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Natural resources, child mortality and governance quality in African countries

Sosson Tadadjeu
Dschang School of Economics and Management,
University of Dschang
E-mail: stadadjeu@yahoo.fr

Henri Njangang
Faculty of Economics and Management (LAREFA),
University of Dschang , Cameroon
E-mail: ndieupahenri@gmail.com

Simplice A. Asongu
(Corresponding author)
African Governance and Development Institute,
P.O Box 8413, Yaoundé, Cameroon
E-mails: asongusimplice@yahoo.com,
asongus@afridev.org

Brice Kamguia
The Dschang School of Economics and Management,
University of Dschang, Cameroon
E-mail: bricekamguiedj@yahoo.fr

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Sosson Tadadjeu, Henri Njangang, Simplice A. Asongu & Brice Kamguia

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Abstract

This paper contributes to the literature by investigating the effect of natural resources on under-five mortality in a sample of 50 African countries over the period 1996 to 2018. We also examine the extent to which governance shapes the relationship between natural resources and under-five mortality. Our results show that natural resources have increased under-five mortality. Resource rents also have detrimental effects on child mortality by age, gender, and the three major causes of infant mortality from infectious diseases. However, an extended analysis of different types of natural resources suggests that point resources (such as oil, natural gas and mineral rents) increase under-five mortality, in contrast to the diffuse resources (such as forest rent). We also find that governance mitigates the positive effect of natural resources on child mortality. Corresponding governance policy thresholds that should be attained in order to reverse the positive effects of natural resources on child mortality are provided. We thus suggest an increase in the funds allocated to the health sector from resource rents and encourage efforts to improve governance standards in sampled countries.

Keywords: Natural resources; Child mortality; Governance; Africa.

***JEl Classification*:** J13; O55; Q33; Q34; Q38

1. Introduction

In the last decades, the improvement of child health has been and continuous to be on the agenda of development partners and governments around the world. The United Nations, through the Millennium Development Goals (MDGs), urged international agencies and national governments to achieve Goal 4, which aimed to reduce child mortality by two-thirds between 1990 and 2015. The Sustainable Development Goals (2016-2030) also reaffirm the importance of improving child survival rates (Goal 3). Given these efforts, the under-five mortality rate fell from 9.8 million in 2000 to 5.3 million in 2018, a drop of over 45% (UN IGME, 2019). However, this apparent success hides huge disparities by region and income level. According to data from IHME (2019), in 2017, 93% of child deaths occurred in the low and middle-income countries, and the major part of these deaths were recorded in Africa. While developing countries like Peru have been able to reduce their child mortality rate by more than half between 2000 and 2017 (from 38.6 deaths per 1,000 in 2000 to 15.5 deaths in 2017), several African countries still have death rates per 1,000 greater than 100. According to the World Bank (2020), the average under-five mortality rate in Sub-Saharan Africa in 2018 was 78 per 1,000, compared to a global average of 39 per 1,000. In addition, if current trends in fertility and mortality continue, in 2030 Africa will record over 60% of deaths of children under five compared to 50% in 2013 (Liu et al., 2015).

Given the high child mortality rates in some parts of the world, particularly in Africa, and its potential political and socio-economic implications, it is highly important to understand its determinants. Recent studies have made major inroads into documenting the determinants of child mortality, highlighting the role of factors such as education (Grépin and Bharadwaj, 2015; Andriano and Monden, 2019), health expenditure (Anyanwu and Erhijakpor, 2009; Bernet et al., 2018), health aid (Mishra and Newhouse, 2009; Pickbourn and Ndikumana, 2019), trade openness (Panda, 2020), income inequality (Wilkinson and Pickett, 2006; Siddiqi et al., 2015), institutional quality (Wigley and Akkoyunlu-Wigley, 2017; Achim et al., 2019), conflicts (Gates et al., 2012), globalization (Welander et al., 2015) and recently economic complexity (Vu, 2020). The present study considers that an important factor of child mortality that has not been sufficiently analyzed is the natural resources. As Gylfason (2001) suggests, if oil revenues are well managed, they can educate, heal and create employment for populations. However, some argue that oil rent engenders authoritarianism, increases the risk and duration of conflict, increases income inequality, and leads to low institutional quality (Van der Ploeg, 2011; Ross, 2015). As an illustration in 2019, Nigeria and Angola were the two largest oil producers in Africa, but they were also the countries with some of the highest under-five mortality rates in 2018 with 120 and 77 per 1000 live births, respectively. This suggests that natural resources may paradoxically be a curse rather than a blessing.

