



The effect of natural resources on sustainable development: The institutional threshold

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Abstract

This study investigates the contentious and non-linear relationship between institutional quality and sustainable development, with a specific focus on how robust institutions moderate the often-paradoxical impact of natural resource wealth. The analysis employs a dynamic panel threshold regression model, estimated using the Generalized Method of Moments (GMM) technique, on a dataset of 70 countries spanning the period 1980 to 2020. This methodological approach is chosen to robustly account for endogeneity and to precisely identify critical breakpoints in the institutional-development nexus. The empirical findings unequivocally confirm a statistically significant threshold effect. The results demonstrate that high-quality institutions are not merely beneficial but a critical precondition for translating natural resource endowments into positive sustainable development outcomes. A precise threshold of 8.43 on the underlying institutional quality index is identified. Below this critical level, the resource curse phenomenon prevails, where natural resources have a muted or even negative effect on development, likely due to rent-seeking and governance failures. However, once a country surpasses this institutional benchmark, the relationship reverses; natural resources then exert a strong, significant, and positive impact on sustainable development. The central policy implication is unambiguous: the developmental benefits of natural resources are not automatic. They are entirely contingent upon a country first achieving a minimum level of institutional robustness. Consequently, for resource-rich nations struggling with development, the paramount priority must shift from mere resource extraction to deep-seated institutional reforms. Strengthening governance, curbing corruption, and enforcing the rule of law are not secondary objectives but fundamental prerequisites for harnessing resource wealth for lasting, sustainable development.

Keywords: GMM, Institutions, Economics, Natural resources, Sustainable development, Relationship between institutional quality and sustainable development.

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Contribution of this paper to the literature

This study introduces a precise institutional quality threshold (8.43) using dynamic panel threshold regression (GMM), empirically demonstrating that natural resources boost sustainable development only beyond this level, a quantified insight previous studies had not established.

1. Introduction

Around the 1990s, the subject of economic development took on an institutional orientation; thus, the free market and the accumulation of capital were no longer the only guarantors of sustainable development. Administration, social organization, corruption, and civil liberties are also essential factors in the prospective economic development of the country. The new institutional economy takes on a fairly important dimension, particularly for countries characterized by an abundance of natural resources but suffering from a slowdown in development. These resources can constitute an obstacle to development; an answer is hidden in the black box of institutions.

Institutions have proven to be vital for economic development; North (2005) notes how the political, legal, economic, and social institutions in a particular country impact its rate of economic growth. Rodrik (1999) and Pritchett (2000) also note how the quality of institutions predicts long-term economic growth of countries. For natural resources and economic development, institutional theorists argue that weak governments and corruption are important factors in what is known as the natural resource curse phenomenon (Neumayer & Dietz, 2005).

Achieving sustainable development requires prudent investment of resource revenues, which is necessary in most Sub-Saharan African countries. In addition to institutional weaknesses, income implications, and corruption in resource revenues severely impede development.

Not enough authors have advocated the idea that efficient institutions are considered a prerequisite for the start of market economies. Examples include Clague, Keefer, Knack, and Olson (1995) and Kaufmann, Kraay, and Mastruzzi (2004) good institutions can contribute to improved economic performance and successful reform, and others such as Rodrik, Subramanian, and Trebbi (2002) and Acemoglu, Johnson, and Robinson (2001) have gone further and have recognized that effective institutions are a vital necessity not only for economic performance but also for sustainable development.

Corruption has been established as a major impediment to economic growth and development in resource-rich countries. Rent-seeking is one means of corruption in resource-rich countries (North, 2005). Rent seeking is defined as “efforts, legal and illegal, to gain access to or control over opportunities to earn profits” (Karl, 2007).

Natural resources have a positive effect on sustainable development when institutions are sound, whereas this correlation disappears if institutions are altered.

Sachs and Warner (1997), based on a sample of 23 countries, the study shows that the relationship between natural resource abundance and economic growth was negative over the period 1970–1990. These authors explain this situation by the fact that the exploitation of natural resources produces large rents, whose redistribution contributes either to the formation of reform-hostile pressure groups or to the amplification of corruption, and thus to the creation of bad institutions. These behaviors are often called rent-seeking, which hampers economic development.

The paper is organized as follows. Section 2 discusses some of the primary studies on the resource-institutional quality nexus. Section 3 describes the methodology-regression framework. Section 4 describes the data set collected for this paper. Section 5 presents the empirical analysis, while Section 6 conveys the empirical results.

2. Related Literature

Institutional quality: primary reason for the example and counter-example of the resource curse: Central Africa: a region endowed with natural resources but poor.

