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Does the exploitation of natural resources promote the industrialization of African countries?

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Abstract

Despite the growing literature on natural resources, little is known about the effect of natural resources on industrialization, particularly in African countries. This study investigates how natural resources affect industrialization process in 28 African countries over the period 1998-2014. Two industrialization indicators (consisting of added value of manufacturing sector and added value of industry) are used. The empirical evidence is based on Ordinary Least Squared (OLS), system Generalized Method Moments (GMM) and Quantile Regression (QR). The results show that natural resources hamper industrialization in African countries.

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1 Introduction

Since 1950, a globally observable statistical link has existed between the importance of industry in an economy and its level of economic growth (Rodrik, 2008, 2009; cited by Goujon and Kafando, 2011). Realizing this importance, many African countries made it a priority after independence. Thus, the majority of these countries will adopt in the years 1960-1970 a model of industrialization by substitution to imports which consists in locally producing the goods necessary to satisfy internal demand and to protect local companies from external competition. Accompanied in this process by the international community including the United Nations Industrial Development Organization (UNIDO) and the African Economic Community, the continent will dedicate the 1980s to the "Decade for the industrial development of Africa".

Industrialization has always been a priority for development in Africa insofar as industry is considered to be the catalyst for long-run growth (ONUDI, 2002; Haussman, Rodrick, 2005) thus contributing to the reduction of poverty (Cadot et Al; 2015), improving human capital (Young, 2012) and also strengthening economic diversity and national investments (Duanté, Restuccia, 2010). African countries have re-committed to industrialization in recent years as part of a larger agenda to diversify their economies, create more jobs, better resist shocks and most notable reduction in poverty (UNCTAD and UNIDO, 2011). This proactive policy has unfortunately not borne the expected fruits and Africa remains lagging behind in global industry and particularly in manufacturing industry (Totouom, 2018). Moreover, according to statistics from the World Bank (2018), the share of the African industrial sector in the GDP decreased from 37.96% in 1980 to 26.5% in 2015. In addition, the share of the manufacturing sector in The GDP of this continent decreased from 18% in 1975 to 11% in 2014, a relative decrease of 38.8% while that of Asia rather increased by 8% during the same period.

However, Africa has significant wealth in terms of natural resources. The continent holds more than half of the world's rare minerals, and it is rich in renewable and non-renewable natural resources. Africa has the largest area of arable land in the world by its geography; it ranks second in the world for the length and breadth of rivers (the Congo and the Nile, respectively) and second for the extent of tropical forest (Foundation for Capacity Building in Africa 2013). Despite these significant endowments of resources, which should nevertheless serve as inputs in industry and attractive elements for manufacturers, the continent is struggling to take off industrially.

Since the seminal work of Sachs and Warner (1995), a large body of literature has investigated the link between natural resources and economic growth, known as the resource curse hypothesis. Sachs and Warner's (1995) resource curse hypothesis, also known as the abundance paradox, argues that resource-rich countries tend to have lower economic growth, less democracy, and worse development results than resource-poor countries. Studies of the resource curse hypothesis have been contradictory. Some researchers like Alexeev and Conrad (2009), Brunnschweiler and Bulte (2008) and Arin and Braunfels (2018) argue that natural resources are positively associated with economic development and do not validate the resource curse hypothesis. However, other studies have supported the existence of the resource curse hypothesis (Kronenberg, 2004; Satti et al. 2014; Gerelmaa and Kotani, 2016; Ahmed et al.

2016). At the crossroads of these two groups of researchers, a third group of researchers asserts that the validation or refutation of the resource curse hypothesis depends on the quality of institutions (Bulte et al., 2005; Antonakakis et al. , 2017; Qiang and Jian, 2020) (Nkemgha et al, 2021).

As for political factors, we distinguish the quality of institutions on the one hand and conflict on the other. Indeed, a large body of literature shows the deleterious effects of natural resource rents on the quality of institutions (Anthonsen et al, 2012; Atangana, 2019). For instance, Atangana (2019) finds that corruption is one of the key dimensions of institutional quality that are particularly negatively affected by dependence on natural resources in Africa. In addition, in resource-rich countries, taxes which represent only a tiny fraction of public finances lead to less government accountability (Anthonsen et al, 2012). Moreover, there is ample evidence to suggest that the abundance of natural resources reduces democracy (Ahmadov, 2014 for a meta-analysis). Indeed, natural resource gains can hinder a country's transition to democracy because they provide more incentive for autocratic rulers to retain power. These leaders are more prepared to use repression or other means to avoid having to democratize or to avoid losing power if they are forced to hold elections (Atangana, 2019). However, several theoretical and empirical studies conclude that institutional quality and democracy are essential conditions to break down the resource curse.