Since the influential works of Sachs and Warner (1995, 1999) supporting the negative effect of natural resources on economic growth, several empirical and theoretical studies have analysed the relationship between natural resources and economic growth with rather mixed evidence. Several studies provide evidence of a negative relationship between natural resources and economic growth (Papyrakis and Gerlagh, 2004; Papyrakis and Gerlagh, 2007; Satti et al., 2014; Tiba and Frikha, 2020). However, other studies provide evidence rejecting the resource curse hypothesis (Brunnschweiler and Bulte, 2008; Adika, 2020). Through a meta-analysis for 1,419 estimates, Dauvin and Guerreiro (2017) show that while there is a soft curse in developing countries, natural resources do not harm growth in developed countries. The way natural resources are measured, as well as their "appropriability" explains part of the heterogeneity of the results found in the literature. In recent decades, studies have extended the effect of natural resources to other aspects of economic development such as health outcomes (De Soysa and Gizelis, 2013; El Anshasy and Katsaiti, 2015; Edwards, 2016; Kim and Lim, 2017; Chang and Wei, 2019; Madreimov and Li, 2019; Chang, 2020). However, few studies have focused on the effect of natural resources on child mortality, particularly in Africa. Empirical literature on the effect of natural resources on child mortality is still at the nascent stage and the results remain inconclusive. Cotet and Tsui (2013) show that oil reduces infant mortality in 150 countries. Wigley (2017) finds that petroleum-poor countries outperform petroleum-rich countries for reducing under-five mortality in a panel of 167 countries. Bellinger and Fails (2020) analyze the effect of oil wealth on child mortality rates in non-democratic countries and identify some specific conditions under which oil can be detrimental to child mortality. What about Africa?

Apart from the literature on natural resources and health, the role of governance has received very little attention. Mehlum et al. (2006) suggest that aggregate income is reduced by natural resources when institutions can easily be captured by a few elite, while when institutions cannot easily be captured more resources engender higher income levels. Several studies share this view that natural resources interact with the quality of institutions, which determines whether resource revenues become a blessing or a curse (Robinson et al., 2006; Epo and Faha, 2020). The effect of natural resources on the economy depends critically on institutions, as these determine the extent to which political incentives are embedded in policy outcomes (Robinson et al., 2006). Countries with institutions that promote state accountability and competence will benefit from natural resources. Countries without such institutions may suffer from a resource curse. Considering this argument, this study seeks to understand if governance quality plays any significant role in the relationship between natural resources and child mortality in Africa.

This paper departs from the previous studies and attempts to fill the gap in the existing literature in at least four points. **First**, we contribute to the growing literature on the resource curse within one specific region. We focus on Africa, which is a particularly interesting case given that Africa is a resource-rich continent but paradoxically a part of the world where children's health problems are much more acute. This study therefore aims to fill this gap by providing one of the first empirical studies on the relationship between natural resources and child mortality in Africa. **Second**, we analyze the effect of resource rents on child mortality by the age of child, gender, as well as the three main causes of child mortality. Despite progress in the fight against childhood diseases, infectious diseases[1] remain a major cause of death among children under five, particularly in sub-Saharan Africa and South Asia. Pneumonia (15%), diarrhoea (8%) and malaria (5%) are identified as the leading causes of death among children under five worldwide (UN IGME, 2019). Using these original indicators makes it possible to identify the age, gender and cause of death for which the effects of natural resources are most detrimental. To our knowledge, no study has tested the effect of natural resources on these three dimensions of child mortality. **Third**, several studies have shown that different types of natural resources can have different effects on economic growth (Bulte et al., 2005; Yilanci et al., 2021), education expenditures (Cockx and Francken, 2016), and access to drinking water and sanitation (Tadadjeu et al., 2020). Their argument implies that different types of natural resources may also have different effects on child mortality. Despite these arguments, existing studies have focused on the effect of oil on infant mortality, which gives only a partial view of the resource curse. We fill this gap by analyzing the effects of five different types of natural resources on under-five mortality. **Fourth**, we examine the moderating role of institutional quality in the relationship between natural resources and child mortality. We assume that better governance promotes transparency in the collection of natural resource revenues and improves the quality of investments, particularly in the health sector. To the best of our knowledge, this paper is the first to empirically examine the role of governance in the relationship between natural resources and child mortality. Besides using the six governance indicators provided by the World Governance Indicators (WGI) of the World Bank, we construct four other indicators through a Principal

[1] Infectious diseases account for 53% of under-five deaths worldwide in 2018 (UN IGME, 2019).

