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Natural Resource Rents and Economic Growth Paradox, the Analysis of Resource Curse and Its Transmission Channels in West Africa: The Role of Public Expenditure Policy

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Abstract

The study analyses the natural resource curse through the component of public expenditure policy, namely productive and unproductive expenditures, as plausible channels transmitting the resource curse in West Africa. The study examines which channel is the most prominent transmitter among public expenditure, Dutch disease, rent-seeking, and political institutions. A dynamic panel was adopted for the 1998-2018 period using Feasible Generalised Least Squares (FGLS) and Dynamic Ordinary Least Squares (DOLS) estimation techniques. The results confirmed the resource curse hypothesis in West Africa via productive expenditure and rent-seeking behaviour as the only relevant transmission channels. Moreover, productive expenditure interacting with natural resource rents mitigates the resource curse and can reverse it under a certain threshold. On the other hand, unproductive expenditure through government consumption expenditure exacerbates the resource curse. The findings suggest that appropriate productive expenditure policy measures in terms of fixed capital formation, and a diligent fight against corruption can overturn the resource curse over time.

Keywords: Resource Curse, Transmission Channels, Natural Resource Rents, Productive and Unproductive Expenditures.

Introduction

The West African sub-region is rich in various types of natural resources and yet it remains economically less advanced (Aidara, 2016). This economic contrast raises questions about the contribution of natural resources to economic growth. For this reason, the study analyses this paradox by examining the phenomenon of resource curse and its relevant transmission channels in the region. The notion of the resource curse has provoked substantial debate among scholars. Although some scholars such as Ploeg (2011); Poteete (2009) argued against the absolute nature of the resource curse, highlighting that the natural resources sector has provided a great economic advantage to developing nations through job creation, public capital accumulation and multiplier effect. On the other hand, many scholars believe that

developing natural resource nations do not benefit from natural resource endowment to improve their socio-economic well-being. Costa & Santos (2013) stressed that natural resource abundance in developing countries does not enable them to achieve high sustainable economic growth and poverty reduction goals. These countries often face low economic growth, severe socio-political problems, pervasive corruption, a lack of secure property rights, persistently high unemployment and large income inequalities (Colgan, 2014).

In order to explain this paradox, Sachs & Warner (2001) attributed the resource curse to the indirect effect of natural resources wealth, implying that natural resources wealth retard economic growth mainly through the crowding-out effect of growth-promoting activities (Papyrakis & Gerlagh, 2007). Thus, most of the attention in the literature has been oriented to the resource curse transmission channels. Studies have been conducted to address the different channels through which resource-rich countries have experienced low economic growth compared to non-resource-rich counterparts. Economists have identified several channels, such as Dutch Disease (Auty, 2001; Matsen & Torvik, 2005), the rent-seeking behaviour (Hodler, 2007; Matallah & Matallah, 2016) and the political institution channel (Robinson et al., 2006). Nevertheless, the public expenditure policy dimension is rarely addressed in the literature on the transmission mechanism of the resource curse. To address this lacuna in the literature, this study examines the role of productive and unproductive expenditure policy as plausible transmission channels of the resource curse, describing the public policy in the acquisition of fixed capital and non-fixed capital. The impacts of productive and unproductive expenditures are compared to those of traditional resource curse channels such as Dutch disease, rent-seeking behaviour and political institutions to define which channel is more relevant for natural resource-rich developing countries.

The study focuses on West Africa's countries from 1998 to 2018. This approach would enrich the literature on the resource curse transmission channels and determine whether public expenditures, such as the productive and unproductive public expenditure, effectively impacts economic growth through natural resource rents. Indeed, the problem related to natural resources' contribution to economic development is a pertinent and factual economic issue for developing nations, which must be studied to allow rational use of their depleting natural resources. The study will enable policymakers to undertake adequate and effective public expenditure policy measures to promote socio-economic development and avoid the resource curse.

The Objectives of the Study

The specific objectives of the study are to: determine the long run relationship between total natural resource rents and economic growth in West Africa; examine the role of public expenditure policy (productive and unproductive expenditures) as plausible transmission channel of the resource curse; compare the relative importance of the transmission channels in the total effect of natural resource rents on economic growth.

Literature Review

Resource curse theory claims that natural resource abundance induces certain distortion in the economy through the transmission channels (Alexis, 2004). Countries that depend on natural resources export would experience poor economic development outcomes because of low economic growth, corruption, and resource-led conflicts (Sachs & Warner, 1997). In a subsequent analysis, Sachs and Warner found a robust negative relationship between natural

resource abundance and economic growth, even after controlling for important economic growth determinants such as initial per capita income, government efficiency, investment rate, and trade policy variables (Sachs & Warner, 1997). Their study covered ninety-five developing countries, and only two resource-rich countries achieved an annual GDP growth rate of 2% between 1971 and 1989. In West Africa, Jalloh (2011) confirmed the presence of resource curse through high corruption in the public sector and frequent civil conflicts. Other studies confirming the resource curse in developing countries include (Bjorvatn & Farzanegan, 2013; Butkiewicz & Yanikkaya, 2010; Hassan et al., 2019).

On the other hand, literature has questioned the absolute nature of the resource curse phenomenon. They argue that the concept of resource curse is relative and could depend on the quality of institutions in the economy (Mehlum et al., 2006), type of resources, i.e. point source vs nonpoint sources and resources price volatility (Ploeg & Poelhekke, 2009) and the degree of ethnic fractionalization (Hodler, 2007). Thus, most of the analysis has been oriented to identify and explain the mechanism of the transmission channel of the resource curse to understand why more leads to less. This issue represents a major challenge for resource-rich developing countries in managing the growing resource revenues. Therefore, many economic scholars analyse where resource revenues should be directed, and what role should governments and institutions play to promote economic growth. Atkinson & Hamilton (2003) argued that if governments consume resource rents, a curse exists but disappears if governments invest resource rents in human capital growth. Bhattacharyya and Collier (2014) showed that natural resources in developing countries are associated with lower public capital, which is accentuated in countries with poor institutions. They suggested that resource-rich developing countries will be more prudent to invest resource rents into public capital such as education, health, and infrastructure. Gylfason (2001), in the same optic, claimed that public investment on health and education is lower in resource-abundant economies despite the inflow of revenues. Sarmidi et al (2014) stressed that natural resources are meaningful to economic growth only after a certain threshold point of institutional quality has been attained. Recently, Hassan et al (2019) mentioned that resource curse exists in the long run through institutions. But, no curse in the short run.