Sala-i-Martin and Subramanian (2003) and Boschini et al. (2007) believe that the impact of natural resource wealth on economic performance is favored by a country's institutions because they are created by society. As for political institutions, they are the processes by which a society chooses the rules that govern it. It is important to mention that there is a negative correlation between natural resource wealth and economic growth only for countries with weak institutions. Natural resources can indirectly promote institutional improvement or strengthening. However, countries endowed with quality institutions will be able to benefit from rents from natural resources because these institutions, thanks to the responsibility and competence of the state, manage to reduce the bad political incentives created by rents. Countries that lack quality institutions will often tend to suffer from a resource curse (Acemoglu et al. 2004 and Robinson et al. 2006). Several authors corroborate the hypothesis of the curse of natural resources due to the absence of strong institutions with regard to African countries such as Botswana and the Democratic Republic of Congo (formerly Belgian Congo and Zaire). This conclusion was drawn on the basis of the comparison of the economic growth of each country. The Democratic Republic of Congo (DRC) has experienced great economic setbacks with very slow growth while Botswana has successfully emerged, that is to say with strong growth (Tcheta-Bampa and Kodila-Tedika, 2018). In addition, Dwumfour and Ntow-Gyamfi (2018) examined the relationship between natural resources, financial development and institutional quality in African countries and highlighted the major role played by the quality of institutions in promoting economic growth. Similarly, Tiba and Frikha (2019), Pérez and Claveria (2020) and Sosson et al. (2020) recently found evidence of the resource curse, highlighting the crucial role democracy plays in mitigating its adverse effects.

On a theoretical level, two divergent perspectives have been observed among economists about the role played by natural resources in an economy: the more positive one is attributed to Adam

Smith (1776) and David Ricardo (1817) who asserted that natural resources play a beneficial role in the process of economic development. Several post-war economists supported this idea until the 1970s (Viner, 1952; Rostow, 1961). Rostow (1961) summed up this belief popular claim that the endowment of natural resources would enable developing countries to make the crucial transition from underdevelopment to industrial transfer, as was the case for countries such as Australia, the United States and Great Britain . Thus, natural resources would facilitate industrial development, create markets and encourage investment according to consensus. This optimistic view prevailed until the beginning of the 1980s. The discovery of the "Dutch disease" opened the way to a second more pessimistic perspective, thus naming the decline of Dutch industry after the discovery of natural gas in Groningen (Cordon and Neary, 1982; Corden, 1984; Neary and Wijnbergen, 1986). The Dutch Syndrome is therefore considered to be an immediate predecessor of the natural resource curse thesis. Gelb (1988) first analyzed the economic effects of oil rents in his book "Oil Windwalls: Curse or Blessing". Through his descriptive analysis, he established a thesis on the resource curse. He found that during the boom period of 1971-1983, the oil economies experienced a more serious deterioration in their domestic capital formation than the non-oil economies. The term "Dutch disease" originates from a 1977 edition of "The Economist" about the decline of the Dutch manufacturing sector after the discovery of multiple sources of natural gas. For Sachs and Warner (1995), Gylfason (2001), Papyrakis and Gerlagh (2004) and Frankel (2010), Dutch disease occurs when natural resources increase and lead to an increase in domestic income and demand for goods. This increase generates inflation and an appreciation of the real exchange rate. As a result, the relative prices of non-resource commodities increase and their exports become expensive relative to world market prices. This leads to a decrease in the competitiveness of these commodities and the investments they attract. In addition, internal domestic inputs such as labor and materials are transferred to the natural resource sector. The prices of these inputs are increasing in the domestic market. As a result, the production costs of other traditional export sectors, such as manufacturing and agriculture, increase, contracting these sectors. This detrimental effect on non-resource sectors is called the "pull" of resources (Humphreys et al, 2007). After Gelb (1988), Auty (2001) used the term "resource curse" to describe how resource-rich countries did not seem to be able to use this wealth to boost their economies and how these countries grew lower economy than countries without natural resources (Nkemgha et al, 2021).

