents as a percentage of GDP and the share of ores and metal exports on merchandise export. Third, we use all the six indicators of institutional quality proposed by

the World Bank in an attempt to answer to the critic that natural resources curse is sensitive to the measure of both natural resources and institutions. Fourth, we estimate a cross-sectional and a system dynamic panel data analysis using conventional instruments or variables suggested in the literature to test for endogeneity of indicators of institutional quality using the two measures of natural resources. Fifth, we adopt the panel threshold estimation to control for heterogeneity and non-linearity.

The observation that African countries need robust economic growth for its development, rely on their natural resource endowments and suffers from poor institutional quality is the underlying relationship we attempt to investigate. In this regard, failure to observe structural transformations that causes economic growth in Africa can in part be associated to (1) their high dependence on natural resources forcing their economies to be primarily based on exporting raw materials and (2) low institutional willingness to build robust institutions due to rent seeking behavior favored by competing interest between the production in the natural resource sectors and institutions. Consequently, identifying the institutional threshold level and the structure of regime change (whether brutal or smooth) that is necessary to ameliorate the relationship between natural resource rents and economic growth in Africa should help in policy formulation.

The objective of this paper is to investigate the role institutions play on the relationship between natural resources on economic growth using a panel data of 44 African countries over the period 1996-2016. Specifically, we examine to what extent the effect of natural resources on growth depends on (1) the measure of natural resources, (2) the indicator of institutional quality and (3) the methodology used for estimations.

II. Literature review

Questions on the importance of natural resources on development has been extensively debated. On issues associated with the effect of natural resources on economic development, we observe two trends in the literature. The first trend investigates the relationship between abundant natural resources and economic growth (Auty, 1993; Sachs and Warner, 1995; 1999; 2001). The second trend analyses the effects of institutions on the natural resource-growth relationship (Mehlum et al., 2006a; Bhattacharya and Hodder, 2010; Sala-i-Martin and Subramanian, 2013).

Concerning the relationship between natural resources and economic growth, Sachs and Warner (1995; 1999) use a broad panel of countries to examine the effect of natural resources, measured by the share of primary product exports, on GDP. They suggest a negative effect of natural resources on growth. Similar results have also been obtained by Auty (2001), Gylfason et al., (1999), Gylfason (2001) and Sala-i-Martin and Subramanian (20013) using different variables and specifications. This negative effect of resources on growth is what is commonly called the resource curse.

Regarding the concept of resource curse, the literature identifies economic and institutional/political factors as the two main factors that explain this curse. On economic factors, the literature identifies the volatility of the revenue of primary factors or the misallocation of production factors as explaining Dutch diseases (Sachs and Warner, 2001; Auty, 2001; Van der Ploeg and Poelhekke, 2009). For institutional and political factors explaining resource curse, several studies exist (Easterly and Levine, 2003; Ishman et al., 2005; Bulte et al., 2005; Tsani, 2013). The principal argument suggested is that wealth generated by resources increases rent-seeking behaviour and corruption (Leite and Weidmann (1999); Dalgaard and Olsson (2008)) or may cause deterioration in the quality of institutions (Sala-i-Martin and Subramanian (20013) and Ishman et al., (2005).

On the relationship between institutions and natural resource-growth relationship, it is recognized that wealth from natural resources affect the type of regime. Wantchekon (2002) using a sample of 141 countries over the period 1950-1990 argues that one percent increase in the share of primary export to GDP increases by 8 percent the probability of a government to exercise authoritarian power. Collier and Hoeffler (2009) and Ross (2001) investigate the effect of rents of natural resources on the economic performances (medium term-economic growth) of democracies. These authors find that autocracies are significantly outperformed by democracies in the absence of resources rents. On the contrary, when the share of resources rents to GDP is high, democracies are outperformed by autocracies.

Furthermore, several studies identify that a boom in natural resources impede economic growth through the occurrence of diffused corruption, “grabbing institutions” or a poor rule of law (Mehlum et al., 2006a and 2006b; Bhattacharya and Hodder, 2010; Sala-i-Martin and Subramanian, 2013). Robinson et al., (2006) focusing on the political economy framework show how political incentives are crucial in understanding the effect resources have on growth.

Recently, Mavrotas et al. (2011) investigating the link between natural resources, institutional development and economic growth in 56 developing countries over the period 1970–2000. They find that natural resources contribute positively to growth when the country has a good level of governance and democracy. Likewise, Belarbi et al., (2015) examining the combined interaction effects of oil resources dependence and institutions on economic growth show that the effect of the former on economic growth becomes positive when the quality of institutions improves. Good governance, stronger democratic institutions and low levels of corruption significantly enhance economic growth in a study comprising of 32 abundant resource rich countries and 47 non-resource rich countries (El Anshashy and Katshaiti, 2013). Furthermore, Bulte et al., (2005) indicate that natural resource abundance promotes economic growth which they explain by the ‘windfall’ flow of income from resource extraction. This flow has a direct effect on the economy and an indirect effect through improving institutional quality.

Nonetheless, an overview of empirical literature on the relationship between natural resources, institutions and growth can be grouped into the following observations. The first set of observations can be associated to results that find that natural resources have a negative

effect on growth in the presence of weak institutions (Sala-i-Martin and Subramanian, 2013 and Belarbi et al., 2015). The second set of observation can be associated to results that suggests a positive relationship between natural resources and economic growth (Haber and Menaldo, 2011; Arezki and van der Ploeg, 2007). The third set of observation of highlight results that indicate that natural resources interact with the quality of institutions and the combined effect of these two factors on growth will depend on the nature of this interaction (Mehlum et al., 2006a).

Case studies also outline the importance of institutional quality in analyzing the effect of natural resources on growth (Dunning, 2008). A good example often mentioned in the literature is the case of Botswana where the discovery of Diamond in the 1970s has sustained impressive economic growth (Acemoglu et al., 2003). However, the same discovery of diamond in Angola and Liberia has instead fueled conflict rather than improving growth (Olsson, 2007; Le Billion, 2008). Similarly, the discovery of oil in Norway (blessing), Nigeria and Equatorial Guinea (curse) has different effects (Larsen, 2004; Sala-i-Martin and Subramanian, 2013, Toto Same, 2008). Another popular case study is the Democratic Republic of Congo where despite being heavily endowed with natural resources has been witnessing conflict and a deterioration of growth and the standard of living (Lalji, 2007).