Component Analysis (PCA), one representing global governance, and the other three representing political governance, institutional governance, and economic governance (Asongu and Nwachukwu, 2016, 2017). We use both individual indicators and composite indicators of governance variables to increase the relevance of policy implications.

To sum up, using the two-step system Generalized Method of Moments (GMM), the following results are established. We find evidence of a positive and significant relationship between natural resources and under-five mortality. Natural resources also have a positive effect on child mortality by age, gender, and the major causes of infant mortality from infectious diseases (i.e. pneumonia, diarrhoea and malaria). Looking at the type of natural resources, we find that point resources such as oil, natural gas and minerals have a positive effect on under-five mortality, as opposed to diffuse resources (i.e. such as forest rent). Finally, we show that the quality of governance enables African governments to partially break resource curse. Corresponding governance policy thresholds that should be attained in order to reverse the positive effects of resources on child mortality are provided.

The rest of this paper is organized as follows: Section 2 describes the theoretical background through which natural resources affect child mortality. Section 3 discloses the data and methodology, while Section 4 presents the empirical results. Section 5 concludes with implications and future research directions.

2. Natural resources and child mortality: Theoretical background

Several studies have provided a review of the literature on transmission channels explaining the negative correlation between natural resources and development (see Frankel, 2010; Badeeb et al., 2017). Based on this theoretical framework, one can conjecture several channels to explain the link between natural resources and child mortality. We group these channels into two broad categories: political channels and economic channels.

2.1 Political channels

First, we suggest natural resources can translate into higher infant mortality through their pernicious political effects (institutions and civil conflicts).

Commodities can be a blessing or a curse for resource-rich countries, some of which suffer severely from corruption, while others have been managed to prosper with a relatively low level of corruption (Neudorfer, 2018). Regarding the type of natural resources, economists have identified oil as a substantial cause of corruption (Okada and Samreth, 2017). Arezki and Bruckner (2011) establish that a growth in oil rent significantly increases corruption and deteriorates political rights. Similarly, Okada and Samreth (2017) find that while more oil rents increase corruption, non-oil resources do not. Regarding the effect of corruption on health outcomes, Li et al. (2018) establish that corruption considerably reduces life expectancy and immunization rates and increases mortality rates. Achim et al. (2019) also provide clear evidence that corruption has adverse effects on physical and mental health. Thus, resources-dependent governments may also be marked by high levels of corruption, which reduces the provision of care for improved child health.

Based on the rentier state theory, several studies have analyzed the relationship between resource wealth, especially oil wealth and democracy. Most of these studies validate the premise that higher levels of oil wealth are associated with more stable autocratic governments which are less likely to change to liberal democratic governments (Ross, 2015; Bergougui and Murshed, 2020). Government dependence on oil reduces democracy and accountability by weakening the links between state and society, facilitating government investment in patronage and repression, and fostering increased political corruption (Ross, 2015). Using data on historical oil exploration, discovery, and extraction in Africa, Anyanwu and Erhijakpor (2014) show oil wealth is associated with a low probability of democratization. A large body of research has shown that political regime is a key determinant of health (Besley and Kudamatsu, 2006; Wigley and Akkoyunlu-Wigley, 2017). Authors such as Besley and Kudamatsu (2006) establish that democracy contributes to improved health as measured by life expectancy and infant mortality. It is therefore possible to postulate that natural resources hinder democracy, which will cause higher under-five mortality.

Concerning the civil conflicts, the appropriation and exploitation of natural resources has frequently been mentioned as a cause of civil conflicts (Collier and Hoeffler, 2004; Welsch, 2008). In fact, competition for rents can exacerbate existing tensions between ethnic groups or factions in power, leading to armed conflict. Experts have cited greed and grievances as reasons for how natural resources can lead to conflict. Whereas the grievance hypothesis regards civil wars as originating from poverty, the greed-based explanation (Collier and Hoeffler, 2004) emphasizes voracity as a cause of conflict (Welsch, 2008). In conflict-affected countries, the damage to the health system may subsequently manifest itself in the destruction of health services, the lack of medical personnel, and the massive displacement of populations exposing them to multiple risk factors (Gates et al., 2012). These risk factors include the increasing prevalence of infectious diseases, including diarrhoeal diseases and respiratory infections, which are among the leading causes of child mortality. One can therefore postulate that natural resources, through its effects on the risk and duration of civil conflicts, can lead to higher child mortality rates.