On the empirical level, several studies have already analyzed the role played by natural resources on the various dimensions of development including economic growth (Sachs and Warner, 1995, 1997, 1999, 2001; Gylfason, 2001; Bulte et al., 2005 ; Mehlum et al., 2006; Rodrik, 2008, 2009; Goujon and Kafando, 2011), poverty (Auty, 2001), conflicts (Colier and Hoeffler, 1998; Fearon, 2005; Ross, 2004); institutions (Ross, 2001; Jensen and Wantchon, 2004, Pourjavan et al., 2013; Anderson and Ross, 2014); financial development (Bhattacharyya and Todler, 2014), education and health (Cockx and Franken, 2016) and access to water and sanitation (Sosson et al., 2020). Despite the growing literature on natural resources, little is known (only the study of Nkemgha et al, (2021) analyzed the role of governance in the relationship between natural resources and industrialization in Africa) about the effect of natural resources on industrialization, particularly in African countries. The aim of this paper is to fill this gap by assessing how natural ressources affect the industrialization process in

African countries. To sum up, the results show that natural resources are negatively associated with industrialization in Africa.

The rest of the paper is organized as follows. Section **2** describes the data and methodology used to capture the link between natural resources and industrialization in the context of african economies. Section **3** discusses our empirical results, while Section **4** concludes.

2 Data and Methodology

2.1 Data

We investigate a panel of 28 African countries with data for the period 1998-2014 from World Development Indicators (WDI). The periodicity and countries under investigation are chosen according to data availability constraints. The full description of the data is as follows:

Tableau I: Descriptive statistics

Variables	Observations	Mean	S.D.	Minimum	Maximum
Added value of manufacture	429	2.129	0.662	-1.439	4.193
Added value of industry	390	-1.734	2.409	-9.276	1.340
Natural Resources	450	2.560	0.891	0.279	4.467
Added Value of Agriculture	446	2.955	0.816	0.709	4.127
Trade	476	3.527	0.559	0.000	5.587
GDP per capita	476	7.185	1.024	5.498	9.912
Foreign Direct Investment	476	2.230	0.596	-3.795	4.384
Financial Development	455	4.631	0.400	-0.097	5.608
Infrastructures	473	0.960	0.807	0.000	2.815
Human Capital	300	3.579	0.670	1.814	4.614
Foreign Aid	475	1.694	0.922	0.007	4.146
Remittances	363	0.559	0.348	0.000	1.293
Inflation	459	3.819	0.550	-1.812	10.104
Domestic Investment	460	2.959	0.596	-1.228	5.389
External Debt	441	1.178	0.668	0.060	3.453

Source : Authors

Table II : Pairwise correlation matrix

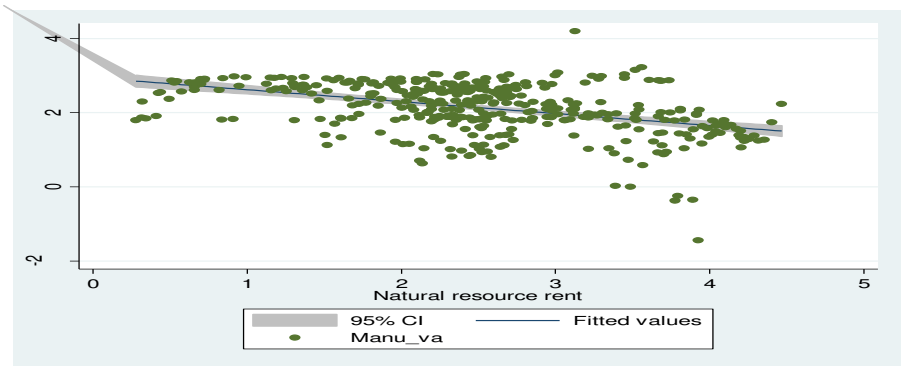
	Manuf	Rentnat	Agricult	GDPPC	Trade	FDI	Findev	Infras	Invest	Educ	Infla	Aid
Manuf	1,000											
Rentnat	-0,441	1,000										
Agricult	-0,329	0,364	1,000									
GDPPC	0,189	-0,351	-0,838	1,000								
Trade	-0,162	0,234	-0,308	0,306	1,000							
FDI	-0,108	0,231	0,031	-0,082	0,449	1,000						
FinDev	0,318	-0,043	-0,131	0,244	-0,087	-0,045	1,000					
Infras	0,403	-0,581	-0,771	0,868	0,200	-0,166	0,317	1,000				
Invest	-0,016	-0,079	-0,116	0,129	0,363	0,378	-0,034	0,201	1,000			
Educ	0,297	-0,325	-0,692	0,822	0,325	-0,075	0,256	0,792	0,141	1,000		
Infla	-0,081	0,158	-0,087	0,047	0,281	0,211	0,001	-0,091	-0,206	-0,012	1,000	
Aid	-0,158	0,344	0,737	-0,901	-0,150	0,165	-0,258	-0,794	-0,009	-0,774	0,000	1,000