In closing, a key trend from studies is the important role of institutions in analyzing the relationship between natural resources and growth. Nonetheless, it important to adequately treat issues associated to methodological and estimation aspects in analyzing the relation between institutions, natural resources and economic growth in a heterogenous setup like African continent.

We contribute to empirical literature by investigating the role of institution on the relationship between natural resources on economic growth in Africa using a panel data including 44 African countries. This study contributes to the gaps found in literature by: (1) using two different measures of natural resources. These measures are natural resource rents as a percentage of GDP and the share of ores and exports on merchandise exported for 44 African countries; (2) using the six different types of indicators of institutional quality suggested by the World Bank; and (3) adopting different specifications and methods of estimations which accounts for endogeneity of the choice of institutions.

In this regard, we first compute the direct effect of natural resources on economic growth and the combined effect of natural resources for each indicator of institutions using a cross-sectional instrumental variable regression. Second, we estimate a system dynamic panel estimation which accounts for potential endogeneity for the six variables of institutional quality suggested by the world bank. Third, we use a Panel threshold model to estimate the a non-linear institution-natural resource-growth relation for all six indicators of institutional quality and also control for heterogeneity.

III. Methodology, Model specifications tests and Data

III.1. Methodology

In this paper, the theoretical specification of our empirical model is based on the model suggested by Mankiw et al. (1992), which is an augmented Solow (1956) type growth model that includes human capital. In this model, the production function is of Cobb–Douglas type and the stock of human capital depreciates at the same rate as physical capital. Similarly, the endogenous growth model purported by Lucas (1988) indicates, that investment in human capital, innovation, and knowledge are significant contributors to economic growth.

To estimate our empirical model, we opt for a panel data regression model. In regression models for panel data, it is typically assumed that heterogeneity associated to the nature of the data can be captured by means of (random or fixed) individual effects and time effects, such that the coefficients of the observed explanatory variables are identical for all observations. In many empirical applications, this poolability assumption may be violated and therefore warrants the adoption of techniques that may account more robustly for heterogeneity.

We suggest using the panel smooth transition regression (PSTR) model. This approach presents both advantages and disadvantages. Concerning advantages, the PSTR specifications allow the natural resources-growth coefficient to vary between countries and also overtime. This provides a simple way to appraise the heterogeneous nature of the relationship between natural resources rents and growth 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 are the different indicators of institutional quality. They include the rule of law, regulatory quality, governance effectiveness, political stability, control of corruption and voice and accountability, respectively.

Nonetheless the PSTR also has some disadvantages. First, the PSTR does not solve the problem of endogenous variable found among the explanatory variables. Second, the PSTR assumes a unique threshold for all the countries. To check for potential endogeneity, we also run estimates using the instrumental variable approach and check for endogeneity of the indicators of institutional quality using instruments suggested by Moshiri and Hayati (2017).

To investigate the non-linear relationship between natural resources rents and economic, we use a PSTR approach developed by González et al. (2005), which is a generalization of the Hansen (1999) Panel Threshold Regression model. Let the basic panel smooth transition regression model with two regimes be expressed as:

$$y_{it} = \mu_i + \beta'_0 x_{it} + \beta'_1 x_{it} g(q_{it}; \gamma, c) + \varepsilon_{it} \quad (1)$$

where $i=1, \dots, N$, and $t=1, \dots, T$, 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, μ_i the fixed individual effect, ε_{it} the error term and c a threshold parameter.

The transition function $g(q_{it}; \gamma, c)$ is a continuous function and depends on the threshold variable q_{it} (Hansen, 1999). Granger and Tarasvirta (1993) provide a logistic specification of the transition function with c denoting threshold parameters, γ determines the smoothness or slope of the transition, q_{it} the threshold variable and m the number of thresholds.

The PSTR model has the advantage of computing heterogeneity between countries through the estimation of the respective marginal effects for each country. The marginal effect reflects observed variations caused by changes in the threshold variable q_{it} . Re-writing equation 1 in the form of the empirical model adopted for the PSTR in this paper, we obtain:

$$GDPG_{it} = \mu_i + \beta_{01}NR_{it} + \beta_{02}INFL_{it} + \beta_{03}OPT_{it} + \beta_{04}INVS_{it} + \beta_{05}POPG_{it} + \beta_{06}HC_{it} + \beta_{07}IGDP_{it} + (\beta_{11}NR_{it} + \beta_{12}INFL_{it} + \beta_{14}INVS_{it})g_1(IQ_{it}; \gamma, c_1) + \varepsilon_{it} \quad (2)$$

where GDPG represents growth is gross domestic product; NR natural resources (total natural resources rent and the percentage of ores and metal export to total export); INFL inflation; OPT openness to trade; INVS investment; POPG population growth; IQ institutional quality (rule of law, Regulatory quality, governance effectiveness, Control of corruption, political stability and voice and accountability); HC Human Capital and IGDP the initial level of GDP per capita. The transition function is $g_1(IQ_{it}; \gamma, c_1)$.

As earlier indicated, one of the shortcomings of the PSTR is that it does not check for endogeneity. To circumvent this problem, we first perform an instrumental variables regression to account for endogeneity for cross-sectional data. For the cross-sectional data, we consider the average values between the period 1996-2016 for the variables reported in equation 3. Furthermore, using the same structural model we estimate a system dynamic panel data with instrumental variables. The equation is presented in equation 3 as:

$$GDPG_{it} = \beta_{01}NR_{it} + \beta_{02}INFL_{it} + \beta_{03}OPT_{it} + \beta_{04}INVS_{it} + \beta_{05}POPG_{it} + \beta_{06}HC_{it} + \beta_{07}IGDP_{it} + \beta_{08}(NR_{it} * IQ_{it})^2 + \varepsilon_{it} \quad (3)$$

where the different variables similar to those used in equation (2) are reported as their average values. The term $(NR_{it} * IQ_{it})^2$ both captures the joint effect of natural resources and institutional quality and the non-linear effect of this joint effect on growth. By estimating equation 3 for cross-sectional and panel data, we control for endogeneity.

Estimating equation 3 requires we instrumented for institutional quality to verify its exogeneity. The expression of the reduced form equation for institutional quality considering the three instruments is expressed in equation 4.

$$IQ_i = \gamma_1 IM_i + \gamma_2 LT_i + \gamma_3 OF_i + \mu_i \quad (4)$$

where, IM represents incidence of malaria, LT represents latitude and OF represents official language.