All these channels enumerated above are argued to be responsible for resource-rich countries' slow economic growth. It may be noted that those channels directly or indirectly explain the market mechanism and the institutional quality of the resource curse. The public expenditure policy channel in terms of productive and unproductive expenditures are rarely examined in the resource curse analysis especially using panel data in developing countries. This is perhaps because most of the literature focused on the absolute role of an institution in shaping government policy. But this could not always be the case because good institutions associated with incorrect public expenditure policy could be detrimental to economic growth. A country like the United States with good institutions is often the victim of a resource curse (Shahbaz et al., 2019). Hence the study will fill this gap by investigating the public policy dimension, i.e. productive vs unproductive expenditures as plausible transmission channels of the resource curse. The following public expenditure transmission mechanism is discussed to support the hypophysis of the study. Figure 2 illustrates the transmission mechanism of productive and unproductive expenditures in the total effect of natural resource rents on economic growth.

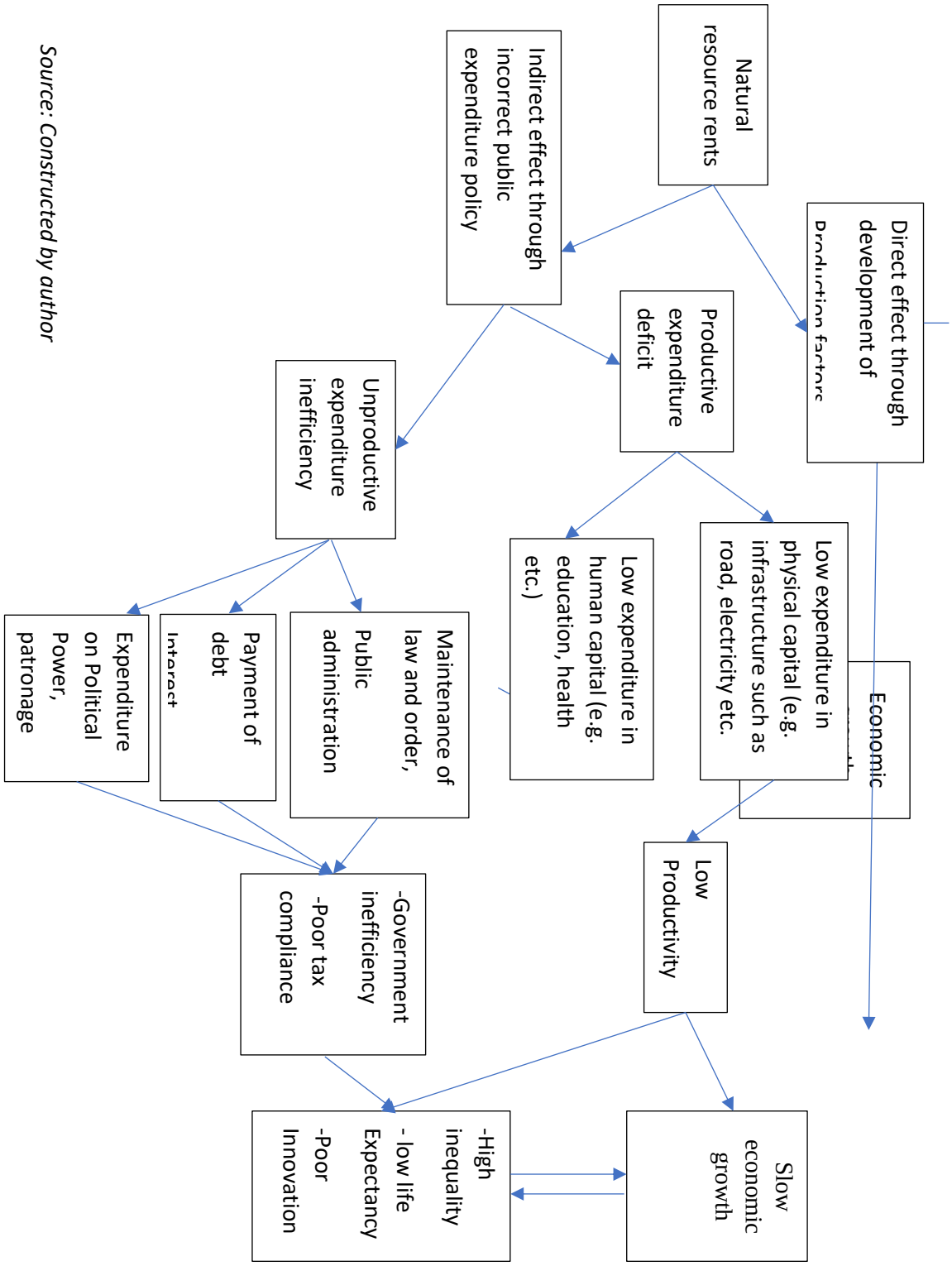

Figure 1 Transmission mechanism of public expenditure

Source: Constructed by author

Figure 2 indicates that natural resource rents directly affect economic growth positively through the development of factors of production and negatively through the indirect effect of public expenditure policy. The indirect effect of natural resource rents on economic growth, which is the subject of this study, implies the public expenditure deficit or ineffectiveness. Cevik et al., (2017) show that Sub-Saharan African countries applied bad fiscal policies that negatively affected economic growth and that natural resources rents, government final consumption expenditure and economic growth had a negative and significant relationship. In addition, the ineffective unproductive expenditure hampers the

economic growth, considering that governments in developing countries devote massive amounts of natural resource revenues through corruption in unproductive sectors for political gains, such as vote-buying and patronage in order to stay in power, which may create a heavy debt burden (Robinson et al., 2006). Collier and Vicente (2012) investigated vote-buying in Sub-Saharan African democracies and showed that it is both prevalent and effective in the region. Empirical findings suggest that unproductive expenditures can have a long-term negative effect on the growth rate of real GDP per capita, leading to higher ratios of the public debt to GDP (Bhatt & Sardoni, 2016). Bleaney et al (2001) also found that unproductive expenditure reversely impacts economic growth.