The International Monetary Fund (IMF) (2004) defines a country “rich in hydrocarbon and/or mineral resources” if it meets the following criteria:

- An average percentage of revenue from hydrocarbons and/or minerals representing at least 25% of total budget revenue for the previous three years or
- An average percentage of export earnings from hydrocarbons and/or minerals, representing at least 25% of total export earnings for the previous three years.

History has shown that countries rich in resources register low levels of social development, such as in the countries of Central Africa. This region, rich in resources such as cocoa, coffee, and cotton, has coasts abundant in fishing resources. Its forest area constitutes the second lung of humanity after that of the Amazon. Besides these resources, oil is mainly cited, which represents on average 80% of the exports of the countries of the Economic and Monetary Community of Central African States. However, despite this wealth, the state of development is worrying, as shown by the surprisingly high levels of poverty.

Collier and Hoeffler (2000) support the idea that countries with a low level of economic development have a favorable climate for the abundance of natural resources to intensify the risk of armed conflict is developed by the authors through the presence of means of financing for various communities. These financings are certainly resulting from the exploitation of natural resources; thus, the most important part of the natural richness returns to the victorious. Indeed, armed antagonisms are expensive; therefore, only the groups that take up arms are devoid of the general interest. They will rather be interested in seeking private gain.

Example and counter-example of the “resource curse.” Nigeria: A case in point of the “resource curse”.

Nigeria is considered the largest oil producer in Africa and among the ten largest producers of crude oil and gas in the world. The Nigerian economy is highly dependent on the oil and gas sector, which accounts for almost 95% of export earnings and 76% of government revenue. Despite their natural potential to build a prosperous economy, most Nigerians live below the poverty line.

The government has invested effort to utilize capacities in the real sector and improve the contributions of the non-oil sector to the formation of gross domestic product, but this has not yielded significant results, despite the country being engaged in oil and gas production for over 50 years. The oil reserve in 2015 is estimated at around 35 billion barrels, while its proven recoverable natural gas reserve is estimated at 187 trillion cubic feet. All this has not resulted in sustainable economic development.

Since the discovery of oil in Nigeria, the country has experienced the paradox of the relationship between natural resources and economic development, known as the "resource curse." Nigeria remains an underdeveloped country with weak institutions, and oil revenues are dispersed without regulation. These conditions have contributed to significant economic distress since the 1970s.

Sala-i-Martin and Subramanian (2003) prove that in Nigeria, the natural wealth resulting in particular from oil has caused damage to institutions which are already mediocre, in 1970 this country recorded a level of GDP per capita of 1113 USD, this GDP deteriorated successively to arrive in 2000 at 1084 USD, Gelb, Gray, and Associates (1988) conclude that the standard of living in Nigeria is quite better before the oil shocks, from 1965 to 1990 Nigeria raised more than 355 billion wealth that has not contributed to improving the standard of living of Nigerians, poor quality institutions is the most important reason for this.

2.1. Institutional Failure Source of Misfortune for Nigerians

The quality of governance has certainly been the misfortune of Nigerians; the government has failed to put in place effective public policies that can protect the agricultural sector, which has been destroyed by the effects of Dutch disease. Thus, agricultural policy in Nigeria was inevitably criticized by Pinto (1987), from where there was more initiative in favor of agriculture to overcome the appreciation of the exchange rate. In the same way, the author proved the diversion of funds intended for the maintenance of agricultural infrastructure and equipment.

Shaxson (2005) points out that the total area of cultivated land fell from 18 million hectares in 1975 to 11.05 million hectares during the three years that followed. On the other hand, agricultural production decreased by 50% in volume. With these unfavorable conditions, Nigeria went from being a net exporter to a net importer of agricultural commodities to satisfy domestic consumption.

The level of corruption and poor governance prevalent in the Nigerian system still remains high, but there are many efforts being made by the Economic and Financial Crimes Commission (EFCC), independent of the Corruption and Related Offenses Commission (ICPC), Transparency International, the World Bank, and many other organizations to reduce it. Nigeria was ranked at the bottom of the list among other oil-rich countries using Transparency International's Corruption Perception Index and other World Bank research indicators in 2012. The poverty rate rose from 36% in 1970 to around 70% in 2000, which ranked Nigeria 28th; currently, the country is considered the poorest in the world despite its great resource wealth (United Nations (UN), 2010).

Smith (2004) showed that mineral wealth is strongly correlated with high levels of corruption and poor governance. Nigeria is among the countries in the world with the largest gap between rich and poor, with a Gini index of around 50.6, compared to countries like India (37.8), Jamaica (37.9), and Rwanda (28.9).