III.2. Model specification tests adopted for this study

Gonzalez et al. (2005) suggest two steps in undertaking a PSTR. First, we test for linearity and second, we estimate the parameters.

III.2.1. Testing for linearity

Testing for linearity of the PSTR model indicated by equation (1) 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 $H_0: \beta_1^* = \dots = \beta_m^* = 0$ 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 (LM_F).

Two comments can be made concerning the linearity tests. First, the test can be used for selecting the appropriate transition variable q_{it} in the PSTR model. Second, the linearity test can also be used to determine the appropriate order m of the logistic function. Granger and Terasvirta (1993) propose a series of test to choose between $m=1$ and $m=2$ number of transitions. Using a regression with $m=3$, test the null hypothesis $H_0^*: \beta_3^* = \beta_2^* = \beta_1^* = 0$. If the first scenario for three transitions ($m=3$) is rejected, we then test for two and one transitions expressed as $H_{03}^*: \beta_3^* = 0, H_{02}^*: \beta_2^* = 0 | \beta_3^* = 0$ and $H_{01}^*: \beta_1^* = 0 | \beta_3^* = \beta_2^* = 0$ in a stepwise manner. Select $m=2$ if the rejection H_{02}^* is strongest one, otherwise select $m=1$ if the rejection H_{01}^* appears to be the strongest.

III.2.2. Parameter estimations

The parameters $(\beta'_0, \beta'_1, \gamma, c)$ in equation (1) are estimated in two steps. We first eliminate the individual effects μ_i by removing individual-specific averages. Second, we apply the nonlinear least square method to the transformed data to determine the values of parameters that minimize the concentrated sum of squared errors expressed as Q^c . While estimating the PSTR model, a practical issue that deserves some attention is how to select the starting values for γ and c , that represents the degree of smoothness of the transition associated to the regime change and the m -dimensional vector of location parameters such that $\gamma > 0, c_{i,min} > \min(q_{it}), c_{i,max} < \max(q_{it}), j = 1, \dots, m$. The values minimizing the function representing the concentrated sum of squared error ($Q^c(\gamma, c)$) can be used as starting values of the nonlinear optimization algorithm.

III.3. Data

Data used in this study is generated from the 2018 World Bank Development Indicator (World Bank, 2018a) and 2018 Worldwide Governance Indicator (WGI) of the World Bank (World Bank, 2018b). In this study, we adopt two variables to proxy natural resources. The

first proxy is natural resource rents² as a percentage of GDP. The second proxy is the percentage of ores and metal exports to total merchandise export. These two variables are chosen rather than natural resource reserves that report the measured stock of natural resources. We argue for this choice because, a given country may be rich in resources reserve but her revenues not being directly drawn from natural resource exploitations because she is yet to exploit these resources. This is clearly not the reported situation for countries of African countries because significant shares of their revenues are gotten from natural resource exploitation. Furthermore, it is difficult to report whether the stock of natural resources has the same effect on economic growth as either natural resource rents or the share of ores and metal of total export. We use the two proxies mentioned above to also verify whether the relationship between natural resources may depend on the type of measure of natural resources. Values for natural resource rents and ores and metal exports reported in this study are computed from the World Bank development indicator report. Nonetheless, we acknowledge that natural resources rent measure may be subjected to price volatility and technological changes, and can be affected by the production cost across countries.

Regarding the indicators of institutional quality, we adopt six variables. They include the rule of law (RL), regulatory quality (RQ), governance effectiveness (GE), control of corruption (CC), political stability (PS) and voice and accountability (VA) published in the 2018 WGI (World Bank, 2018b, Kaufman, 2010).

Other related economic variables we use in this study are also obtained from the 2018 World Bank development indicator report. They include growth in gross domestic product (GDPG), inflation (INFL) defined as the annual percentage of consumer price index, trade openness (OPT) measured as efforts by a country to either restrict or invite trade between countries and calculated by the ratio of the sum of export of goods and services plus import of goods and services to GDP, investment (INVS), measured as the percentage of the gross fixed capital formation to GDP, population growth rate (POPG) defined as the annual growth rate of the total population, human capital (HC) measured as the rate secondary school enrollment and initial level of GDP per capita (IGDP) which is the log of ten years lag of the GDP per capita. The IGDP enables us to determine if there is a convergence process between the 44 countries that constitute our panel data. Descriptive statistics are presented in Table 1A in the annex.

IV. Empirical results

IV.1. Results for stationarity test, nonlinearity test, test for number of threshold and endogeneity test

The different procedures associated with specifying the PSTR rely on the assumption that all variables are stationary. Table 2A in the appendix shows stationarity results estimated using the test elaborated by Im et al. (2003). Results indicate that all the variables are stationary and

² Natural resource rents 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.

significant. After testing for stationarity, we also test for linearity because the PSTR is applicable to nonlinear variables. The different tests³ for linearity vs PSTR with $m^*=2$ indicate that the null hypothesis of linearity for the model ($H_0: \beta_1 = 0$ or $H'_0: \gamma = 0$) is rejected at 1%. The model is therefore nonlinear. This indicates that for each regression we have a maximum of two regimes.

We test for the endogeneity⁴ of the indicators of institutional quality. In other to address this issue, we perform an endogeneity test by Durbin-Wu-Hausman. The null hypothesis purports that the variables for institutional quality are exogenous and the alternative hypothesis that they are endogenous. Rejecting the alternative hypothesis for each variable reflecting institutional quality would indicate that the said variable is exogenous. Following Moshiri and Hayati (2017) we use conventional instruments found in the literature to verify if the variables for institutional quality are exogenous. Instruments used for the endogeneity test are the incidence of malaria in a given country (Acemoglu et al., 2000) and the official language spoken in the country (Hall and Jones, 1999) and the latitude of (Hall and Jones, 1999; Easterly and Levine, 2016). Table 1 present the endogeneity test for the six variables used in this study as our institutional quality variable.

Please insert Table 1 here

Using instrumental variable approach, the results in Table 1 suggests that all the six indicators of the institutional quality are exogenous because we reject the alternative hypothesis of endogeneity. These results are also obtained by Moshiri and Hayati (2017) using the same indicators on a cross-sectional sample of 149 endowed natural resources countries. Furthermore, Table 3A in the appendix reports results for both the Sargan and Basman tests for overidentification. These statistics indicate that the instruments are valid as all the p-values are greater than 0.05.