Therefore, the study suspects that West African countries may suffer from the resource curse problem through incorrect expenditure policy. This is because the vast majority of those countries have poor education and health care systems, lack of infrastructure such as roads, electricity, clean water supply etc (Aidara, 2016).

Methodology

Model Specification

The model analysis refers to the conditional convergence hypothesis and Barro-style (1991) growth regression following (Sachs & Warner, 1999; Lederman & Maloney, 2003). We control for initial income, the possible transmission channel variables and other growth determinant variables. The model is written as follow:

$$\ln GDPC_{it} = \theta_0 + \theta_1 \ln GDPC_{98} + \theta_2 \ln NR_{it} + \theta_k \sum_1^m Z_{it} + \theta_l \sum_1^n X_{it} + u_{it} \quad (1)$$

Where i denotes the cross-section unit of each country and t is the time unit of year. m and n indicate the numbers of transmission channels and other growth determinant variables, respectively. $lnGDPC_{it}$ represents the natural log of GDP per capita denoting the economic growth in country *i* from 1998 to 2018. $ln\, GDPC_{98i}$ is lag GDP per capita, which is the initial income in the literature of conditional convergence theory. NR_{it} represents the total natural resource rents, the term $\sum_1^m Z_{it}$ indicates the set of plausible resource curse transmission channel variables, they are: $\ln PEX_{it}$ denoting the log of the productive expenditure and $\ln UEX_{it}$ is the log of unproductive expenditure. They are introduced as measures for public expenditure policy to examine their respective impacts on economic growth. $\ln REER_{it}$ is the log of real effective exchange rate, it is introduced to account for Dutch disease phenomenon (Akanni, 2007). $\ln CPI_{it}$ is the log of corruption perception index, it represents the rent-seeking behaviour (Brunnschweiler & Bulte, 2008). $\ln RL_{it}$ is the log of rule of law is introduced to account for the political institution (Akanni, 2007). $\sum_1^n X_{it}$ denotes a set of other growth determinant variables including the log of average years of schooling (lnAYS), which represents the human capital as an important factor of growth, the log of terms of trade (lnTOT) and trade openness (lnOPN) account for trade policy. θ_0 is the constant or intercept, θ_1 , θ_2, θ_3 and θ_K are parameters and u_{it} idiosyncratic error or idiosyncratic disturbances.

Capturing the Role of Public Expenditures Policy

To determine the role of public expenditure policy as plausible transmission channels of the resource curse, we first examine whether productive and unproductive expenditures, as well as Dutch disease, rent-seeking and political institution variables, can act as transmission channels of the resource curse. The question is whether they can explain part of the negative effect of natural resource rents on economic growth. Therefore, we expect potential crowding-out effects, so the transmission channels must be significant and negatively

correlated to natural resource rents, equation 2, and significantly positively correlated to the economic growth as we introduce them gradually into the growth model, equation 1. In other words, if a resource curse exists, introducing the transmission channels into the growth model would reduce the negative coefficient of total natural resource rents in magnitude and will be less statistically significant. For these reasons, the significance level of total natural resource rents (NR) in identifying the transmission channels is considered at a 20% level of significance (Lay & Toman, 2004). To test this hypothesis, the indirect transmission channels model is:

$$\sum_1^m Z_{it} = \beta_0 + \beta_1 NR_{it} + \beta_2 \sum_1^n X_{it} + \epsilon_{it} \quad (2)$$

In equation (2), all variables are defined as equation (1) and β_0, β_1, β_2 are parameters, ϵ_{it} idiosyncratic error or idiosyncratic disturbances.

To investigate the impact of productive and unproductive expenditures on the relationship between total natural resource rents and economic growth, the interaction term between public expenditure (PUEX) and total natural resource rents (NR) are introduced into the growth model, equation 1. The following equation is obtained.

$$\ln GDPC_{it} = \gamma_1 \ln GDPC_{98i} + \gamma_2 NR_{it} + \gamma_3 \ln PEX_{it} + \gamma_4 (NR_{it} * PUEX_{it}) + \gamma_5 \ln UEX_{it} + \gamma_6 \ln REER_{it} + \gamma_7 \ln CPI_{it} + \gamma_8 \ln RL_{it} + \gamma_9 \ln AYS_{it} + \gamma_{10} \ln TOT_{it} + \gamma_{11} \ln OPN_{it} + u_{it} \quad (3)$$

In equation (3), all variables are defined as equation (1). $PUEX_{it}$ is the public expenditure comprising productive expenditure (PEX) and unproductive expenditure (UEX), which are separately included in equation 3 to determine their respective effects. This equation indicates that the responsiveness of economic growth to natural resource rents depends on the level of public expenditure. This implies that if countries are different in public expenditure policy, then the effect of natural resource rents on economic growth may differ across countries. Therefore, we determine ρ to indicate the responsiveness of the steady-state level of economic growth to natural resource rents. Thus, equation 3 is differentiated with respect to total natural resource rents to derive the marginal effect of natural resource rents on economic growth.

$$\frac{\Delta LnGDPC}{\Delta NR} = \rho = \gamma_2 + \gamma_4 PUEX \quad (4)$$

The four possibilities with the contingency hypotheses in this specification of the coefficients γ_2 and γ_4 are:

1- If $\gamma_2 > 0$ and $\gamma_4 > 0$, there is no resource curse hence natural resources affect the economic growth positively, and public expenditure enhances the positive effect of natural resource rents on economic growth.
2- If $\gamma_2 > 0$ and $\gamma_4 < 0$, there is no resource curse; hence natural resources affect economic growth positively, but public expenditure has a negative impact on the positive effect of natural resource rents on economic growth, which implies that public expenditure is not productive to economic growth.
3- If $\gamma_2 < 0$ and $\gamma_4 > 0$, resource curse exists; hence natural resources negatively affect economic growth. However, the public expenditure mitigates the negative effect of

natural resource rents on economic growth. If the absolute value of $\gamma_4 > \gamma_2$ then public expenditure policy is productive enough to overture the resource curse.