2.2 Economic channels

Second, we suggest natural resources could lead to higher mortality rates through two economic mechanisms, namely income inequality and health expenditure.

There is an emerging strand of literature suggesting that natural resources are associated with increased income inequality (Fum and Hodler, 2010; Buccellato and Mickiewicz, 2009; Carmignani, 2013). Natural resources are often unequally distributed within countries, between ethnic groups, or between regions. Basedau and Lay (2009) show that elites may distribute rents selectively and create clientelism networks, from which those who largely benefit are leaders of politically important. Through this channel, personal ties motivate access to and distribution of resource revenues which end-up with a relatively small part of the population. Regarding the effect of income inequality on health, the health economy literature provides evidence suggesting that income inequality is associated with poorer health (see Wilkinson and Pickett (2006) for a meta-analysis). Therefore, if resource endowment is an additional factor leading to income inequality, other things being equal, we should see evidence that natural resources are associated with higher under-five mortality rates.

Another economic channel through which natural resources can affect child mortality is health expenditure. An important measure of the level of investment in health is health expenditure in a country. Accordingly, government expenditure such as health expenditure, can enable the administration and provision of health care services and hence play the role of a relevant policy tool for the government (Anyanwu and Erhijakpor, 2009). Thus, public health expenditure is recognized as having an important contribution to improving health outcomes (see Bernet et al., 2018; Chireshe and Ocran, 2020). Theoretically, natural resources can be an effective way for resource-rich countries to increase health budgets and therefore positively affect health outcomes. However, emerging literature shows that natural resources are negatively associated with health expenditure (Cockx and Francken, 2014; Turan and Yanıkkaya, 2020). Cockx and Francken (2014) found a significant inverse relationship between natural resources and public health expenditure. Consequently, through its negative effects on health expenditure, natural resources will lead to a decrease in health care provision and an increase in child mortality.

3. Data and methodology

3.1 Data

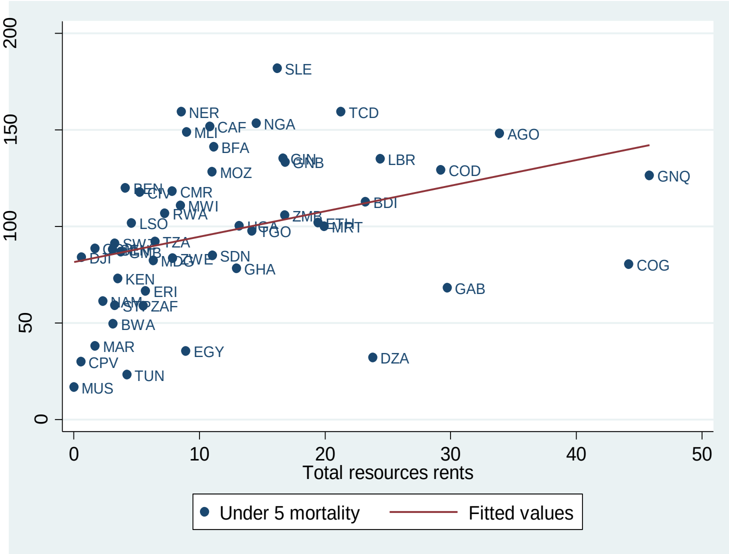
Our sample covers 50 African countries over the period 1996-2018 with data from various sources: World Bank (2020): World Development Indicators (WDI), World Bank (2020): World Governance Indicators (WGI), World Health Organisation (WHO, 2020): Global Health Observatory data repository, and Alesina et al. (2003). The periodicity under investigation is chosen according to data availability constraints.