IV.2. Estimations result

In this section, we comment in a stepwise manner results from the cross-section instrumental variable estimations (4.2.1), a system dynamic panel-data instrumental variable estimation (4.2.2) and the Panel threshold estimation (4.2.3) for the two variables used to study natural resources and the six indicators of institutional quality.

IV.2.1. Cross-section instrumental variable estimations of natural resource rents on economic growth

³ The various tests of linearity vs PSTR model for all the 14 PSTR regressions computed in this study are provided by the authors upon request.

⁴ Green (2012) suggests that we can examine endogeneity of a variable by estimating a single equation. Moreover, if the F statistics of the IV variable in the first regression is less than 10 then the instruments are weak.

Although results from the endogeneity test indicate that all the six indicators of institutional are exogenous, it is necessary to estimate an IV regression for robustness check. Using cross-sectional data for 44 African countries, Table 2 post IV estimates for the model outlined in equation 3 for natural resource rents as a percentage of GDP (Col.1 to Col.6) and the share of ores and metal exports to total export (Col.7 to Col.12). We run this regression for the six indicators of institutional quality because we suggest that effect on natural resources on economic growth may be sensitive to the choice of the indicator used to capture institutional quality.

Concerning the percentage of natural resource rent to GDP, Table 2 indicates that the direct effect of natural resources on economic growth is positive and significant when we consider rule of law (Col.1) and governance effectiveness (Col.4). Looking at the joint effect ((Natural resources rent as % GDP *IQ)²) the values were negative for all six indicators of institutional quality though not significant. This switch in signs may be indicating non-linearity.

On the other hand, results for the share of ores and metal to total export show no significant direct effect with growth in GDP when we undertake a cross-sectional instrumental variable estimate. Regarding the combined effect, the interaction between the percentage of ores and metals of total export and the indicator for institutional quality was positive and significant only for model which included control of corruption (Table 2, Col.8). The switch of signs also purports the presence on a non-linear relationship between natural resources and growth.

An analysis of some other covariates indicate that human capital related positively and significantly for the models which controlled for the rule of law, political stability, governance effectiveness and voice and accountability when we consider the share of natural resource rents to GDP. For the share ores and metal exports of total export, we observe a positive and significant relations for all six models of the different institutional quality indicators. Concerning the variable investments, the relationship was positive and significant for the variables rule of law, corruption, political stability and voice and accountability when considering the percentage of natural resource rent of GDP. For estimates using the of the share of ores and metals export of total export, the relationship was significantly positive for all six indicators of institutional quality (Table 2, Col.7-Col.12). Trade openness post positive and significant results for rule of law; political stability and government effectiveness for the share of natural resource rents to GDP and rule of law, political stability and voice and accountability for ores and metal percentage of total export.

Please insert Table 2 here

IV.2.2. System dynamic panel-data instrumental variable estimation for natural resource rents on economic growth

Table 3 reports a system dynamic panel data estimates for the two different measures of natural resources. We undertake this analysis because results obtained from the cross-sectional section Instrumental Variables estimations may be less effective. The cross-sectional

data for the 44 African countries is constructed by attributing the average values of the variables used in our analysis over the period 1996-2016. For robustness check, we therefore propose to undertake a system dynamic panel data estimate which accounts for endogeneity. The panel data used for this process takes into consideration both the individual dimension and the time dimension to estimate the model suggested in equation 5.

Table 3 indicates that when we consider the percentage of natural resource rent to GDP (Table 3, Col.1-Col.6), the direct effect of natural resources rent on economic growth is negative and significant for the indicators rule of law (Col.1), control of corruption (Col.2), regulatory quality (Col.5) and voice and accountability (Col.6). This result is similar to results obtained by Bjorvant and Farzanengan (2013), Avom and Carmignani (2010) and Nuno et al., (2009). In resource rich countries, tradable production that focuses on the natural resources sector rather than other manufacturing sectors (Sach and Warner, 1995) and declining prices of raw materials (Singer, 1950) explain this negative relationship. In the case of African countries, we observe a combined effect of both explanations where little diversification of their economy is coupled with falling world prices of natural resources. The ensuing effect is a reduction in income from natural resources that could be channeled towards investment projects causing growth. This negative effect for the region is that resource rents crowd out the manufacturing sector, adversely affecting growth and hampering efforts by countries to structurally transform their economies.

Furthermore, the interaction effect of natural resources and indicators of institutional quality are positive and significant for rule of law (Col.1), control of corruption (Col.2) and voice and accountability (Col.6). This indicates a priori that better rule of law, less corruption or rent seeking behaviors and more accountability mitigate the negative relationship between natural resources and economic growth. We also observe that the change in sign indicates a non-linear relationship between natural resources and economic growth as argued in this paper.

Considering the percentage of ore and metal exports of total export, results suggests that natural resource has a positive and significant effect when we control for and political stability (Table 3, Col.9) and Governance effective (Table 3, Col.10). The interaction effect reveals a negative and significant relationship for political stability (Col.9) and governance effectiveness (Col.10); but positive and significant relationship for voice and accountability (Col. 12). Damette and Seghir (2018) also found a negative interaction between oil revenue and governance effectiveness in oil exporting countries.

Please insert Table 3 here

An analysis of other covariates indicate that inflation was negative and significant when we control for all six indicators of institutional quality for natural resource rent as a percentage of GDP (Table 3, Col.1-Col.6). This relationship was positive and significant for rule of law (Col.7) and regulation quality (Col.11) for the share of ores and metals to total export. The variable population growth was positive and significant when we controlled for institutional quality for estimates using natural resource rents as a percentage of GDP. For human capital,

we observe a negative and significant relationship for all six institutional variables when considering the percentage of ores and metal exports of total export. This observation was only valid for control of corruption as well as voice and accountability for estimates using natural resource rents as a percentage of GDP. The variable trade openness was negative and significant only for estimate for the percentage of ores and metal exports of total export when we consider each of the six variables for institutional quality.

IV.2.3. Panel Threshold estimations for natural resource rents on economic growth

Results from Tables 2 and 3 suggest the presence on a non-linear relationship between natural resources and economic growth. This is evident because the signs of coefficient for both the percentage of natural resource rents in GDP and the share of ores and metals to total export change when we interact these variables with the indicators of institutional quality. In addition, neither the cross-sectional instrumental variable approach nor the system dynamic panel-data estimates instrumental variable estimation techniques are not effective in analyzing the non-linear effect of natural resources on growth. We therefore suggest to use panel smooth transition regression approach which deals with non-linear approach using institutional quality as threshold variable.