4- If $\gamma_2 < 0$ and $\gamma_4 < 0$, resource curse exists; natural resource rents negatively affect economic growth and public expenditure exacerbates this negative effect. Public expenditure is not productive, and it worsens the resource curse.

Threshold Calculation of Public Expenditure

As discussed in equation (4), the contingent hypothesis describes the different possibilities from which expenditure policy can affect economic growth. Hence, the threshold determination would estimate public expenditure level from which natural resource rents would benefit the economic growth and overturn the resource curse. From equation (4), the positive effect of natural resource rents on economic growth is satisfied under the following condition:

$\rho > 0$ or $\gamma_2 + \gamma_4 PUEX > 0$

Therefore, the threshold level of productive expenditure beyond which natural resource rent enhances the economic growth and solves the resource curse problem is attained when:

$$PEX > -\frac{\gamma_2}{\gamma_4}$$

At this threshold, productive expenditure is beneficial for economic growth.

Relative Importance of Transmission Channels of Resource Curse

The relative importance of transmission channels represents their respective indirect impacts on the total effect of natural resource rents on economic growth. To compare these relative effects, we determine the direct, the indirect and the total effect of natural resource rents on economic growth. Thus, the direct effect measures the effect of natural resource rents on growth in the presence of transmission channels (Equation 1), the indirect effect estimates the effect that natural resource rents have on economic growth through the transmission channels, and the total effect is the sum of direct and indirect effects. This is to understand the multi-faceted effect of natural resource rents on growth through those transmission channels of the resource curse. The indirect effects indicate to what extent natural resource rents impact economic growth through hampering the adoption of public expenditure policy, stabilising the exchange rate, fighting corruption and strengthening the rule of law. It is obtained by substituting the indirect transmission channels model (Equation 2) into the growth model (Equation 1). The following growth model is obtained

$$GDPC_{it} = (\theta_0 + \theta_3\beta_0) + \theta_1 GDPC_{98it} + (\theta_2 + \theta_3\beta_1)NR_{it} + (\theta_3\beta_2 + \theta_4)\sum_1^n X_{it} + \theta_3\epsilon_{it} + u_{it} \quad (5)$$

In equation 5, all variables are defined as equation 1. This equation represents the growth model with the direct and indirect effect of natural resource rents on economic growth. $(\theta_0 + \theta_3\beta_0)$ is the constant or intercept, θ_3 represents the coefficients of the transmission channels in the growth model. β_1 represents the coefficient of the total natural resource rents in the indirect transmission channel model. θ_2 indicates the coefficient of the direct effect of total natural resource rents in the growth model. $\theta_3\beta_1$ is the indirect effect of natural resources on economic growth. $(\theta_2 + \theta_3\beta_1)$ is the total effect of natural resource rents on economic

growth through transmission channels. $\sum_1^n X_{it}$ is added as growth determinants for robustness check. The equation 5 informs us to what extent the economic growth decreases through the transmission channels mechanism, if the natural resource rents increase by one unit. Therefore, the percentage of each transmission channel in the total effect of natural resource rents on economic growth is calculated by taking the indirect effect of each transmission channel (TC) over the total effect of natural resource rents. The higher the percentage, the greater the importance of the transmission channels of the resource curse.

The relative importance of TC = $\frac{\theta_3\beta_1}{\theta_2+\theta_3\beta_1}$ x 100%.

$\theta_3\beta_1$: Indirect effect of transmission channels
$\theta_2 + \theta_3\beta_1$: Total effect of natural resource rents

Data Description

The data used in the study are balanced annual secondary data, collected from the World Bank database except for the Corruption Perception Index, the Rule of Law Index and Trade Openness, which are collected from Transparency International reports, Worldwide Governance Indicators, and the United Nations Conference on Trade and Development respectively. The economic growth is measured by the real annual GDP per capita using GDP per capita purchasing-power-parity (PPP). The natural resource abundance is measured by total natural resource rents as a percentage of GDP. This includes non-renewable (oil, gas, minerals, coal) and renewable natural resources (forest). The productive expenditures refer to government expenditures that directly affect the economic growth rate in the long run by determining an increase in the rate of capital accumulation, which includes both human and physical capital (education, health, infrastructure etc.) (Bhatt & Sardoni, 2016). It is represented by gross fixed capital formation as a percentage of GDP. Unproductive expenditures consist of government expenditures that do not directly affect capital accumulation and growth, and do not create an asset, such as maintenance of law and order, public administration, etc (Bhatt & Sardoni, 2016). It is represented by general government final consumption expenditure, as a percentage of GDP. The real effective exchange rate is a measure of the value of a currency against a weighted average of several foreign currencies divided by a price deflator or index of costs.

Corruption perception index ranks countries by their perceived levels of public sector corruption, the scores lie between 0 and 10, where 0 denotes very corrupt, and 10 is very clean. The rule of law variable is normalized so that the scores lie between 0 and 5 using Johnson's (1948) technique simplified by Burbidge et al., (1988) to allow the log form, where 0 corresponds to a weak government and 5 to good government performance in implementing sound policies and regulations that enable and promote the private sector development. Average years of schooling is the average number of completed years of education of a country's population aged 25 years and older, excluding years spent repeating individual grades (UNESCO). Terms of trade index are the percentage ratio of the export unit value indexes to the import unit value indexes, which is measured. Trade Openness is the sum of exports and imports of goods and services measured as a share of gross domestic product (GDP).

Results and Discussion

Natural Resource Curse Evidence

To test the resource curse hypothesis, we estimate the relationship between the total natural resource rents and the economic growth using the Feasible Generalised Least Squares (FGLS) estimator. The FGLS estimator provides robust and unbiased results in the presence of serial correlation, heteroskedasticity, and cross-sectional dependence when N < T (Hoechle, 2007). The results are presented in Table 1. In order to check for the robustness of the resource curse, we estimate the same equation using Dynamic Ordinary Least Squares (DOLS) estimator developed by Kao and Chiang (2000) to control for eventual endogeneity (Table 1, column 3). We also introduce the initial income variable to see if the resource curse persists and determine the dynamic behaviour of the model.