Source : Authors

The dependent variable is industrialization measured by two indicators: (i) the added value of the manufacturing sector as a percentage of the GDP and (ii) the added value of industry as a percentage of the GDP. These two indicators of industrialization are increasingly being used in the recent literature (Gui-Diby and Renard, 2015; Nkoa, 2016 Njangang and Nounamo, 2020). The main independent variable is natural resources (Rentnat). Rentnat is measured as the total natural resources as percentage of GDP. To reduce bias that may arise from possible variable omissions, seven control variables are included in this study. They comprise (i) trade openness, (ii) GDP per capita growth (iii) foreign direct investment, (iv) Insfrastructure, (v) Added value of Agriculture, (vi) human capital and, (vii) financial development. A detailed description of variables as well as definition of variables are presented in the appendix. Table **I** gives the summary statistics of the variables and the pairwise correlation analysis is presented in Table **II**. It can be seen from Table **II** that the natural resources have a negative and significant association with industrialization. To make sure, we will carry out an empirical verification of these different associations. A brief description of the expected signs is given in the following paragraph.

The effect of foreign direct investment on industrialization is mixed. While GUI-DIB et al (2015) find no effect, NKoa (2016) found a positive and significant relationship between the two variables. Regarding the relationship between per capita income and industrialization, Rowthorn and Ramaswamy (1999) found a positive and significant relationship. Likewise, per capita income has a positive and significant effect on industrialization (Rowthorn and Ramaswamy, 1999). As for infrastructure, it also has a positive effect on industrialization (Azolibe and Okonkwo, 2020). Unlike infrastructure, human capital has no effect on industrialization (Effiom and Okoi, 2018). Doumbe Doumbe and Zhao (2017) found a positive effect of financial development on industrialization. According to Mello (1996), agriculture positively impacts industrialization. As for trade openness, it has a positive and significant effect on industrialization (Dodzin and Vamvakidis, 2003).

Figure 1: Added value of manufacturing sector et industrialization



Source : Authors

2.2 Methodology

The aim of this paper is to investigate the impact of natural resources on industrialization in African countries. According to the recent literature on industrialization (Njangang and Nounamo, 2020), we formulate the following model:

$$Indus_{it} = \beta_0 + \beta_1 Indus_{it-1} + \beta_2 Rentnat_{it} + \beta_3 X_{it} + \mu_i + v_t + \varepsilon_{it} \quad (1)$$

Where $Indus_{it}$, represents industrialization for country i in the period t, $Rentnat_{it}$ is the natural resources for country i in the period t, X_{it} is a vector which includes all control variables, μ_i is an unobserved country-specific effect, v_t is time specific effect, and ε_{it} is the error term.

We use different specifications and three estimation techniques to analyses the effect of natural resources on industrialization. We first use Ordinary Least Square (OLS) method to estimate Equation (1). However, the OLS estimators are inconsistent and likely to be biased since the lagged value of industrialization ($Indus_{it-1}$) is correlated with the error term (Nickell, 1981) raising the problem of endogeneity. Moreover, in the literature survey of the resource curse thesis, future studies on the natural resource curse need to carefully address issues of endogeneity in measures of natural resource dependence (Badeeb et al. 2017). The GMM method is used in the recent literature on natural sources to solve the endogenous problem (Nkemgha et al, 2021).To address this endogeneity issue, we apply the System Generalised Method of Moment (GMM) proposed by Arellano and Bond (1991), Arellano and Bover (1995) and Blumdell and Bond (1998). GMM is useful for several advantages. First, GMM estimator has been widely used to address the endogeneity problem that appears in panel data estimation (Arellano and Bover, 1995; Blumdell and Bond, 1998). Second, GMM estimator also take into account the biases that appear due to country-specific effects. Third, GMM also avoids simultaneity or reverse causality problems. The consistency of the GMM estimator depends on two things: the validity of the assumption that the error term does not exhibit serial correlation (AR (2)) and the validity of the instrument's (Hansen test). The third method used is a nonparametric method: a Quantile Regression. It is applied when an estimate of the different quantiles of a population is desired. In addition, quantile regression has several other useful features. First, the quantile regression estimator minimizes the weighted sum of the absolute residuals rather than the sum of the squared residuals, and the estimated coefficient vector is

therefore not sensitive to outliers. Second, a quantile regression model uses a linear programming representation and simplifies the examination. Third, this analysis is particularly useful when the conditional distribution does not have a standard shape, such as an asymmetric or truncated distribution. The quantile regression approach therefore makes it possible to obtain a much more complete view of the effects of the explanatory variables on the dependent variable.