Table 4 shows estimated results of our empirical model outlined in equation 4. It presents the regression results for the two scenarios outlined in the methodology. In the first scenario, the coefficients associated to β_0 indicate estimated results when we do not include the threshold variable (the different indicators of institutional quality) in the PSTR model. In the second scenario, the coefficients associated to β_1 indicate the estimated results when we include the threshold variable in the PSTR. Table 4 also reports the results of the estimated threshold variable (\hat{c}) and the estimated slope parameters ($\hat{\gamma}$) using for each indicator of institutional quality chosen as the threshold variable.

Considering the first scenario, the relationship between natural resources and economic growth is not significant albeit being negative when we control for rule of law and government effectiveness and positive for control of corruption, regulatory quality and voice and accountability in the case where we consider the percentage of natural resource rents on GDP (Table 4, Col.1-Col.5). Brunnsweiler and Bulte (2008a; 2008b) find similar results and suggest the non-significance of natural resources (natural capital) due to potential endogeneity.

Please insert Table 4 here

When we consider the second scenario, for which we introduce the threshold variables for institutional quality in regression model, the relationship between natural resource rents and economic growth becomes positive and significant when we control for rule of law (Col.1), control of corruption (Col.2) and regulatory quality (Col.4). This indicates that institutions that fight corruption, enforce the rule of law of adopt quality regulation ameliorates the neutral relationship between natural resource rents and economic growth. This amelioration

takes place when these institutions do not have competing interests with producers or production in the natural resource sector. Furthermore, transitioning from the first regime to the second regime is smooth as indicated by the smooth transition function in the PSTR model.

These findings are similar to results obtained by Mehlum et al. (2006a and b), Sala-i-Martin and Subramanian (2013) and Belarbi et al. (2016). Consequently, strong and accountable institutions that have transparent policies should prevent malpractices by actors in the natural resource sector and therefore encourage adequate utilization of resources from this sector to consolidate development in African countries. According to Claessens and Laeven (2003), if institutional quality is strong, then revenues from natural resource sectors should boost economic development, through better property right that tend to improve asset allocation which favors the growth process through structural transformation.

We also comment on the first and second scenarios for estimates obtained when we consider the share of ores and metal of total export, controlling for the different variables of institutional quality. The first scenario which do not include threshold variable suggest a negative and significant effect when considering rule of law (Table 4, Col.6) and regulatory quality (Table 4, Col.9); and a positive and significant effect when we control for corruption (Col.7) and voice and accountability (Col.10). For the negative and significant effect, similar results are obtained by Ndjokou and Tsopmo (2017) as well as Claudio and Gregorio (2005). When we include institutional quality as threshold variable, we observe a swap in signs as this relationship becomes positive when we control for the rule of law and regulatory quality and negative for corruption and voice and accountability. For these effects, we attribute to a change in regime across the transition function.

Considering other covariates, Table 4 reports different results for the indicators of institutional quality and the measures for natural resources. Regarding the variable natural resource rents as a percentage of GDP, we find a positive relationship between the share of gross fixed capital formation to GDP and economic growth when controlling for rule of law and negative relationship when controlling for governance effectiveness. For the second scenario, these results swap signs. On the contrary when we consider shares of ores and metal to total export the relationship between investment and economic growth was positive for indicators of institutional quality in the first scenario and negative when we control for political stability and regulation and quality.

Concerning the variable inflation, this relationship was negative and significant for rule of law but positive for corruption and government effectiveness in the first scenario considering natural resource rents. For the second scenario, the relationship was negative for corruption and governance. However, estimates using the share ores and metals to total export report that the relationship between inflation was negative when controlling for rule of law, corruption, political stability and regulations. Introducing the threshold variables, this relationship was positive for these indicators of institutional quality.

Human capital was negative and significant for the controlled variables rule of law, corruption as well as regulation and quality when we consider natural resource rents as a percentage of GDP. For the share ores and metal in total export this relationship was negative and significant when we control for rule of law, political stability and regulation and quality.

V. Conclusion

This study analyzed the role of institutions in ameliorating the relationship between natural resources and economic growth using a panel-data of 44 African countries over the period 1996-2016. Natural resource rents as a percentage of GDP and the share of ores and metals to total merchandise export are used to measure natural resources. For institutional quality, we use six indicators. They include the rule of law (RL), regulatory quality (RQ), governance effectiveness (GE), control of corruption (CC), political stability (PS) and voice and accountability (VA).

Furthermore, in a stepwise manner we undertake a cross-sectional instrumental variable analysis and a system dynamic panel-data instrumental variable regression to successively verify for potential endogeneity of the indicators of institutional quality. In addition, we also use a panel smooth transition regression, to test the non-linear relationship between natural resources and economic growth and heterogeneity.

Instrumenting for each of the six indicators of institutional quality as suggested by Moshiri and Hayati (2017), results indicate that all six indicators are exogenous. We also observe a nonlinear relationship between natural resources and economic growth. Results from the cross-sectional instrumental variable analysis and the system dynamic panel-data instrumental variable regression indicate that effect of natural resources on economic growth for panel of 44 African countries could be contingent on (1) the measure of natural resources, (2) the choice of the indicator of institutional quality, (3) the nature of the model specification and (4) the methodology adopted. There is need to adequately chose the measure of both natural resources and institutions as well as model specification or methodology when addressing questions on natural resources curse in an African context.

Estimates for the PSTR model which argue for a non-linear relationship between natural resources and growth indicate different results when we consider the two measures of natural resources and control for the six indicators of institutional quality. When consider natural resource rents as percentage of GDP, we observe no significant effect on growth when controlling for all the indicators of institutional quality. Nonetheless, we observe a positive and significant effect of natural resource on growth when we introduce the threshold variable for institutional quality for the indicators reflecting the rule of law, control of corruption and governance effectiveness. This indicates that there is a threshold for which these institutional variables ameliorate the non-significant effect of natural resources on growth.

Concerning the share of ores and metal of total export we find different results based on the indicator for institutional quality. Results for the PSTR which do not include threshold

variable suggest a negative and significant effect when considering rule of law and regulatory quality and a positive and significant effect when we control for corruption and voice and accountability. When we include institutional quality as threshold variable, we observe a swap in signs as this relationship becomes positive when we control for the rule of law and regulatory quality and negative for corruption and voice and accountability. For these effects, we attribute to a change in regime across the transition function.