Table 1
Growth Regression with FGLS and DOLS

Variables	Overall sample		
Independent Variables	FGLS (1)	FGLS (2)	DOLS (3)
lnNR	-0.0239**	-0.0170**	-0.0741**
	(-2.32)	(-2.27)	(-2.27)
lnGDPC98		0.997***	
		(4.93)	
Const	6.739***	0.198	
	(180.84)	(0.15)	
N	315	315	270
Wald chi2(10)	5.36	30.00	5.15
Prob > chi2	0.002	0.0000	0.002

Note: t-statistics in parentheses and (*), (**), (***) represent the significance level of the coefficients at the 10%, 5% and 1% level respectively. The DOLS from Kao and Chiang (2000) is used with lag 1 and lead 1, but the results presented here do not display lag and lead variables.

According to the results displayed in Table 1, the coefficients of total natural resource rents are consistently negative and statistically significant at 5% level in all regressions. This indicates a statistically significant long-run negative relationship between total natural resource rents and economic growth, which confirms the presence of the resource curse in the West Africa sample from 1998 to 2018. Hence, with any 10% increase in natural resource rents, the economic growth is expected to decrease by 0.17% per year (Table 2, column 2). The resource curse sign persists after controlling for initial income and endogeneity, indicating the robustness of resource curse. The initial income (lnGDPC98) coefficient is positive and statistically significant at the 1% level (Table 2, column 2), denoting a strong growth dynamic from year to year. As expected, this result shows the absence of conditional convergence among countries. It implies that although most countries are rich in natural resources, they are different in many aspects, and a dynamic economic growth characterises them. These results are supported by (Çevik et al., 2017; Jalloh, 2011; Sachs & Warner, 1995). Figure 2 shows the scatterplot of the relationship between total natural resource rents and economic growth.

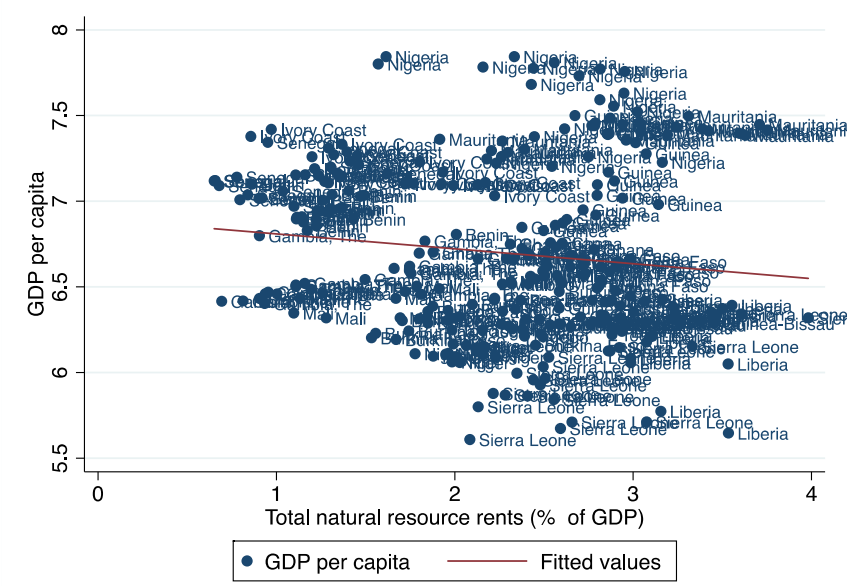

Figure 2 Scatterplot of the relationship between total natural resource rents and economic growth in West Africa.

Thus, it can be concluded that natural resource abundance inhibits the economic growth in West Africa, supporting the resource curse to be a strong theory contrary to Alexis (2004), who questioned the existence of the resource curse attributing it to omitted variables bias issue**.**

Identification of Transmission Channels of the Resource Curse

In this section, we identify the transmission channels of the resource curse among productive expenditure (PEX), unproductive expenditures (UEX), Dutch disease (REER), rent-seeking (CPI) and political institution (RL). Therefore, they must first be significant and negatively correlated with total natural resource rents and positively related to economic growth. This is because a transmission channel serves as intermediaries in creating the negative correlation between natural resource rents and economic growth. The relationship between total natural resource rents and the transmission channels is estimated by adding other growth determinant variables, namely average years of schooling, terms of trade and trade openness using equation 2. The results are presented in Table 2.

Table 2
Indirect Transmission Channels

Independent variables	Dependent variables				
	lnPEX (1)	lnUEX (2)	lnREER (3)	lnCPI (4)	lnRL (5)
lnNR	-0.0743*	-0.0128	-0.0666**	-0.0301*	-0.0562***
	(-2.52)	(-0.55)	(-2.85)	(-1.58)	(-3.43)
lnAYS	0.0246	-0.188**	0.0955	-0.0405	-0.131***
	(0.34)	(-2.95)	(1.52)	(-0.75)	(-3.73)
lnTOT	0.199***	0.271***	0.696***	0.166***	0.0833***
	(4.68)	(7.12)	(18.35)	(6.54)	(4.30)
lnOPN	0.531***	0.360***	0.307***	0.0826***	0.111***
	(2.72)	(3.31)	(1.61)	(2.59)	(4.44)
N	315	315	315	315	315
Wald chi2(10)	7705.73	7347.98	23226.44	1444.34	72.33
Prob>chi2	0.0000	0.0000	0.0000	0.0000	0.0000

Note: t-statistics in parentheses and (*), (**), (***) represent the significance level of the coefficients at the 10%, 5% and 1% levels, respectively.

As expected in Table 2, all plausible transmission channels are negatively correlated to total natural resource rents (lnNR) and statistically significant except for unproductive expenditure (UEX), which is statistically insignificant. These results imply that the productive expenditure (PEX), Dutch disease (REER), rent-seeking (CPI) and political institution (RL) significantly explained the variation in total natural resource rents, whereby any 10% increase in total natural resource rents decreases productive expenditure (PEX) by -0.7%, real effective exchange rate (REER) by -0.67%, corruption perception index (CPI) by -0.3% and the rule of law by -0.56% per year. The effects of the explanatory variables are mixed in different models. The average years of schooling (AYS) is negative and statistically significant with the unproductive expenditure (UEX) and the rule of law models at 5% and 1% level respectively (Table 2, columns 2 and 5). Both terms of trade (TOT) and trade openness (OPN) are statistically significant and positive in all models at the 1% level. Next, we introduce these plausible transmission channels gradually into the growth equation (Equation1) to investigate if they can explain part of the negative coefficient of total natural resource rents' effect on economic growth. The results are presented in Table 3.