3 Results

3.1 Baseline Result

Table **II** reports results of the preliminary estimation using OLS method. The results clearly suggest that the exploitation of natural resources decrease the industrialization process, which means that natural resources hamper industrialization ceteris paribus. For instance, results in column (1) suggest that a 1 unit increase in natural resources explotation, the industrialisation variable will decrease by 0.32.

Tableau II: Baseline results with OLS method

	Dependent: Manufacturing, value added (% GDP)					
	(1)	(2)	(3)	(4)	(5)	(6)
Rentnat	-0.321***	-0.294***	-0.261***	-0.296***	-0.302***	-0.175***
	(0.0341)	(0.0363)	(0.0390)	(0.0403)	(0.0385)	(0.0597)
Agricult		-0.153***	-0.206***	-0.350***	-0.440***	-0.440***
		(0.0377)	(0.0442)	(0.0648)	(0.0640)	(0.0802)
Trade			-0.00579**	-0.00397	-0.00198	-0.00664*
			(0.00258)	(0.00262)	(0.00278)	(0.00390)
GDPPC				-0.179***	-0.304***	-0.691***
				(0.0593)	(0.0613)	(0.101)
FDI					-0.0383	0.0756
					(0.0709)	(0.0948)
Findev					0.508***	0.373***
					(0.0758)	(0.0853)
Infrast						0.357***
						(0.124)
Human capital						0.301***
						(0.0997)
Cons	2.941***	3.326***	3.608***	5.311***	4.104***	5.697***
	(0.0908)	(0.132)	(0.181)	(0.592)	(0.642)	(0.818)
Observations	404	390	390	390	369	235
Adjusted R^2	0.479	0.300	0.409	0.325	0.324	0.410

Note: ***, **, *: represent the significance thresholds at 1%, 5% and 10% respectively. Values in parentheses represent standard deviations.

To assess the robustness of the result with respect to collinearity among the control variables, we calculate the variance inflation factor (VIF) based on the base regression in column (6) of Table **II**. The variation factors for the control variable in Table **III** do not indicate the presence of serious collinearity problems, all variables being well below the VIF value which is10 (Kennedy, 1992).

Tableau III: Variance Inflation Factor

Variables	VIF	1/VIF
Agricult	3.50	0.29
Trade	1.92	0.52
GDPPC	7.23	0.14
FDI	1.42	0.70
Findev	1.31	0.76
Infrast	8.05	0.12
Human Capital	3.39	0.29

Source : Authors

3.2 Robustness checks

We analyze the sensitivity of our results in terms of inclusion of additional control variables, alternative methods, alternative dependent variables and endogeneity accounting.

3.2.1 Robustness checks: alternative measure of industrialization

We studied the sensitivity of our results using an alternative dependent variable, namely the added value of the industrial sector. The results presented in Table **IV** confirm the significant negative relationship between the abundance of natural resources and industrialization. For example, the results in column (1) show that a 10% increase in natural resources is associated with a 7.63% decrease in industrialization. Overall, the results presented in Table **IV** confirm the resource curse for industrialization in resource-rich African countries. Consistent with the baseline results, we also observe a negative relationship between a country's GDP per capita and industrial added value, while the effect of the variable agriculture is not significant.

Tableau IV: OLS regression with alternative dependent variable

	Dependent variable : Industry, added value (% of GDP)					
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Rentnat	-0.763***	-0.809***	-0.963***	-0.933***	-1.065***	-0.682***
	(0.135)	(0.147)	(0.149)	(0.152)	(0.172)	(0.193)
Agricult		-0.0467	0.207	0.421	0.357	0.0810
		(0.163)	(0.172)	(0.266)	(0.282)	(0.337)
Trade			0.0377***	0.0365***	0.0188	0.0173
			(0.00950)	(0.00956)	(0.0115)	(0.0136)
GDPPC				-0.226	-0.407*	-1.246***
				(0.214)	(0.237)	(0.355)
FDI					0.676**	1.042***
					(0.333)	(0.358)
Findev					-0.862	-2.732***
					(0.599)	(0.731)
Infrast						2.577***
						(0.391)
Human capital						-0.481
						(0.373)
Cons	0.461	0.698	-0.975	-3.245	-0.921	17.75***
	(0.374)	(0.608)	(0.730)	(2.272)	(3.739)	(4.724)
Observations	368	351	351	351	335	223
Adjusted R^2	0.775	0.761	0.414	0.621	0.524	0.653

Note: ***, **, *: represent the significance thresholds at 1%, 5% and 10% respectively. Values in parentheses represent standard deviations.