In closing, we purport that it is difficult to generalize the finding that institutions ameliorate the relationship between natural resource rents and economic growth for all six indicators of institutional quality. This is because the extent and role on institutions vary for indicators of institutional quality as well as the variable used to reflect natural resources. Nonetheless, the non-linear relationship between natural resources and economic growth is significantly ameliorate when we consider the variables rule of law and regulations and quality for both natural resource rents as a percentage of GDP and the share of ores and metals to total export.

This should suggest that if priority was to be given to any of the six indicators of institutional quality, these two variables should be considered as priorities in designing policy that ameliorate natural resource management and its effect on economic growth.

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Appendix

List of Tables

Table 1: Test for Institutional Quality Endogeneity

Variables	Durbin scores test chi2[1]	Wu-Hausman F [Fisher (1, 4)]
Rule of law	0.915 [p=0.338]	0.870 [p=0.356]
Regulatory quality	0.416 [p=0.518]	0.391 [p=0.534]
Control of corruption	2.486 [p=0.114]	2.455 [p=0.124]
Governance effectiveness	4.490 [p=0.114]	2.460 [p=0.124]
Voice and accountability	0.041 [p=0.839]	0.038 [p=0.845]
Political stability	2.370 [p=0.123]	2.334 [p=0.134]

Source: Computed by authors from WDI 2018 and the WGI 2018.

Table 2: Cross-section Instrumental Variables estimation of natural resource on economic growth. Dependent variable GDP growth rates

Variables	Estimates for share of natural resource rents to GDP						Estimates for share of ores and metal of total export					
	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>	<i>Model 4</i>	<i>Model 5</i>	<i>Model 6</i>	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>	<i>Model 4</i>	<i>Model 5</i>	<i>Model 6</i>
	<i>RL</i>	<i>CC</i>	<i>PS</i>	<i>GE</i>	<i>RQ</i>	<i>VA</i>	<i>RL</i>	<i>CC</i>	<i>PS</i>	<i>GE</i>	<i>RQ</i>	<i>VA</i>
	<i>Col.1</i>	<i>Col.2</i>	<i>Col.3</i>	<i>Col.4</i>	<i>Col.5</i>	<i>Col.6</i>	<i>Col.7</i>	<i>Col.8</i>	<i>Col.9</i>	<i>Col.10</i>	<i>Col.11</i>	<i>Col.12</i>
Natural resources rent % GDP	0.406** (0.200)	0.409 (0.225)	0.257 (0.163)	0.380** (0.194)	0.868 (0.825)	0.280 (0.228)						
(Natural resources rent % GDP *IQ) ²	-0.006 (0.003)	-0.007 (0.004)	-0.004 (0.003)	-0.005 (0.003)	-0.012 (0.11)	-0.003 (0.003)						
Ores and metal export % of total export							0.015 (0.072)	-0.205 (0.125)	-0.003 (0.034)	-0.221 (0.150)	-0.184 (0.135)	0.048 (0.038)
(Ores and metal export % of total export *IQ) ²							0.001 (0.004)	0.013* (0.006)	0.002 (0.003)	0.009 (0.006)	0.018 (0.011)	-0.002 (0.003)
Inflation	0.032 (0.019)	0.031* (0.018)	0.006 (0.012)	0.006 (0.009)	0.018 (0.018)	0.015 (0.010)	0.013 (0.008)	0.012 (0.011)	0.014 (0.008)	0.012 (0.0125)	0.014 (0.10)	0.012 (0.007)
Population growth	1.001 (0.852)	1.246 (0.856)	0.999 (1.271)	1.559 (0.980)	-0.485 (2.367)	0.101 (1.1229)	1.565* (0.876)	6.065** (0.993)	1.624** (0.841)	2.129 (1.084)	2.116** (1.016)	1.347 (0.850)
Human capital	0.0497* (0.0285)	0.029 (0.243)	0.062** (0.30)	0.073** (0.030)	0.1113 (0.086)	0.034* (0.019)	0.0585** (0.031)	0.101** (0.072)	0.072** (0.033)	0.103** (0.0448)	0.089** (0.037)	0.046* (0.027)
Investment	0.117** (0.0958)	0.211*** (0.0596)	0.177** (0.077)	0.105 (10.105)	-0.058 (0.339)	0.285*** (0.434)	0.226*** (0.059)	0.226** (0.072)	0.232*** (0.053)	0.241*** (0.071)	0.238*** (0.067)	0.226*** (0.062)
Trade openness	0.055* (0.0318)	0.037 (0.256)	0.036** (0.021)	0.060* (0.034)	0.081 (0.077)	0.004 (0.016)	0.026** (0.013)	0.018 (0.016)	0.028*** (0.012)	0.015 (0.017)	0.0149 (0.016)	0.028** (0.013)
Initial level of GDP per capita	-1.936** (0.881)	-0.440 (1.182)	-3.099** (1.393)	-2.095*** (0.773)	-2.638 (1.799)	0.610 (1.099)	-1.628** (0.651)	-1.446 (0.9924)	-1.783** (0.586)	-1.598* (0.933)	-1.101 (0.897)	-1.755** (0.583)
Constant	3.426 (6.435)	-7.138 (10.457)	12.534 (10.271)	2.528 (5.615)	6.961 (10.752)	-1.566 (7.852)	2.715 (5.918)	-0.524 (7.265)	2.642 (5.233)	0.359 (7.127)	-2.590 (7.381)	4.391 (5.241)
R ²	0.266	0.358	-	0.443		0.475	0.641	-	0.431	-	-	-
Wald chi (2)	218	173	43.52	226.35	87.27	195	58.85	42.77	63.47	42.92	46.19	56.24

Source: Computed by authors from WDI 2018 and the WGI 2018. Note: (***), (**), (*) denote significance at 1%, 5% and 10%, respectively. Standard errors are reported in parentheses. Institutional quality (IQ) indicators are RL (Rule of law); RQ (Regulatory quality); GE (Governance effectiveness); CC (Control of corruption); PS (Political stability) and VA (Voice and accountability).