Dependent variable

The principal dependent variable is the under-five mortality rate (mortality_5) which represents the probability, per 1000 live births, that a newborn baby will die prior to reaching the age of five, if object of age-specific mortality rates of the specified year. For robustness, we also use the under-five mortality rate by gender, distinguishing between female mortality rate and male mortality rate aged 0 to 5 years. Although under-five mortality is the most widely used variable for measuring child mortality, it is worth noting that this variable does not capture all dimensions of child mortality. As alternative measures in the robustness analyses, we use the infant mortality rate, which represents the mortality of children aged 0-12 months (Infant mortality), and the neonatal mortality rate, which denotes the mortality of children aged 0-28 days (Neonatal mortality). We also use indicators representing the three main causes of child mortality in developing countries, namely, mortality from pneumonia, mortality from diarrhea, and mortality due to malaria. These indicators reflect mortality per 1,000 live births of children aged 0-59 months due to pneumonia, diarrhea, or malaria. Data for the latter measures are available in the WHO (2020)[2].

[2]Data for these indicators is available for the period 2000-2017.

Figure 1: Relationship between natural resources and under-five mortality



Independent variable

Our main independent variable is the total natural resource rents as a percentage of GDP (Total rents). Natural resource rents are the sum of oil, natural gas, coal, mineral, and forest rents. In order to assess the incidence of different natural resource types, coal rent, oil rent, forest rent, gas rent, and mineral rents are used, all expressed as a percentage of GDP. Figure 1 shows a positive correlation between natural resources and under-five mortality, which is consistent with the resource curse hypothesis. In other words, resource-rich countries have on average higher under-five mortality rates compared resources-poor countries.

Governance variables

We analyze the role of governance in the relationship between natural resources and under-five mortality using six unbundled governance indicators; namely: the rule of law, control of corruption, regulatory quality, government effectiveness, voice and accountability, and political stability plus four measures that are bundled through PCA, notably political governance, economic governance, institutional governance, and general governance.

According to Asongu and Nwachukwu (2016, 2017), this study employs PCA in order to derive composite governance indicators. Building on the attendant literature, the PCA is a widely used a statistical method that is employed to reduce a set of highly correlated variables into a smaller set of uncorrelated variables which are known as principal components (PCs).“*Eco. gov (economic governance) is the formulation and implementation of policies that deliver public commodities. Pol. Gov (political governance) is defined as the election and replacement of political leaders. Inst. gov (institutional governance) is the respect of the State and citizens of institutions that govern interactions between them* (Asongu and Nwachukwu, 2017 p.258)”. Table 1 presents the results of the PCA and the construction of each governance indicator. Table 2 displays the summary statistics.

Control variables

To ensure that the results are not biased by omission of variables and in line with the recent literature on child mortality (Wigley, 2017; Pickbourn and Ndikumana, 2019), this paper includes several controls variables. They comprise log of GDP per capita, female primary school enrollment, urban population growth and prevalence of female to HIV/AIDS. For robustness, we also use additional control variables such as women parliamentarians, trade openness, official development assistance (ODA), CO2 emissions and ethnic fractionalization. The negative relationship between income per capita and child mortality is well documented in health economic literature (Khanam et al., 2009). Higher incomes may be correlated with healthier environments (including housing), more nutritious diets. While several studies agree that women education, particularly through better knowledge of medical practices in child health, reduces child mortality (Grépin and Bharadwaj, 2015), the prevalence of HIV/AIDS among women is rather a factor that is detrimental to child survival (Adetunji, 2000). However, the effect of urbanization is mixed (see Brueckner, 2019). For robustness, we also use additional control variables such as women parliamentarians, trade openness, ODA, CO2 emissions and ethnic fractionalization.

Table 1: Principal component analysis (PCA) for governance

Principal components	Eigen value	Component matrix (loadings)						Proportion	Cumulative proportion
		VA	PS	GE	RQ	CC	RL		
First PC (G. Gov)	4.695	0.38	0.356	0.425	0.418	0.414	0.444	0.782	0.782
Second PC	0.494	0.1390	0.857	-0.356	-0.321	-0.108	-0.062	0.082	0.865
First PC (Pol. Gov)	1.607	0.707	0.707					0.803	0.803
Second PC	0.392	-0.707	0.707					0.196	1.000
First PC (Eco. Gov)	1.870			0.707	0.707			0.935	0.935
Second PC	0.129			0.707	-0.707			0.064	1.000
First PC (Inst. Gov)	1.865					0.707	0.707	0.933	0.933
Second PC	0.134					0.707	-0.707	0.067	1.000

P.C: Principal Component. CC: Control of Corruption. GE: Government Effectiveness. PS: Political Stability. R.Q: Regulation Quality. RL: Rule of Law. VA: Voice and Accountability. G. Gov (General Governance): First PC of VA, PS, RQ, GE, RL and CC. Pol. gov (Political Governance): First PC of VA and PS. Eco. gov (Economic Governance): First PC of RQ and GE. Inst. gov (Institutional Governance): First

PC of RL and CC.