3.2.2 Regression with more control variables

The results of Tables **II** and **IV** established a negative and statistically significant effect of the abundance of resources on industrialization. In Table **V**, we check whether our baseline results can be the result of omitting bias from the control variables. To mitigate this possibility, we have added five additional controls, namely: foreign aid, remittances, inflation, domestic investment and external debt. The results of this model are confined to Table **V**. Analysis of this table shows that the coefficient associated with the natural resource remains negative and statistically significant. Thus, the results corresponding to the effect of natural resource abundance on industrialization are remarkably robust to the inclusion of more control variables. Regarding the additional control variables, the following results are established. Foreign aid is a variable potentially correlated with the dependence of some African countries on natural resources. The negative sign of the foreign aid variable was therefore predictable on the basis of this assumption. The results found by Bulte et al. (2018), although not closely related to our study, conclude that countries receiving more aid tend to suffer from a contraction in the manufacturing sector. The estimated coefficients associated with remittances are negative and

statistically significant, suggesting that remittances reduce manufacturing value added. This result, although in disagreement with that found by Efobi et al. (2016), finds its explanation in the structure of remittances received by households in Africa. Several studies have shown that remittances to developing countries primarily finance household consumption (Combes and Ebeke, 2011). In addition, the majority of goods consumed in sub-Saharan Africa are imported goods and therefore have a negative impact on the manufacturing sector of these countries.

Tableau V: OLS regression with more control variables

	Dependent variable : Manufacturing, added value (% GDP)					
	(1)	(2)	(3)	(4)	(5)	(6)
Rentnat	-0.321***	-0.302***	-0.189***	-0.225***	-0.101*	-0.0422
	(0.0341)	(0.0368)	(0.0421)	(0.0461)	(0.0564)	(0.0688)
Agricult		-0.198***	-0.0680	-0.145*	-0.0398	-0.122
		(0.0473)	(0.0676)	(0.0825)	(0.0806)	(0.107)
Trade			-0.00182	-0.000796	0.00487	-0.00416
			(0.00284)	(0.00305)	(0.00329)	(0.00492)
GDPPC				-0.165*	-0.489***	-0.497***
				(0.0939)	(0.0980)	(0.137)
FDI					-0.351***	-0.242**
					(0.0880)	(0.121)
Findev					0.360***	0.255***
					(0.0764)	(0.0780)
Infrast					0.407***	0.437***
					(0.102)	(0.127)
Human capital						0.226*
						(0.125)
Aid		-0.0729	-0.0949*	-0.181**	-0.239***	-0.0286
		(0.0460)	(0.0559)	(0.0756)	(0.0719)	(0.105)
Remittances			-0.137**	-0.153**	-0.281***	-0.303***
			(0.0638)	(0.0655)	(0.0623)	(0.0819)
Inflation				0.0896	0.135	-0.228
				(0.0943)	(0.0855)	(0.291)
Invest					0.191***	0.0997
					(0.0702)	(0.134)
Debt						0.261***
						(0.0760)
Cons	2.941***	3.345***	3.192***	4.479***	4.164***	4.964***
	(0.0908)	(0.132)	(0.194)	(0.964)	(0.947)	(1.488)
Observations	404	389	299	285	274	182
Adjusted R^2	0.379	0.402	0.444	0.556	0.343	0.417

Note: ***, **, *: represent the significance thresholds at 1%, 5% and 10% respectively. Values in parentheses represent standard deviations.

Previous results obtained with the OLS method established a statistically significant negative effect of natural resources on the industrialization process. However, the possibility of reverse causation, endogeneity, or unobserved heterogeneity can bias the results and call our results into question. To deal with these potential problems, we estimate equation (1) using system GMMs. The results of this estimate are contained in Table **VI**.

3.2.3. System GMM regression

The analysis of the effect of natural resources on industrialization by the GMM system method show an absence of the second-order autocorrelation at the 5% threshold and the validity of the instrument identification test for all the six columns. Overall, we observe the negative association between natural resources and industrialization in table **VI**.

Theoretically, industrialization is often explained on the basis of the theory of production or growth. Industrial growth is explained by the growth of inputs (endogenous growth theory) and by technology. Table VI shows that the variables linked to capital (financial development and FDI) as well as labor (human capital) have a positive and significant effect on industrialization. These variables indicate that industrial development is underway, in accordance with the theory of endogenous growth.