Table 3: System dynamic panel-data estimates of natural resource rents on economic growth. Dependent variable GDP growth rates

Variables	Estimates for share of natural resource rents to GDP						Estimates for share of ores and metal of total export					
	<i>Model 1</i> <i>RL</i> <i>Col.1</i>	<i>Model 2</i> <i>CC</i> <i>Col.2</i>	<i>Model 3</i> <i>PS</i> <i>Col.3</i>	<i>Model 4</i> <i>GE</i> <i>Col.4</i>	<i>Model 5</i> <i>RQ</i> <i>Col.5</i>	<i>Model 6</i> <i>VA</i> <i>Col.6</i>	<i>Model 1</i> <i>RL</i> <i>Col.7</i>	<i>Model 2</i> <i>CC</i> <i>Col.8</i>	<i>Model 3</i> <i>PS</i> <i>Col.9</i>	<i>Model 4</i> <i>GE</i> <i>Col.10</i>	<i>Model 5</i> <i>RQ</i> <i>Col.11</i>	<i>Model 6</i> <i>VA</i> <i>Col.12</i>
One lagged GDP	0.035 (0.051)	0.015 (0.048)	0.099** (0.050)	0.106** (0.049)	0.0074 (0.048)	0.087* (0.049)	-0.203*** (0.056)	-0.170** (0.056)	-0.237*** (0.054)	-241*** (0.056)	-0.135** (0.054)	-0.184*** (0.056)
Natural resources rent % GDP	-0.372*** (0.081)	-0.353*** (0.071)	-0.057 (0.060)	-0.003 (0.094)	-0.104* (0.062)	-0.245*** (0.073)						
(Natural resources rent % GDP *IQ) ²	0.003*** (0.0008)	0.004*** (0.009)	0.000 (0.001)	-0.001 (0.001)	0.001 (0.007)	0.002** (0.001)						
Ores and metal export % of total export							0.018 (0.024)	0.0138 (0.026)	0.043** (0.021)	0.058** (0.025)	-0.021 (0.023)	-0.020 (0.023)
(Ores and metal export % of total export *IQ) ²							-0.000 (0.000)	0.000 (0.001)	-0.001*** (0.000)	-0.001** (0.000)	0.001 (0.003)	0.001** (0.000)
Inflation	-0.149** (0.050)	-0.125** (0.048)	-0.107** (0.049)	-0.151** (0.051)	-0.145** (0.051)	-0.115** (0.050)	0.086* (0.045)	0.044 (0.047)	0.012 (0.046)	0.032 (0.047)	0.089* (0.047)	0.070 (0.046)
Population growth	2.470** (1.064)	0.499 (1.082)	3.572*** (1.094)	3.568*** (1.067)	2.253** (1.075)	2.523** (1.112)	0.087 (0.761)	-0.313 (0.734)	-0.813 (0.667)	0.152 (0.739)	0.670 (0.734)	0.573 (0.801)
Human capital	-0.0628 (0.040)	-0.105** (0.039)	-0.067 (0.0432)	-0.043 (0.044)	-0.055 (0.042)	-0.075* (0.043)	-0.083** (0.030)	-0.063** (0.033)	-0.101*** (0.029)	-0.086** (0.0319)	-0.065** (0.032)	-0.066** (0.031)
Investment	-0.033 (0.050)	-0.026 (0.050)	-0.044 (0.0485)	-0.084* (0.049)	-0.057 (0.049)	-0.048 (0.049)	0.111** (0.048)	0.099** (0.049)	0.164*** (0.048)	0.100** (0.046)	0.107** (0.051)	0.169*** (0.049)
Trade openness	0.014 (0.028)	0.005 (0.027)	-0.008 (0.028)	0.019 (0.026)	-0.010 (0.029)	0.001 (0.029)	-0.061** (0.022)	-0.419* (0.022)	-0.049** (0.025)	-0.047** (0.020)	-0.046** (0.026)	-0.088*** (0.023)
Initial level of GDP per capita	1.285 (0.978)	0.704 (0.964)	3.089** (1.163)	1.575 (1.004)	1.219 (0.904)	1.802* (1.067)	3.117*** (0.938)	1.545* (0.896)	2.458** (0.862)	3.167*** (0.882)	1.396 (0.915)	2.493** (0.873)
Constant	-3.310 (7.60)	7.580 (7.759)	-19.66** (8.421)	-11.45 (7.184)	-2.956 (7.13)	-6.716 (8.059)	-11.256 (5.829)	-1.326 (0.818)	-5.172 (5.201)	-12.003 (5.437)	-2.672 (5.761)	-8.147 (5.529)
Wald chi (2)	52.13	58.83	35.56	39.80	30.43	44.37	31.21	19.51	43.72	39.29	24.58	43.55

Source: Computed by authors from WDI 2018 and the WGI 2018. Note: (***), (**), (*) denote significance at 1%, 5% and 10%, respectively. Standard errors are reported in parentheses. Institutional quality (IQ) indicators are RL (Rule of law); RQ (Regulatory quality); GE (Governance effectiveness); CC (Control of corruption); PS (Political stability) and VA (Voice and accountability).

Table 4: Panel Threshold estimations for natural resource rents on economic growth. Dependent variable GDP growth rates