Table 2: Descriptive statistics

Variables	Obs	Mean	Std.	Min	Max
Child Mortality					
Mortality_5	1,150	97.491	48.361	14.5	265.8
Female mortality_5	1,150	91.441	46.480	13	261.5
Male mortality_5	1,150	103.229	50.223	15.9	269.8
Infant mortality	1,150	62.650	27.231	12.5	157.5
Neonatal mortality	1,150	30.749	10.634	5.6	59.2
Mortality_pneumonia	900	12.222	7.127	0.7	38.9
Mortality_diarrhea	900	9.281	6.494	0	39.5
Mortality_malaria	900	11.149	13.88	0	71.1
Natural resources					
Total rents	1,130	12.065	11.901	0.001	84.228
Coal rent	1,130	0.108	0.528	0	7.869
Forest rent	1,134	5.634	6.182	0	40.426
Mineral rent	1,134	1.816	4.504	0	46.624
Gasrent	1,104	0.235	0.788	0	7.071
Oil rent	1,130	4.255	10.643	0	78.541
Control variables					
GDP per cap. (ln)	1,112	7.107	0.988	5.233	9.9297
Female education	909	93.03	26.266	21.441	151.314
Urban pop. Growth	1,143	3.651	1.629	-1.231	17.499
HIV female	1,127	3.209	4.837	0.1	24.2
Women in parliaments	1,029	15.760	11.07	0	63.75
CO2 emissions	1,043	0.944	1.70523	0.016	11.203
Trade openness	1,059	70.11	36.845	17.858	347.99
Ethnic fractionalization	1,127	0.632	0.244	0	0.930
ODA received	1,118	8.523	9.170	-0.250	92.141
Governance variables					
Control of Corrupt.	1,000	-0.613	0.586	-1.826	1.216
Gov. Effectiveness	999	-0.717	0.588	-1.884	1.05
Political stability	1,000	-0.532	0.855	-2.444	1.219
Regulatory quality	1,000	-0.655	0.586	-2.297	1.127
Rule of Law	1,000	-0.667	0.614	-2.129	1.077
Voice and Account.	1,000	-0.613	0.717	-2.226	1.007
G. Gov	999	0.0000	2.166	-5.417	5.784
Pol. Gov	1,000	0.0000	1.267	-3.009	2.883
Eco. Gov	999	0.0000	1.367	-3.374	4.264
Inst. Gov	1,000	0.0000	1.365	-3.020	4.085

3.1 Methodology

Three empirical strategies are employed to investigate the effect of natural resources on Under 5 mortality. First, following by Cotet and Tsui (2013), we begin by implementing pooled Ordinary Least Squared (OLS) to estimate Equation (1):

$$Mortality\_5_{i,t} = \alpha + \beta_1 Total\_rents_{i,t} + \beta_2 X_{i,t} + \varepsilon_{it} \quad (1)$$

Where $Mortality\_5_{i,t}$ is Under 5 mortality rates in country i for year t. $Total\ Rents_{i,t}$ represents natural resource rents. $X_{i,t}$ is the vector of control variables and ε_{it} is the error term.

Second, we estimate equation (1) using the fixed effects method by including the time-specific effects represented by $\mu_i$and ν_t, respectively. Although these previous methodological approaches are interesting, they do not take into account the problems of endogeneity resulting in particular from measurement errors or inverse causality between our dependent variable and the explanatory variables. We fill this gap by using a dynamic panel specification and apply the GMM proposed by Arellano and Bover (1995) and Blundell and Bond (1998) specified in equation (2).

$$Mortality\_5_{i,t} = \alpha + \beta_1 Mortality\_5_{i,t-1} + \beta_2 Total\_rents_{i,t} + \beta_3 X_{i,t} + \mu_i + \nu_t + \varepsilon_{it} \quad (2)$$