Nigeria is also facing the challenge of Dutch disease following the discovery of large deposits of mineral resources such as oil and gas, with a general increase in their prices.

Many literatures, such as Humphreys (2007), and others have confirmed Dutch disease as one of the main problems of the resource curse. The fall in the price of oil leads to the appreciation of currencies, which makes locally manufactured goods more expensive and imports cheaper, resulting in the crowding out of other economic sectors. The economic fabric is based on crude oil in Nigeria, which has reduced economic diversity. The decline of technology, manufacturing, and agriculture retards economic growth by reducing the demand for and supply of labor in these sectors.

The national oil-derived income in Nigeria is highly volatile, as it depends on the world price of oil. This is also known as "boom and bust" cycles. Fluctuations in the market price or stock of resources affect government revenue, which indirectly impacts the entire economy, from the national budget, which is usually planned based on oil revenue.

Frequent adjustments up or down of tax expenditures are costly, as they tend to discourage private investment and, at the same time, hamper the provision of public goods (Smith, 2004). Also, the government tends to borrow a significant amount of debt during crises to sustain its budget deficit. This was the case in the early 1980s when Nigeria's debt increased due to substantial indebtedness, which was largely to compensate for the collapse in oil prices, and the borrowing was not linked to future growth.

Weak and irresponsible institutions, as well as insufficient investment in education, are important factors in the deterioration of the economic fabric in resource-rich countries. Weinthal and Luong (2006) asserted that the main political consequence is to consider external rents as sources of institutional weakness. Through this external source, it is easy for the government to finance state expenditures and it does not provide incentives for the government to build strong institutions. This undermines a viable tax system because there was no revenue from domestic sources. This therefore creates a weak link between citizens and the government and offers leaders the opportunity to incur inexplicable discretionary expenditure.

A good example of such expenditure is the Ajaokuta steelworks that Nigeria built in the 1970s to appease the Yoruba region, which guzzled over \$3.0 billion and yet was unable to produce a ton of commercial steel. Furthermore, various studies have shown that investment in education suffers in resource-rich countries.

Gylfason (2001) confirmed that when countries begin to rely on natural resource wealth, they tend to neglect the need for a diverse and skilled workforce that can support other productive sectors during crises or when resource stocks are fully depleted. As a result, the share of GDP spent on education is decreasing, which may have long-term negative effects on the economy when governments decide to diversify in the future.

2.2. Botswana: "A Success Story" of the Optimal Use of Natural Resources

Botswana has proven to be the counterexample of the fatalism of the curse of natural resources; this country constitutes the hope of sub-Saharan Africa. Acemoglu et al. (2001) specify that Botswana has recorded the strongest growth in the world and benefited from a GDP per capita of 11,510 USD (World Bank, 2005). This economic success was dependent on a favorable institutional and political economic context. Thus, the experience of Botswana proves that the paradox of the curse of natural resources is no longer a law. This country has succeeded in advancing its economic development through the proper management of its mining revenues. Indeed, this effective resource management is the result of the institutional context as well as the economic policies that have been put in place in Botswana to use natural resources as a catalyst for economic development and social progress.

Similarly, in 2011, the economy of Botswana recorded a growth rate of 8%. This prosperity continued following the global economic crisis of 2009, characterized by a greater global demand for diamonds, the main export of the country. The level of development stabilized at 5.8% in 2012; this decrease is particularly due to the mining sector,

which fell by 8%, unlike the non-mining sectors, which experienced an increase of 9.7%. In 2014, the level of economic growth reached 6%.

In Botswana, the government adopted the institutions inherited from the British Crown to generate a democratic parliamentary system, with property rights preserved for all citizens. [Acemoglu et al. \(2001\)](#) also add that political elites are equally subject to the law, which is upheld by an independent judiciary.

[Leith \(2000\)](#) adds that the development of the country continued with a transformation of its economy. Aside from the well-developed mining sector, the public sector experienced significant growth. This evolution was certainly facilitated by good budgetary discipline and effective governance adopted by the country.

Botswana has succeeded in turning the curse of natural resources into a blessing; it is mainly because it has opted for three necessary measures: economic diversification to avoid dependence on the mining sector, decoupling revenue and expenditure, and investing excess wealth in the well-being of future generations. With these policies, Botswana has been able to overcome the pitfalls that other resource-rich countries have not been able to avoid.