Table 3
Growth regression with FGLS estimator for transmission channels

Independent variables	FGLS (1)	FGLS (2)	FGLS (3)	FGLS (4)	FGLS (5)	FGLS (6)	FGLS (7)
lnGDPC98	0.997***	0.984***	0.976***	0.970***	0.961***	0.933***	0.893***
	(4.93)	(14.39)	(14.52)	(17.98)	(20.30)	(27.34)	(28.35)
lnNR	-0.0170****	-0.0167****	-0.0143****	-0.0134**	-0.0119*	-0.008*	-0.0149*
	(-2.27)	(-2.10)	(-1.79)	(-1.60)	(-1.36)	(-0.90)	(-1.48)
lnPEX		0.0149	0.0164	0.0190*	0.0183*	0.0263**	0.0277**
		(1.40)	(1.54)	(1.72)	(1.59)	(2.03)	(2.06)
lnUEX			-0.0251**	-0.0266**	-0.0282**	-0.0358**	-0.0271*
			(-1.97)	(-1.98)	(-2.01)	(-2.13)	(-1.59)
lnREER				0.00970	0.00850	0.0163	0.0233
				(0.40)	(0.33)	(0.54)	(0.78)
lnCPI					0.0457**	0.0626***	0.0722***
					(2.05)	(2.43)	(2.79)
lnRL						-0.00142	-0.0054
						(-0.06)	(-0.23)
lnAYS							0.108***
							(4.34)
lnTOT							0.0412*
							(1.96)
lnOPN							0.0193
							(0.85)
_cons	0.198	0.227	0.331	0.319	0.333	0.455	0.279
	(0.15)	(0.50)	(0.74)	(0.84)	(0.99)	(1.68)	(1.05)
N	315	315	315	315	315	315	315
Wald chi2(10)	30.00	223.48	234.28	355.86	468.09	868.28	1210.25
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: t-statistics in parentheses and (*), (**), (***) and (****) represent the significance level of the coefficients of lnNR at the 20%, 15% and 10% and 5% levels, respective and 5% levels, respectively

From Table 3, it can be observed that with the introduction of the possible transmission channels into equation 1, the coefficient of total natural resource rents (lnNR) remains negative in all regressions and gradually decreases as we include the transmission channel variables. It becomes less significant as these variables explain part of the negative effect of

total natural resource rents on economic growth. However, only productive expenditure (PEX) and rent-seeking (CPI) are statistically significant and positively related to the economic growth, which fulfils the second requirement of resource curse transmission mechanism (Table 3 column 6). The results indicate that the resource curse in the West African region is explained by the indirect effect of productive expenditure (gross fixed capital formation) and rent-seeking behaviours (corruption perception index). The results imply that dependence on natural resource rents crowds out productive expenditure (gross fixed capital formation), thereby inhibiting economic growth. This could be explained by the fact that the abundance of natural resource reduces the need for savings and investment due to the availability of natural resources that provide a continuous flow of future income, less dependent on man-made transfers of capital for the future period, hence damping the productive manufacturing sector (Gylfason & Zoega, 2006).

In addition, natural resource price volatility is also the source of the vulnerability of the resource-rich economy, which drives the economy relatively often from booms to busts (Sachs & Warner, 1999). Therefore, discouraging and complicating long-term planning that is characterised by distorting public expenditure policies (Ploeg & Poelhekke, 2009).This finding corroborates that of Karimu et al (2016) who argued that natural resource rents on average tend to induce public investment in Sub-Saharan African countries. They highlight that the effect is greater in countries with weak political institutions and characterised by a large investment deficit. Government of such a country invests more in national security (Military) and exclusively supports its ethnic group to protect its interests in the resource-rich geographic region (Ross, 2001). Hu et al (2020) found that fixed-asset investment is negatively correlated with energy resources in six provinces of China and positive with economic growth. Thus, confirming the transmission channel through the productive expenditure channel.

The results also show that rent-seeking channel through corruption perception index (CPI) is consistent with Jalloh (2011), who claimed that high corruption in the public sector and frequent civil conflicts channel the negative impact of resource endowments on economic growth in West Africa. Moreover, it is argued that the natural resource boom is associated with the rise of groups of political interest, which influence the political elites by the means of corruption to adopt policies that favour them in order to gain access to the natural resource rents (Torvik, 2002). Hence rent-seeking behaviour can provoke corruption and distort resource allocation (Shleifer & Vishny, 1993).

Robustness of the Growth Model

For the robustness check, first, we control for other growth determinant variables in the growth model, namely average years of schooling (AYS), terms of trade (TOT) and trade openness (OPN), to see if the identified transmission channels still maintain their signs and significances. The results are presented in Table 3, column 7. The results show that all the transmission channels identified conserve the same sign and significance. The real effective exchange rate and the rule of law variables remain insignificant. The resource curse sign also persists with a 10% significance level. The control variables are positive and statistically significant except for trade openness. The average years of schooling (AYS) and the terms of trade (TOT) are statistically significant at 1% and 10%, respectively. Second, the growth model (equation 1) is estimated with DOLS estimator to control for eventual endogeneity in the model. The results are displayed in Table 4, column 1, and column 4 after controlling for AYS, TOT and OPN. It could be seen that the DOLS estimates are consistent with FGLS results with higher significance levels and different magnitudes. As expected, the variables of interest,

productive expenditure (PEX) and unproductive expenditure (UEX) are both highly significant at the 1% level compared to the FGLS estimates. The Corruption Perceptions Index (CPI) is positive and statistically significant at a 1% level in both estimates. The rule of law (political institution) is negative and statistically significant at the 1% level, which indicates that the political institution is having a negative impact on growth. This denotes the character of bad political institutions in West Africa. Moreover, the average year of schooling (AYS) and the terms of trade are both positively linked to the economic growth as in FGLS estimates and statistically significant at the 1% level. Therefore, the DOLS and FGLS estimators come to a similar conclusion in estimating the growth model.