GMM estimators are frequently used in the literature to address a number of problems such as endogeneity and heteroskedasticity (Baum et al., 2003). Arellano and Bond (1991) propose a GMM procedure with which to estimate the underlying dynamic panel model through the employment of lagged values of the endogenous explanatory variables as instruments in order to address the simultaneity dimension of the endogeneity problem. Despite the superiority of the Difference-GMM technique over previous estimators, an issue with the Difference-GMM is that, as shown by Bound et al. (1995), lagged levels are associated with weak instruments for first-differences, especially when a series is very persistent. Moreover, by taking first differences, information on the long-run nexus between the outcome variable and the explanatory variables can be lost. When weak instruments are apparent, the small-sample and asymptotic robustness of the Difference-GMM estimator are affected and by extension, engender inefficient and biased estimated coefficients (Baltagi, 2008). To limit the effects of weak instruments and increase the efficiency of our estimates, we use the two-step System GMM of Blundell and Bond (1998). Two-step System GMM combines the estimations in differences and in levels within a system of equations by employing the lagged differenced instruments for the series that are in levels, and the lagged levels of instruments for the series that are in first differenced.

The consistency of the GMM estimator is contingent on whether lagged values of the explanatory variables constitute valid instruments. We use the Arellano and Bond (1991) AR(2) test of the serial correlation properties, and the Hansen J-test of over-identifying restrictions, which is employed to assess the validity of the instruments. The system GMM estimator assumes that too many instruments compared to the number of country-level observations could lead to the over fitting of the endogenous variables and weaken the test for over identifying restrictions (Roodman, 2009). As a rule of thumb, the number of instruments should not be higher than the number of countries. For the variance of linear efficient two-step system GMM, the Windmeijer (2005) finite-sample correction is also employed.

4. Results

4.1 Baseline results

Table 3 presents the results of the baseline estimates. Columns (1) and (2) show the results of the pooled OLS estimates. In column (1), the relationship between total resource rents and under-five mortality is tested without control variables. The coefficient associated with resource rents is positive and statistically significant. This suggests that resource rents are on average associated with higher under-five mortality rates. Our result remains unchanged when we control for per capita income and female education in column (2). In column (3), where we account for all control variables, we also find that resource rents have a positive and statistically significant effect on under-five mortality. Specifically, a 10 unit increase in natural resource rents is associated on average with a 5.58 unit increase in the under-five mortality rate. Regarding the control variables, we find that per capita income and female education reduce under-five mortality. This result is in line with those of Khanam et al. (2009) and Grépin and Bharadwaj (2015) showing that an increase in household income and better secondary education among women improves children's health. However, we find that urbanization and HIV/AIDS prevalence among women increase child mortality. This means that HIV-positive women are more likely to infect and kill their children. Similarly, the pressure on health facilities in urban areas, which is characteristic of many developing regions due to high rates of rural-urban migration, leads to increased mortality rates.

Although pooled OLS provides evidence in favor of the resource curse on child health, these results suffer from one limitation in that they do not take into account country and year fixed effects. In order to overcome these shortcomings, we estimate our model using the fixed effects method. The results summarized in columns (4), (5) and (6) show once again that natural resources have a positive and significant effect on under-five mortality, although the effect is smaller.

Table 3: Pooled OLS and fixed-effects results

	Dependent variable: Mortality_5					
	Pooled OLS			Fixed effects		
	(1)	(2)	(3)	(4)	(5)	(6)
Total rents	0.965***	0.600***	0.558***	1.265**	1.184***	1.029**
	(0.111)	(0.100)	(0.0887)	(0.494)	(0.364)	(0.384)
GDP per cap. (ln)		-22.26***	-19.99***		-18.36***	-17.70***
		(1.373)	(1.314)		(4.256)	(4.258)
Female education		-0.865***	-0.974***		-0.652***	-0.763***
		(0.0477)	(0.0444)		(0.193)	(0.189)
Urban pop. Growth			5.815***			5.402
			(0.849)			(3.335)
HIV female			2.875***			2.268**
			(0.178)			(0.870)
Constant	85.59***	326.7***	291.7***	81.68***	274.2***	255.4***
	(1.902)	(9.986)	(11.46)	(7.974)	(30.88)	(35.55)
Observations	1,13	874	859	1,13	874	859
R-squared	0.057	0.550	0.653	0.120	0.549	0.623
Number of countries				50	48	47
R^2 (between)				0.120	0.549	0.623
R^2 (overall)				0.0573	0.517	0.629
R^2 (within)				0.00011	0.468	0.578
Hausman Test Prob>chi2						0.0000

Notes: *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively. Robust standard errors reported in parenthesis.