Botswana has adopted a policy of diversification primarily for two main reasons. First, the government aimed to diversify the economic base to avoid dependence on a single sector, which is the mining sector in Botswana. The government recognized that inherited wealth is temporary and would not last long, as the diamond reserves in the ground will eventually be depleted. Second, it became necessary for Botswana to develop other non-mining sectors, especially those related to mining in terms of job creation, because the mining sector directly employs only 2% of the workforce.

To support economic diversification, the government has taken a number of measures, such as the creation of the Business and Economic Advisory Council (BEAC). This entity aims to identify obstacles to economic diversification, draw up a strategic framework, and develop an action plan to overcome them, with the goal of creating projects that enable the government to progress. The BEAC published two reports, successively in 2006 and 2008: "Botswana Excellence: A Strategy for Economic Diversification and Sustainable Growth" and "Action Plan," which were adopted by the government. Since the adoption of the action plan, Botswana's economic fabric has diversified significantly. Consequently, incentives have been established to build the capacity of Botswana businesses, create an environment conducive to development, and develop tools to aid diversification, including the encouragement of private initiative, and support for agriculture and tourism.

Other than economic diversification, the Botswana government has managed to institute a pro-development fiscal policy. This was achieved through the decoupling of revenue and expenditure, while avoiding pro-cyclical spending. The government has avoided intensive investments in unprofitable projects, the accumulation of debts, and lack of transparency. Indeed, this decoupling of expenditure and revenue is a vital necessity for economic recovery. Moreover, the revenue from the mining sector is considered a primary source of public revenue. Thus, the government adopted a policy of pressure on expenditure and effectively used its revenue surpluses. All these factors have enabled the country to escape the resource curse.

In order to support the evolution of expenditure during periods characterized by high expansion and increased expenditure during crises, Botswana has strictly followed its national development plan, which operates on a six-year planning cycle, with corrections and modifications according to the evolution of the economic situation. This budgetary approach has indeed played a crucial role in the effective management of the country's windfall.

[Leith \(2000\)](#) proves that this planning allowed an efficient decoupling of expenses while describing the possible and feasible expenses, as defined by the Ministry of Finance and Development Planning, as well as according to rules. In case the budget of investment is available during the period that covers the plan, its ambitions are insignificant, in case of uncertainty of being able to cover the costs within the deadlines.

Alongside the importance of the development plan, the policy of investment of revenue from mining wealth is put in the Pula Fund created in 1993. The objective of this fund is to ensure a certain flexibility in the management of international reserves and to predict with some accuracy the dividends that will be paid by the Bank of Botswana to the government. Similarly, Botswana has managed to lengthen these assets in order to guarantee intergenerational equity through its sovereign wealth fund, which in itself represents the guarantor of commodity price volatility.

2.3. Good Governance: A Prerequisite for Good Wealth Management

It is of crucial importance that the nature of the institutions put in place affects the management of natural resource wealth; thus, with the Pula Fund and sustainable budgetary measures being a necessity, they are not sufficient to guarantee good management of the revenues from the mining and, mainly, diamond sector.

[Acemoglu et al. \(2001\)](#) shows that the success of Botswana lies mainly in the political regime characterized by stability and, above all, the existence of a culture of good governance. The latter has facilitated decision-making, particularly over the long term. In the long run, similarly, the collaboration of civil society, which is embodied in economic life to make its voice heard, has given rise to a compromise in the formulation of economic policies. We often speak of a social contract between the different compartments of society; therefore, the government, with these positive signals, finds itself obliged to respect the institutions that are in charge of investment and savings, to defend the budgetary rules, and also to strengthen economic diversification.

[Acemoglu et al. \(2001\)](#) demonstrate that institutional quality explains the divergence in terms of growth between the former colonies in Africa and beyond. It is the case of Botswana, which better explains the role played by institutional quality through the protection of private property and institutional limits on executive power in economic success.

[Limmi \(2006\)](#) concluded that Botswana's success has been achieved through four dimensions of governance that are necessary for effective resource management, namely government efficiency, market-friendly regulation, anti-corruption, and participation and transparency. In what follows, we will analyze how these aspects can improve the management of resources.

Let's start with the effectiveness of government, which is defined as the quality of public services and the ability of its officials, because resource management policies depend on the institutions and people who create them.

In Botswana, the budgetary measures adopted have made it possible to reduce the use of mining revenues as much as possible and to devote them to investments for the benefit of future generations. In terms of market regulation, the country, in collaboration with the private sector, has guaranteed the efficient exploitation of mineral wealth as well as the development of other sectors. Indeed, contracts relating to natural resources are generally concluded over periods of ten years, and even twenty-five years for diamond mines. The general climate of economic

policy is conducive to business, hence the elimination of exchange controls and few non-tariff barriers to imports. Taxation is light for this purpose; taxation is around 25% on personal income and 15% for financial services and manufacturing.