The Role of Productive and Unproductive Expenditures

The roles of productive and unproductive expenditure policies are examined by introducing their respective interaction terms to the total natural resource rents using equation 3. Therefore, it is analysed whether the marginal effect of total natural resource rents on growth depends on expenditure policy. The hypothesis is that a good expenditure policy would overturn the resource curse. So, with the introduction of the interaction terms, the sign of the resource curse would disappear, and these interaction terms should be positive or the absolute value of the coefficient of the interaction terms (γ_4) should be larger than the absolute value of the coefficient of total natural resource rents (γ_2). In contrast, the bad expenditure policy would maintain and exacerbate the resource curse with a negating effect of interaction terms. Table 4 represents the growth model results with interaction terms, and after controlling for AYS, TOT and OPN variables.

Table 4
Growth regression with DOLS with interaction terms

	Growth	Interaction Terms		Robust Growth	Robust Interaction terms	
		lnNR*lnPEX	lnNR*lnUEX		lnNR*lnPEX	lnNR*lnUEX
Independent Variables	DOLS (1)	DOLS (2)	DOLS (3)	DOLS (4)	DOLS (5)	DOLS (6)
lnNR	-0.264***	-0.958***	-0.262***	-0.282***	-0.678***	-0.286***
	(-10.68)	(-9.54)	(-10.61)	(-11.64)	(-7.85)	(-11.71)
lnPEX	0.661***	0.0772	0.664***	0.596***	0.268***	0.598***
	(23.47)	(0.87)	(23.28)	(23.11)	(3.51)	(23.02)
lnUEX	-0.418***	-0.423***	0.781**	-0.316***	-0.322***	0.379
	(-11.11)	(-11.22)	(3.27)	(-9.23)	(-9.48)	(1.79)
lnREER	0.946***	0.874***	1.556***	0.737***	0.706***	0.956***
	(17.18)	(15.72)	(17.11)	(15.19)	(14.53)	(11.68)
lnCPI	0.636***	0.687***	0.637***	0.590***	0.620***	0.707***
	(9.33)	(10.06)	(9.30)	(9.70)	(10.29)	(11.75)
lnRL	-0.519***	-0.534***	-0.522***	-0.483***	-0.493***	-0.719***
	(-7.29)	(-7.50)	(-7.36)	(-7.77)	(-8.00)	(-11.21)
lnNR*lnPEX		0.239***			0.137***	
		(7.11)			(4.72)	
lnNR*lnUEX			-0.261***			-0.133**
			(-5.22)			(-2.98)
lnAYS				0.269***	0.253***	0.330***
				(3.57)	(3.40)	(4.44)
lnTOT				0.365***	0.343***	0.368***
				(9.83)	(9.31)	(9.74)
lnOPN				0.0188	0.00432	-0.0145
				(0.46)	(0.11)	(-0.35)

N	270	270	270	270	270	270
Wald chi2(10)	1356.77	1423.11	1676.41	1403.06	1487.61	1545.75
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000

Note: t-statistics in parentheses and (*), (**), (***) represent the significance level of the coefficients at the 10%, 5% and 1% levels, respectively. The DOLS form Kao and Chiang (2000) is used with lag 1 and lead 1, but the results presented here do not show lag and lead variables

The variables of interest in Table 4 are total natural resource rents (lnNR), productive expenditure (lnPEX), unproductive expenditure (lnUEX) and their respective interaction terms to the total natural resource rents (lnNR*lnPEX), (lnNR*lnUEX). The results indicate that after the introduction of the interaction terms into the growth model separately, the sign and significance of lnNR, lnPEX and lnUEX and their interaction terms are consistent after controlling for AYS, TOT and OPN variables, which denotes the robustness of the regressions.

Capturing the Impact of Productive Expenditure Policy (LnNR*lnUEX)

Table 4, columns 2 and 5 show that after the introduction of the interaction terms of productive expenditures (lnNR*lnPEX) in the growth model, the resource curse signs persist and are statistically significant at the 1% level. The implication is that the effect of productive expenditure policy on economic growth, which depends on the level of natural resource rents, is not sufficient to fully capture most of the indirect negative effect of natural resource rents on economic growth. Thus, describing the deficit and ineffectiveness of productive expenditure. The coefficients of lnNR*lnPEX and lnPEX are positive and statistically significant at the 1% level. The effect of positive lnNR*lnPEX on growth shows that productive expenditure policy has a positive impact on the negative effect of natural resource rents on economic growth depending on the level of natural resource rents, thereby reducing that negative effect, hence mitigating the effect of the resource curse. This result implies that high natural resource rents stimulate the impact of productive expenditure on economic growth. Therefore, countries with high natural resource rents can reduce or reverse the resource curse as more natural resource rents are channelled into productive government expenditure (Karimu et al., 2016).

These findings are supported by Arin et al., (2019), who argued that rising resource prices favoured resource-dependent countries during the boom period. The study reveals that public productive expenditure deficit characterises the resource curse in West Africa. These findings are consistent with (Karimu et al., 2016), who reported a large investment expenditure deficit in natural resource-rich developing countries with weak instructional quality. The study also highlights the weak institutional quality in the region, as the political institution through the rule of law has a statistically negative impact of 1% significance on growth as well as the high level of corruption. As noted earlier, natural resource rents induce productive expenditure, evidenced by their negative relationship in Table 2, column 1. Thus productive expenditure threshold beyond which the resource curse is reversed is reached when the government spends at least 5% of GDP each year as productive expenditure resulting in fixed capital formation.

Capturing the Impact of Unproductive Expenditure Policy (LnNR*lnUEX)

Table 4, columns 3 and 6, indicates that, after the introduction of the interaction between total natural resource rents (lnNR) and unproductive expenditure (lnNR*lnUEX) into the growth model, the resource curse signs remain negative and statistically significant at 1%.