Variables	Estimates for share of natural resource rents to GDP					Estimates for share of ores and metal of total export				
	<i>Model 1</i> <i>RL</i> <i>Col.1</i>	<i>Model 2</i> <i>CC</i> <i>Col.2</i>	<i>Model 3</i> <i>GE</i> <i>Col.3</i>	<i>Model 4</i> <i>RQ</i> <i>Col.4</i>	<i>Model 5</i> <i>VA</i> <i>Col.5</i>	<i>Model 1</i> <i>RL</i> <i>Col.6</i>	<i>Model 2</i> <i>CC</i> <i>Col.7</i>	<i>Model 3</i> <i>PS</i> <i>Col.8</i>	<i>Model 4</i> <i>RQ</i> <i>Col.9</i>	<i>Model 5</i> <i>VA</i> <i>Col.10</i>
Natural resources rent (β_0)	-0.040 (0.039)	0.022 (0.036)	-0.124 (0.142)	0.066 (0.041)	0.208 (0.135)					
Natural resources rent*(β_1)	0.235*** (0.052)	0.254*** (0.051)	0.258 (0.169)	0.305*** (0.049)	-0.086 (0.132)					
Ores and metal export (β_0)						-0.471** (0.198)	0.173** (0.081)	0.103 (0.072)	-0.076** (0.024)	0.675*** (0.166)
Ores and metal export*(β_1)						0.467** (0.199)	-0.188** (0.084)	-0.112 (0.0738)	0.070*** (0.0171)	-0.60*** (0.161)
Population growth	-0.014 (0.556)	0.075 (0.651)	-0.101 (0.563)	-0.925* (0.568)	0.783 (0.735)	0.250 (0.657)	0.165 (0.644)	0.606 (0.662)	-0.032 (0.650)	0.399 (1.60)
Trade openness	0.001 (0.015)	0.008 (0.015)	0.001 (0.015)	0.007 (0.014)	0.025 (0.241)	-0.017 (0.018)	-0.012 (0.017)	-0.012 (0.0179)	-0.014 (0.017)	0.068 (0.042)
Human capital	-0.037** (0.018)	-0.048** (0.023)	-0.022 (0.023)	-0.055** (0.022)	-0.015 (0.027)	-0.044** (0.021)	-0.037 (0.020)	-0.046** (0.020)	-0.047** (0.020)	-0.037 (0.037)
Initial level of GDP per capita	0.675 (0.562)	0.843 (0.561)	-0.165 (0.546)	0.455 (0.581)	0.454 (0.670)	1.189** (0.519)	1.075** (0.519)	1.630** (0.551)	1.121** (0.521)	1.639 (1.616)
Inflation (β_0)	-0.125* (0.070)	0.078** (0.032)	1.726** (0.547)	0.091 (0.069)	-0.635 (0.462)	-0.323** (0.111)	-0.303** (0.101)	-0.288*** (0.09)	-0.698** (0.226)	-0.097 (0.146)
Investment(β_0)	0.128* (0.052)	0.049 (0.034)	-1.068** (0.335)	0.059 (0.041)	0.158 (0.236)	0.186** (0.087)	0.155** (0.068)	0.166** (0.066)	0.390** (0.150)	-0.196 (0.138)
Inflation* (β_1)	0.085 (0.056)	-0.114*** (-0.033)	-1.479** (0.548)	0.024 (0.07)	0.656 (0.463)	0.332** (0.116)	0.310** (0.108)	0.314*** (0.098)	0.693** (0.230)	-0.20 (0.138)
Investment*(β_1)	-0.137** (0.052)	-0.0385 (0.0366)	1.095** (0.357)	-0.133*** (0.035)	-0.165 (0.152)	-0.126 (0.082)	-0.097 (0.065)	-0.112* (0.059)	-0.323** (0.146)	0.057 (0.054)
R ²	0.253	0.252	0.225	0.356	0.204	0.333	0.338	0.342	0.333	0.508
C ₁ [(\hat{c})]	-1.361	-1.244	-1.283	-1.232	-1.180	-1.141	-1.004	-1.405	-1.226	-1.413
C ₂ [(\hat{c})]	-1.034	-0.154	-1.332	-0.567						0.054
Gama [($\hat{\gamma}$)]	800.9	464.6	681.5	8596	135.24	2522.9	20259	27	61	18928

Source: Computed by authors from WDI 2018 and the WGI 2018. Note: (***), (**) (*) denote significance at 1%, 5% and 10%, respectively. Standard errors are reported in parentheses. Institutional quality (IQ) indicators are RL (Rule of law); RQ (Regulatory quality); GE (Governance effectiveness); CC (Control of corruption) and VA (Voice and accountability).

Table 1A: Descriptive statistics (1996-2016)

<i>Variables</i>	<i>Observations</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>Minimum</i>	<i>Maximum</i>
Gross Domestic Product Growth	914	4.937	9.585	-62.073	149.972
Rule of law	792	-0.725	0.564	-2.130	0.730
Regulatory quality	792	-0.682	0.563	-2.297	0.804
Control of corruption	792	-0.681	0.554	-1.805	1.216
Governance effectiveness	792	-0.763	0.559	-1.890	1.020
Political stability	792	-0.555	0.855	-2.5	1.020
Voice and accountability	792	-0.641	0.661	-2.00	0.862
Ores and metal exports	672	12.937	19.606	000	86.419
Natural Resources rent	908	14.427	13.722	0.184	74.40
Inflation	853	15.735	145.796	-9.797	4145.108
Trade openness	886	74.558	45.511	17.858	531.737
Investment	860	21.078	15.840	-2.424	219.069
Human capital	520	40.887	23.74	5.210	107.588
Population Growth	924	2.559	0.892	-0.036	7.917
Initial level of GDP per capita	894	6.845	0.966	4.751	9.705

Source: Computed by authors from WDI 2018 and the WGI 2018.

Table 2A: Im et al (2003) Unit Root Test Statistics

<i>Variables</i>	<i>Statistics</i>	<i>Significance level</i>
Gross Domestic Product Growth	-17.468	0.000
Rule of law	-7.581	0.000
Regulatory quality	-5.861	0.000
Control of corruption	-7.959	0.000
Governance effectiveness	-5.66	0.000
Political stability	-11.212	0.003
Voice and accountability	-2.686	0.000
Ores and metal exports	-5.616	0.000
Natural Resources rent	-3.14	0.000
Inflation	-10.488	0.000
Trade openness	-21.30	0.000
Investment	1.39	0.080
Human capital	-	-
Population Growth	-19.070	0.000
Initial level of GDP per capita	-35.992	0.000

Source: Computed by authors from WDI 2018 and the WGI 2018

Table 3A: Sargan test of Over-identifying restrictions

<i>Variables</i>	<i>Sargan(score) chi2(1)</i>	<i>Basman (score) chi2(1)</i>
Rule of law	4.821 [p=0.089]	4.922 [p=0.085]
Regulatory quality	5.069 [p=0.079]	5.208 [p=0.074]
Control of corruption	2.970 [p=0.225]	2.904 [p=0.234]
Governance effectiveness	3.583 [p=0.166]	3.540 [p=0.169]
Voice and accountability	5.651 [p=0.059]	5.895 [p=0.059]
Political stability	1.790 [p=0.408]	1.690 [p=0.428]

Source: Computed by authors from WDI 2018 and the WGI 2018

Table 4A List of Countries used in constructing the panel data

Algeria	Chad	Gabon	Guinea-Bissau	Sao Tome and Principe
Angola	Comoros	Gambia	Kenya	Senegal
Benin	Congo, Dem. Rep.	Ghana	Lesotho	Sierra Leone
Botswana	Congo, Rep.	Tunisia	Liberia	Zimbabwe
Burkina Faso	Ivory Coast	Uganda	Libya	
Burundi	Swaziland	Zambia	Madagascar	
Cameroon	Tanzania	Namibia	Malawi	
Central African Republic	Togo	Niger	Mali	
South Africa	Egypt, Arab Rep.	Nigeria	Mauritania	
Sudan	Equatorial Guinea	Rwanda	Mauritius	

Source: Computed by authors.