With regard to anti-corruption policies, the government has moved towards a transparent and equal distribution of resources. Indeed, the African Development Bank in 2009 clarified that corruption was no longer a problem in Botswana because the country benefited from budgetary procedures and controls requiring accounting procedures, a powerful computer system that refuses any unauthorized overspending in the budget. On the other hand, Botswana has encouraged the fight against corruption by setting up an autonomous authority in 1994, the Directorate of Corruption and Economic Crime, with the aim of informing the President directly of all cases of corruption. Thus, the constitution guarantees the independence of the Attorney General vis-à-vis the government and politicians.

Finally, the notion of transparency and participation means the participation of citizens, the protection of freedoms and civil rights, and the transparency of the political process. These various measures make it possible to exercise control over the leaders who might commit abuses. In the classification of countries, in 2010, Transparency International placed Botswana in the top quarter and still at the top of the list of African countries. Indeed, the government has put in place a number of structures, such as the public accounts committee of parliament. Its mission is to control expenditures and summon those responsible in the event of misappropriation of funds.

3. Methodology: GMM of Arellano and Bond (1991)

Econometrics in panel data has certain privileges; it makes it possible to analyze the dynamics of adjustment. Baltagi (2005) shows that econometrics in panel data is mainly used in models which tend to explain the dynamics of demand for natural gas, the dynamics of the evolution of wages, or the dynamics of economic convergence processes. Thus, the dynamic relations are characterized by the existence of the endogenous variable shifted by one period in the list of explanatory variables.

This model is characterized by the presence of two sources of autocorrelation: first, the heterogeneity between the individual effects; second, the shifted endogenous variable. Indeed, heterogeneity poses problems of correlation between the explanatory variables and the error term, which invalidates the classical assumptions of the ordinary least squares (OLS) method. Therefore, according to Bourbonnais (2004), the OLS provides biased and inefficient results.

The fixed effect estimator (within) aims to correct the problem of self-correlation of errors but does not eliminate the issue of correlation between the shifted endogenous variable and the error. Consequently, the within estimator will also be biased. Therefore, these two econometric methods (OLS and within) appear unsuitable for the robust estimation of our model.

The chosen econometric method is based on the estimator of the generalized method of moments: GMM of Arellano and Bond (1991), which makes it possible to solve the problems of autocorrelation, it is based on the conditions of orthogonality between the variable endogenous lagged several periods and live perturbations for the construction of an instrumental variable matrix. The GMM method of Arellano and Bond (1991) is divided into two steps; in the first, generalized least squares (GLS) estimation is applied to the new form of the model. In the second step, Arellano and Bond (1991) use the differentials of the residuals estimated in the first step, the result provides the GMM estimator of Arellano and Bond (1991) has two steps (Two-step).

Thus, the model is estimated in first differences to eliminate effects specific to the countries. The lags in the level of the endogenous variables are then used as instruments. These instruments ensure the absence of autocorrelation of order 2, d , where an autocorrelation test of the residuals, accompanied by a Sargan test of over-identification, is recommended to verify the validity of the instruments.

The determination of the GMM estimator depends on the validity of the assumption that the error terms are not autocorrelated and on the validity of the instrumental variables used. To ensure the absence of autocorrelation of the error terms and the validity of the instruments used, Blundell and Bond (1998) propose two essential tests, namely: the Sargan test, which makes it possible to analyze the identification of the model and the validity of the instruments used for estimation, and the usual test for the absence of autocorrelation of the error terms. We estimate this system of equations with the GMM method applied to panel data.

4. Data

The study includes 70 countries classified into 46 developing countries and 24 developed countries, and data that characterize them, namely the abundance of natural resources, indicators of well-being, the quality of institutions, and conditional variables. The choice of data is explained by their availability as well as their relevance.

Thus, in what follows, we proceed to examine the stationarity of the basic variables for our model, namely natural resources and institutional quality. Indeed, we base ourselves on the illustration of Baltagi (2005), who recommends that the unit root test starts from two main hypotheses. The first hypothesis supposes that the individuals of the panel have a common unit root, which is justified by the tests of Levin, Lin, and Chu, as well as Breitung. The second hypothesis, which supposes that the individuals are heterogeneous or have different unit roots, is tested by the tests of Im, Pearson, ADF Fisher, and PP-Fisher.

Similarly, recent literature proves that panel stationarity tests are more powerful than those based on individual time series, among the recently developed tests is the LLC unit root test of Levin, Lin, and Chu (2002) (IPS) of Im, Pesaran, and Shin (2003) and Okey (2009) shows that these test categories are more robust than that of the traditional ADF test which suffers from a problem of low rejection power of the null hypothesis of stationarity of the series and mainly for the series of short period.