This implies that the effect of government general final consumption expenditure (unproductive expenditure) on economic growth depending on the level of natural resource rents, is insufficient to fully capture most of the indirect negative effect of natural resource rents on economic growth. Though the coefficients of lnNR*lnUEX is negative and statistically significant at the 1% level. Unproductive expenditure has an insignificant direct effect on growth. The effect of negative lnNR*lnUEX on growth signifies that the government's general final consumption expenditure policy has a negative impact on the negative effect of natural resource rents on growth, thus exacerbating that negative effect, hence worsening the resource curse. These results indicate that high natural resource rents dampen the impact of unproductive expenditure on economic growth. Therefore, countries with high natural resource rents are likely to experience low economic growth as the government consumption expenditure policy is not effective to promote growth.

These findings are supported by Atkinson and Hamilton (2003), who argued that countries where governments use natural resource rents for consumption, would experience the curse of natural resources. Although unproductive expenditure is not confirmed as a transmission channel of the resource curse in West Africa, the results point that government general final consumption expenditure associated with natural resource rents aggravates the resource curse. Therefore, reducing unproductive expenditures could alleviate the resource curse.

Relative Importance of Transmission Channels

To compare the relative importance of the transmission channels, the direct, indirect and the total effect of natural resource rents on economic growth are calculated. The transmission channels confirmed in the study are productive expenditure (PEX) and corruption perception index (CPI). Their direct and indirect effects are deducted from Table 3 column 6 and Table 2, columns 1 and 4 respectively.

Table: 5
Relative importance of transmission channels

Transmission channels	Direct Effect (θ_2)	θ_3	β_1	Indirect Effect ($\theta_3\beta_1$)	Contribution $\theta_2 + \theta_3\beta_1$	Relative Importance (%)
NR	- 0.008				-0.008	64
PEX		0.0263	-0.10	-0.00263	-0.00263	21
CPI		0.0626	-0.03	-0.0019	-0.0019	15
Total				-0.00453	-0.01253	100

Source: Calculated by author

Table 5 shows that the direct effect of natural resource rents on economic growth is – 0.008, representing 64% of the total effect. The indirect effect of natural resource rents on economic growth via productive expenditure (PEX) is -0.00263. This implies that any 10% increase in natural resource rents decreases the economic growth by -0.026% per year through the productive expenditure mechanism. This effect accounts for 21% of the total effect that natural resource rents exert on economic growth. The indirect effect of natural resource rents on economic growth via corruption perception index (rent-seeking) is -0.0019. These results suggest that an additional 10% increase in natural resource rents decreases the economic growth rate by -0.019% through corruption mechanism. This effect accounts for 15% of the

total effect that natural resource rents have on economic growth. The total effect of natural resource rents on economic growth is -0.0125. The transmission channels account for 36% of the total effect that natural resources have on economic growth and 64% for natural resource rents. These results indicate that dependence on natural resources is largely responsible for the resource curse in West Africa, followed by productive expenditures (gross fixed capital formation) and rent-seeking behaviour (corruption perception index) channels.

The results are supported by Hu et al (2020), who demonstrated that the resource curse in the Chinese province of Xinjiang is caused mainly by the dependence on energy resources of about 63% and 37% by other transmission channels such as education, level of nationalisation and investment.

Conclusion

The contribution of natural resources to the economic growth in developing countries remains a myth. To analyse this paradox, the study examines the resource curse phenomenon and its relevant transmission channels in West Africa, and investigates the role of public expenditure policy in the nexus between natural resources and economic growth. A dynamic panel was adopted for the 1998-2018 period using FGLS and DOLS estimation techniques. The study enriches the literature of resource curse and its transmission channels in developing countries. The following findings are derived from the study:

- There was strong empirical evidence of the resource curse in West Africa even after controlling for growth determinant variables such as human capital, terms of trade and trade openness. The study showed that the resource curse is not only caused directly by the natural resources dependence, but it is indirectly related to various economic policies as transmission channels such as productive expenditure policy and corrupt rent-seeking behaviour.
- Government final consumption expenditure (unproductive expenditure), Dutch disease (real effective exchange rate) and political institution (rule of law) are not transmission channels of the resource curse in West Africa sample, because they failed to fully explain the resource curse transmission mechanism significantly.
- The government productive expenditure policy associated with natural resource rents mitigates the resource curse and reverses it only after a certain threshold of productive expenditure to GDP is reached.
- Government consumption expenditure exacerbates the resource curse in West Africa. Political institution characterised by the lack of the rule of law hinders the economic growth in West Africa.

The study revealed an important public expenditure policy implication, which requires a good political institutional quality based on the rule of law to promote economic growth and resolve the resource curse. First, West African countries should reduce their dependence on natural resources by diversifying the economy through an adequate allocation of natural resource rents across different economic sectors to foster the creation of fixed capital. Therefore, an active measure of expenditure policy is required to promote other sectors by increasing productive expenditures. Particularly in public infrastructure such as the education sector to increase the number of years of schooling of the population, and natural resource infrastructure to promote the domestic transformation of natural resources. Policymakers should not excessively depend on natural resources rents for government consumption expenditure. Second, a dynamic control of rent-seeking activities through a diligent fight

against corruption and the enforcement of the rule of law must be undertaken to promote growth. Third, the development of trade should be considered, the improvement of trade terms increases export revenues, which could increase a country's national income and positively affect economic growth (Fosu & Gyapong, 2011). These propositions would all together compensate for the shortage of public capital, increase the productivity of human capital, create jobs, provide different sources of revenue for the government and solve the resource curse problem over time.

Future research may be interested to identify other different plausible channels of the resource curse; factors such as colonial influence, natural resources industries and the conditionality of mining contracts are rarely addressed in the literature and should be investigated. These factors are directly or indirectly related to natural resource exploitation. For example, former colonial powers in many resource-rich African countries have political and economic influence over these countries as they desire to capture and exploit their resources (Murombedzi, 2016). Thus, future researchers should examine them to understand how those factors would probably lead to the negative effect of natural resources on economic growth. The findings suggest that natural resources become a curse because of incorrect government policy in allocating natural resource rents.

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Appendix

Figure 3 Relationship between total natural resources rents and GDP per capita growth in each selected West African country from 1998-2018.