Analysis of Table VI shows that natural resources have a negative and significant effect on industrialization (models 1-6). Thus, an increase in natural resources of 1% leads to a decrease in the industrialization process of 0.26% (model 6). This result can be explained by the fact that the countries rich in natural resources of Africa are regularly classified by the Gobal Peace Index as being risky countries or unstable countries (these are for example Libya, Chad, Democratic Republic of Congo, Nigeria, Central African Republic, Mali and Niger), thus confirming the work of Ross (2004) who demonstrated that countries dependent on natural resources are more vulnerable to conflicts. This result is compatible with the work of Nkemgha et al. (2021) which found the same result for the countries of sub-Saharan Africa. In addition, the negative relationship between natural resources and industrial development could be interpreted as diminishing returns on material inputs (resources used for production).

Human capital has a positive and significant effect on industrialization. Thus, an increase in human capital of 1% leads to an increase in the added value of the manufacturing sector of 0.43% (model 6). The explanation for this result can be found in the endogenous growth theory which assumes that public and private investments in human capital generate external savings and productivity improvements that offset natural tendencies towards diminishing returns (Romer, 1990; Barro, 1990). This result is contrary to the work of Effiom and Okoi (2018) who found that the development of human capital has no effect on industrialization in Nigeria.

As for financial development, it has a positive and significant effect on industrialization in Africa. Thus, an improvement in financial development of 1% leads to an increase in the added value of the manufacturing sector by 0.9% (model 6). This result can be explained by the fact that improved financial development makes it easier for investors to access credit, which

ultimately boosts industrialization. This result is compatible with the works Doumbe Doumbe and Zhao (2017).

As for trade openness, it has a negative and significant effect on industrialization. Thus, an increase in trade openness of 1% leads to a drop in industrialization of 0.06% in Africa (model 5). This result can be explained by the fact that trade openness leads to strong competition between foreign companies (which achieve economies of scale, which realize the absolute cost advantages and which sometimes receive subsidies from their government) and local African companies (which do receive a subsidy). This result is consistent with the infant industries argument. This result is not compatible with the work of Dodzin and Vamvakidis (2003).

Tableau VI: GMM regression

	Dependent variable : Manufacturing, added value (% GDP)					
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent (-1)	0.770***	0.663***	0.677***	0.694***	0.682***	0.465***
	(0.0144)	(0.0443)	(0.0442)	(0.0328)	(0.0611)	(0.115)
Rentnat	-0.169***	-0.236***	-0.249***	-0.266***	-0.204***	-0.268**
	(0.0231)	(0.0587)	(0.0563)	(0.0466)	(0.0437)	(0.126)
Agricult		-0.184**	-0.207***	-0.576***	-0.442***	-0.299
		(0.0717)	(0.0701)	(0.0798)	(0.0572)	(0.210)
Trade			0.000221	-0.00623	-0.0668*	-0.428
			(0.0287)	(0.0280)	(0.0339)	(0.384)
GDPPC				-0.480***	-0.372***	-0.403*
				(0.0871)	(0.0839)	(0.200)
FDI					0.0876*	-0.0427
					(0.0484)	(0.0953)
Findev					0.568***	0.908**
					(0.139)	(0.416)
Infrast						-0.230
						(0.335)
Human capital						0.439*
						(0.240)
Cons	0.905***	1.835***	1.897***	6.423***	2.493***	1.550
	(0.0840)	(0.456)	(0.401)	(0.884)	(0.853)	(2.247)
Observations	378	365	365	365	346	225
AR(2)	0.502	0.505	0.511	0.659	0.584	0.490
Nb. countries	27	26	26	26	26	25
Instruments	20	20	22	22	20	20
Hansen OIR	0.699	0.388	0.230	0.119	0.103	0.810
Fisher	4367	527.8	1465	679.2	320.9	146.6

Note: ***, **, *: represent the significance thresholds at 1%, 5% and 10% respectively. Values in parentheses represent standard deviations.

3.2.4. Using a nonparametric analysis : *Quantile Regression*

Using quantile regression, we also test the robustness of the results to the extreme values of our dependent variable. This possibility is due to the fact that in quantile regression the sample is divided into quantiles based on the distribution of the dependent variable. The results are shown in Table **VII**. We can see in Table **VII** that the importance of the coefficient associated with the variable of natural resources changes as one moves towards the larger quantile. The coefficient associated with natural resources at the first quantile (0.25), is insignificant, suggesting that natural resources do not have a significant effect on industrialization at this stage. However, when we move to the distribution center (0.5), the effect of natural resources on industrialization is negative and statistically significant at the 1% level. When we move to the last quantile (0.75), the effect of natural resources on industrialization remains negative and significant, although its magnitude is tiny. This result suggests that for a certain level of initial industrialization not requiring enormous financial resources generated by the abundance of natural resources, the effect is insignificant. However, as the level of industrialization increases and therefore requires greater financial resources, the natural resource curse takes effect and follows deindustrialization.