Table 1 presents results from six different unit root tests to determine if the "institutional quality" variable is stationary (stable over time) or non-stationary (has a unit root). The variable "institutional quality" is stationary. All tests robustly reject the null hypothesis of a unit root.

Table 1. Stationarity tests (unit root) of the institutional quality variable.

Method	Statistical	Prob.**	Number of individuals (country)	Number of observations
Null hypothesis: Unit Root (process having a unit root common to all individuals)				
Levin, Lin & Chu	-5.5249	0.000	28	720
Breitung t-stat	-3.9125	0.000	28	720
Null Hypothesis: Unit Root (individual unit root process)				
Im, Pesaran and Shin W-stat	-9.3176	0.000	28	720
ADF - Fisher Chi-square	248.6438	0.000	28	720
PP - Fisher Chi-square	308.2791	0.000	28	720
Null hypothesis: No Unit Root (process having a unit root common to all individuals)				
Hadri Z-stat	5.1386	0.000	28	720

Table 2 exhibits that the variable "Natural Resources" is stationary. The results strongly indicate the absence of a unit root, meaning its statistical properties (like mean and variance) do not change over time.

The natural resources variable is stationary. This is a crucial result because it confirms that the variable's behavior is stable over the period studied (1980-2020). Using a stationary variable in the GMM regression prevents the problem of spurious regression, where relationships appear significant purely due to trending data rather than a true economic link. This validates the subsequent findings about the relationship between natural resources and sustainable development.

Table 2. Stationarity tests (unit root) of the natural resources variable.

Method	Statistical		Prob.**	Number of individuals (country)	Number of observations
Null hypothesis: Unit Root (process having a unit root common to all individuals)					
Levin, Lin & Chu	-2.1245		0.000	28	720
Breitung t-stat	-1.3254		0.000	28	720
Null Hypothesis: Unit Root (individual unit root process)					
Im, Pesaran and Shin W-stat	-6.2458		0.000	28	720
ADF - Fisher Chi-square	145.6524		0.000	28	720
PP - Fisher Chi-square	218.2578		0.000	28	720
Null hypothesis: No Unit Root (process having a unit root common to all individuals)					
Hadri Z-stat	3.1057		0.000	28	720

Table 3 confirm that the variable "HDI" (Human Development Index) is stationary. The results consistently indicate that the variable does not have a unit root, meaning its statistical properties are stable over time.

The HDI variable is confirmed to be stationary. This is a critical finding for the study's validity. Since all three key variables (Institutional Quality, Natural Resources, and HDI) are stationary, the regression model remains valid for analysis (Equation 2: $HDI_{it} = \alpha_0 HDI_{it-1} + \dots + \alpha_7(NR \cdot IQ) + \epsilon_{it}$) is built on a solid foundation. Using stationary variables ensures that the estimated relationships and the calculated institutional threshold of 8.43 are statistically reliable and not spurious artifacts of non-stationary data.

Table 3. Stationarity tests (Unit root) of the HDI variable.

Method	Statistical	Prob.**	Number of individuals (country)	Number of observations
Null hypothesis: Unit Root (process having a unit root common to all individuals)				
Levin, Lin & Chu	-4.2705	0.000	28	720
Breitung t-stat	-2.8521	0.000	28	720
Null Hypothesis: Unit Root (individual unit root process)				
Im, Pesaran and Shin W-stat	-6.5348	0.000	28	720
ADF - Fisher Chi-square	215.6248	0.000	28	720
PP - Fisher Chi-square	286.5308	0.000	28	720
Null Hypothesis: No unit root (process having a unit root common to all individuals)				
Hadri Z-stat	3.1278	0.000	28	720

The results of the unit root tests for the variables of interest, namely natural resources, institutional quality, and sustainable development, confirm the stationarity of the variables; therefore, the econometric modeling would yield statistically valid results.

5. Empirical Analysis

We aim to define the model to empirically study the role of institutional quality in consolidating the contribution of natural resources to sustainable development.

5.1. Model Specification

The reference model looks like this:

$$HDI_{it} = \alpha_0 HDI_{it-1} + \alpha_1 SCOL_{it} + \alpha_2 GDPR_{it} + \alpha_3 latit_{it} + \alpha_4 OPNR_{it} + \alpha_5 IQ_{it} + \alpha_6 NR_{it} + \epsilon_{it} \quad (1)$$

With, HDI_{it} , is the sustainable development indicator, HDI_{it-1} is a variable of the past sustainable development indicator, this variable makes it possible to measure the effect of the past on the present variable, $SCOL_{it}$ is the measurement of the level of primary, secondary and higher education, $GDPR_{it}$, is the growth rate of per capita GDP, $latit_{it}$ is the absolute value of the distance from the equator, $OPNR_{it}$, is the indicator how measure the degree of integration of a country into the world economy. The most common way to calculate it is to average exports and imports divided by GDP. IQ_{it} , is the mean value of the following ICRG variables: Corruption, the rule of law and the quality of bureaucracy, assumed to be a variable of interest in this section since our objective is to determine a

minimum threshold for this variable so that it will have a stimulating effect on sustainable development at through natural resources, hence with this minimum threshold the natural resources become an engine of development instead of being a brake, NR_{it} is the measure of the total benefits drawn from the corresponding natural resources to the sum of profits derived from oil, natural gas, coal (Anthracite and hard coal), minerals and forests.

The objective is to study the links of interactions between natural resources and institutional quality and their consequences on the strengthening of sustainable development. It is important to add the term of interaction between institutional quality and natural resources $NR*IQ$, therefore, the new form of the model is:

$$HDI_{it} = \alpha_0 HDI_{it-1} + \alpha_1 SCOL_{it} + \alpha_2 GDP_{it} + \alpha_3 latit_{it} + \alpha_4 OPNR_{it} + \alpha_5 IQ_{it} + \alpha_6 NR_{it} + \alpha_7 (NR * IQ) + \varepsilon_{it} \quad (2)$$

Through this writing, three scenarios can arise:

First, in the case where α_6 and α_7 have both positive (negative) signs, we conclude that natural resources have a positive (negative) effect on sustainable development, and institutional quality favors this effect. Conversely, if α_6 is positive and α_7 is negative, we conclude that natural resources stimulate the level of sustainable development, and this impact is reduced with the improvement of institutional quality. In the last case, if α_6 is negative and α_7 is positive, it is important to record a threshold of institutional quality beyond which natural resources could have a positive effect on sustainable development.

To determine the threshold, we proceed to derive the HDI from NR, we obtain the following equation.

$$\frac{\partial HDI}{\partial NR} = \alpha_6 + \alpha_7 * IQ \quad (3)$$

At the optimum, we obtain $\frac{\partial HDI}{\partial NR} = 0$, which implies $IQ = \frac{-\alpha_6}{\alpha_7}$ (4)

Finally, the optimal institutional threshold is as follows:

$$IQ \text{ threshold} = \frac{-\alpha_6}{\alpha_7}$$

Table 4. Descriptive statistics.

	Mean	Stand dev.	Min.	Max.	Skewness	Kurtosis	Jarque-Bera	Prob.
HDI	0.6730	0.158	0.241	0.952	-0.461	5.237	8.631	0.000
scol	100.646	16.056	34.888	165.326	-0.275	4.601	5.048	0.000
GDP	4.247	8.0317	-62.076	149.973	-0.618	2.149	3.604	0.001
latit	3.641	24.415	0.0111	220.407	-0.348	3.069	3.317	0.001
OPNR	71.033	36.461	0.0209	220.407	-0.183	1.627	2.174	0.000
IQ	0.532	0.221	0.160	0.975	-0.627	1.031	4.375	0.000
NR	19.030	18.362	0.107	92.018	-0.319	2.018	5.162	0.000

The Table 4 represents the descriptive statistics. It is evident that the skewness coefficient is close to 0 for the majority of countries in both samples. Regarding the Jarque-Bera statistic, we can accept the normality of the residuals.

Table 5. Variable correlation matrix.

	HDI	Scol	GDP	Latit	OPNR	IQ	NR
HDI	1						
Scol	0.402	1					
GDP	-0.162	-0.161	1				
Latit	0.045	-0.012	0.025	1			
OPNR	0.160	0.135	0.008	0.418	1		
IQ	0.713	0.201	-0.091	0.055	0.030	1	
NR	-0.376	-0.032	0.248	-0.049	0.281	-0.312	1

We notice a strong correlation between institutional quality and the human development indicator, which is approximately 0.713, and the natural resources variable is relatively correlated with human development (See Table 5).

6. Empirical Results

By relying on the technique of GMM in the system on the different variables of our model, we arrive at the results of the estimation illustrated in the Table 6.

The first column clearly illustrates that the determinants of the HDI are positive and significant, with the exception of the variable NR, which is negative and not significant. According to the empirical literature, several studies have shown that natural resources, in the absence of other variables describing the internal environment of countries, have an equivocal impact on development.