Tableau VII : Quantile Regression

	Dependent variable: Manufacturing, added value (%)		
	Quantiles		
	0.25	0.5	0.75
Rentnat	-0.147	-0.190***	-0.173***
	(0.111)	(0.0617)	(0.0583)
Agricult	-0.225	-0.278***	-0.320***
	(0.150)	(0.0829)	(0.0784)
Trade	-0.562***	-0.826***	-0.703***
	(0.188)	(0.104)	(0.0985)
GDPPC	0.00124	0.00531	-0.000940
	(0.00729)	(0.00404)	(0.00381)
FDI	0.0815	-0.0613	-0.0857
	(0.177)	(0.0980)	(0.0927)
Findev	0.517***	0.456***	0.225***
	(0.159)	(0.0882)	(0.0834)
Infrast	0.538**	0.483***	0.326***
	(0.231)	(0.128)	(0.121)
Human capital	0.178	0.353***	0.267***
	(0.186)	(0.103)	(0.0974)
Observations	235	235	235

Note: ***, **, *: represent the significance thresholds at 1%, 5% and 10% respectively. Values in parentheses represent standard deviations.

Starting from the observations made on the stylized facts of industrialization, we studied the existing relationship between this concept and that of natural resources through various estimates. It turns out that in general, these two concepts have a negative relationship.

4 Conclusion

Several studies have been carried out in the context of the curse of natural resources and the abundance of these resources in relation to development, economic growth and volatility. However, very few studies have focused on the link between the abundance of natural resources and industrialization specifically in the African context. This paper examines the effect of natural resources on industrialization in Africa. Thus, it concerns the analysis of 28 resource-rich African countries during the period 1998 - 2014 using a panel of data. To carry out our investigation, we mobilized several estimation methods such as Ordinary Least Squares, Generalized Moments Methods and quantile regression. The results of the estimate show that the abundance of natural resources has a negative effect on industrialization. This confirms the hypothesis of the curse of natural resources in the context of African countries. Therefore, for natural resources to constitute the raw materials for the industrialization of Africa (blessed resources), African leaders should be able to promote good governance more like in Botswana so that youth are less encouraged to take up arms for the control of resources. African governments should also encourage entrepreneurship with the aim of raising sufficient tax resources in order to be less dependent on natural resources.

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Appendices

Table A1: List of countries

Algeria	Congo, Dem. Rep	Ghana	Nigeria
Angola	Congo,	Mali	Sierra Leone
Botswana	Cote d'Ivoire	Mauritania	South Africa
Burkina Faso	Egypt	Morocco	Soudan
Cameroon	Equatorial Guinea	Mozambique	Tanzania
Central African Republic	Gabon	Namibia	Zambia
Chad	Guinea	Niger	Zimbabwe

Table A2: Variable définitions

Variables	Signs	Variables definition (measurement)	Sources
Manufacturing	Manuf	Manufacturing, value added (% of GDP)	World Bank (WDI)
Foreign Aid	Aid	Net ODA received (% of GNI)	World Bank (WDI)
Infrast	Internet	Number of Internet users (per 100 people)	World Bank (WDI)
Gross Domestic Product	GDP	Gross Domestic Product (GDP) per capita growth (annual %)	World Bank (WDI)
Inflation	Inf	Consumption price index	World Bank (WDI)
Industry	Indus	Industry, value added (% of GDP)	World Bank (WDI)
Foreign direct investment	FDI	Foreign direct investment, net inflows (% of GDP)	World Bank (WDI)
Human capital	Educ	School enrollment, secondary (% gross)	World Bank (WDI)
Trade	Trade	Total amount of exports and imports over GDP	World Bank (WDI)
External Debt	Debt	External debt (% of GDP)	World Bank (WDI)
Domestic investment	Invest	Gross fixed capital formation (% of GDP)	World Bank (WDI)
Financial development	Findev	Broad money (% of GDP)	World Bank (WDI)
Agriculture	Agricult	Added value of agriculture (% of GDP)	World Bank (WDI)
Natural resources	Rentnat	Total natural resources (% of GDP)	World Bank (WDI)
Remittances	Remittances	Personal remittances, received (% of GDP)	World Bank (WDI)

Source: Authors