In the second column, the interaction between NR and NR*IQ institutional quality is examined. The results show that NR has a negative and significant effect. Meanwhile, the coefficient of the interaction term is positive and significant, indicating that the impact of NR on sustainable development depends on the variable associated with institutional quality. This result implies that there is a minimum threshold of institutional quality beyond which NR promotes sustainable development.

To acquire a certain robustness to the results, we proceed to expand the list of explanatory variables by adding other variables that are significantly correlated with sustainable development, namely the Gini index and foreign direct investment. These two variables have been confirmed by the literature, which indicates that they are closely dependent on the level of development.

Thus, Alesina and Rodrik (1994) and Adelman and Robinson (2002) confirm that the Gini index as a measure of income dispersion in a country is a major determinant of the level of development, similarly Aitken, Hanson, and Harrison (2003) prove that FDI is important for development, especially in the context of natural resource research, hence the attraction of FDI specialized in the field of extraction is a necessity.

Column (3) transcribes the estimation results after adding the control variables.

The Gini index is significant and negative; income inequality is harmful to development. This result has been explained theoretically: by preventing the accumulation of human capital, income inequality compromises all educational opportunities for disadvantaged populations, thereby slowing down social mobility and skill development.

With regard to the effect of FDI on development, the results show that it is positive and significant. Thus, an increase in FDI of 1 point would produce an increase in the HDI of approximately 0.7 points. It should be noted that the FDI considered in this estimate pertains to the exploitation of natural resources.

We note that the values of the coefficients of columns (2), (3), and (4) show that the average threshold of institutional quality is 8.43. Therefore, any country that wishes to benefit from the advantages of natural resources must reach a minimum level of institutional quality higher than 8.43. Otherwise, in cases where institutional quality exceeds 8.43, the relationship between natural resources and sustainable development is positive. However, below this threshold, the relationship becomes negative.

Table 6. Natural resources and sustainable development: GMM system.

	1	2	3	4
HDI	0.857** (32.62)	0.851*** (30.66)	0.834*** (28.56)	1.024** (40.25)
Scol	0.128** (0.79)	0.124*** (0.88)	0.119** (1.26)	0.125*** (1.29)
GDPR	0.198*** (1.92)	0.187** (1.90)	0.175* (1.74)	0.217** (2.37)
Latit	0.260** (0.77)	0.254* (0.65)	0.321** (1.18)	0.208* (0.62)
OPNR	0.212* (0.84)	0.215** (0.91)	0.248 (1.12)	0.261** (1.86)
IQ	0.293** (0.17)	0.281* (0.19)	0.291** (0.84)	1.204*** (1.36)
NR	-0.466* (-4.60)	-0.552*** (-4.82)	-0.563*** (-4.51)	-0.624*** (2.84)
NR*IQ	- -	0.076*** (1.35)	0.053*** (1.22)	0.084*** (1.64)
Gini	- -	- -	-0.657** (-0.11)	-0.672*** (-0.13)
FDI	- -	- -	- -	0.724** (0.42)
Cons	0.072** (3.16)	0.084*** (3.21)	0.094** (3.35)	0.097** (3.41)
Threshold		7.26	10.62	7.42

Note: Between parentheses are indicated the absolute values of the Student's "t".
*** Significant at the 1% level; ** Significant at the 5% level; * Significant at the 10% level.

7. Conclusion

The assertion that the impact of natural resource wealth on economic development is negative is either false or insignificant. In the 'Why Nations Fail' study, what distinguished Botswana was its institutional performance prior to the diamond discovery. On the other hand, it is thus obvious that Cameroon had mediocre institutions before 1977. Australia, Chile, Norway, and the United States all had relatively good institutions at the time of the discovery of natural resources. Thus, through this article, we have shown that the economic impact of natural resources is conditioned by good quality institutions.

We also present decisive clarifications that could reduce the ambiguities found in the precursor studies on this subject, thus the results found confirm the results of the empirical literature which reveal that not enough countries continue to suffer from problems of underdevelopment despite their abundance in natural resources. This is mainly due to the fragility of institutions; a good institutional quality could be used to benefit from the positive externalities of natural rents and therefore escape the vicious circle of underdevelopment.

The classic impact of natural resources on human development was studied, while taking into account its interaction with institutional quality. The results show that natural resources positively affect development provided that countries first display a certain threshold of institutional quality, which is around 8.43. The impact of natural resources on sustainable development is not automatic; therefore, it depends on a minimum threshold of institutional quality beyond which countries could benefit from the privileges resulting from the flow of natural resources.

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