Although fixed effects estimates are more robust than pooled OLS, they also suffer from a major limitation in that they do not account for the simultaneity dimension of endogeneity. In order to resolve this limitation, we apply the two-step system GMM estimator, whose results are summarized in Table 4. All the models passed the AR(2) tests, as indicated by p-value showing that the serial correlation in the error terms is not second order. The number of instruments is less than the number countries. On the whole, the validity of the instruments used as a necessity for System-GMM is confirmed, as indicated by the p-values of the Hansen

J test. Accordingly, considering all test statistics of these models we can conclude that the estimated models are adequately specified. Once again, we find that natural resources have a positive and significant effect on under-five mortality.

Table 4: Two-step system GMM results

	Dependent variable: Mortality_5				
	(1)	(2)	(3)	(4)	(5)
L.Mortality_5	0.947***	0.956***	0.873***	0.922***	0.890***
	(0.00259)	(0.00353)	(0.0225)	(0.00996)	(0.0108)
Total rents	0.0144***	0.00937**	0.0401***	0.0805***	0.0554***
	(0.00335)	(0.00388)	(0.0150)	(0.0177)	(0.0188)
GDP per cap. (ln)		-1.800**	-1.629**	-0.637	-0.812***
		(0.740)	(0.824)	(0.458)	(0.253)
Female education			-0.164***	-0.244***	-0.250***
			(0.0324)	(0.0180)	(0.0231)
Urban pop. Growth				-1.628***	-0.162
				(0.318)	(0.149)
HIV female					0.521***
					(0.0488)
Constant	1.496***	13.53**	35.05***	36.62***	35.14***
	(0.233)	(5.521)	(9.159)	(5.475)	(4.221)
Observations	1,028	1,008	838	838	823
Number of countries	50	50	48	48	47
Number of instruments	35	24	23	39	43
AR(1)	0.323	0.317	0.243	0.315	0.272
AR(2)	0.279	0.260	0.308	0.595	0.370
Hansen OIR	0.0007	0.0038	0.0030	0.0226	0.0039

Notes: *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively. Corrected standard errors reported in parenthesis. The coefficients are based on the two-step GMM system estimation, using the finite sample correction of Windmeijer (2005). All explanatory variables are treated as potentially endogenous. The lags of the explanatory variables are taken as an instrument for the difference equation, while the first differences of the explanatory variables are taken as an instrument for the level equation.

4.2 Robustness checks

We apply two approaches to test the robustness of the previous results. First, we introduce five additional control variables including women parliamentarians, CO2 emissions, trade openness, ethnic fractionalization, and ODA received. We summarize the estimation results in Table 5. From column (1) to column (5), when we introduce each control variable individually, the coefficient associated with the natural resources remains positive and statistically significant. In column (6), where we introduce the five additional control variables in the same specification, the coefficient associated with natural resources remain positive and significant. Thus, natural resources rents, through its negative effects on the quality of institutions, democracy and health expenditure, leads to higher infant mortality rates. Similarly, natural resources dependence, a source of wealth for existing generations, could increase inequalities, which also leads to higher infant mortality rates.

Table 5 : Additional control variables

	Dependent variable: Mortality_5					
	(1)	(2)	(3)	(4)	(5)	(6)
L. Mortality_5	0.886***	0.887***	0.866***	0.871***	0.895***	0.925***
	(0.0086)	(0.0054)	(0.0135)	(0.0090)	(0.0137)	(0.0100)
Total rents	0.0769***	0.0596***	0.0809***	0.0611***	0.0626***	0.0861***
	(0.0151)	(0.0098)	(0.0235)	(0.0160)	(0.0232)	(0.0166)
GDP per cap. (ln)	-1.053***	-2.442***	-1.320***	-0.859***	-1.152***	-1.354**
	(0.392)	(0.255)	(0.432)	(0.214)	(0.415)	(0.641)
Female education	-0.207***	-0.234***	-0.259***	-0.250***	-0.236***	-0.139***
	(0.0148)	(0.0095)	(0.0210)	(0.0158)	(0.0356)	(0.0223)
Urban pop. growth	-0.0712	-0.125	-0.0660	-0.174	0.212	-0.0939
	(0.182)	(0.0816)	(0.145)	(0.109)	(0.297)	(0.200)
HIV female	0.336***	0.560***	0.491***	0.468***	0.465***	0.389***
	(0.0348)	(0.0343)	(0.127)	(0.0358)	(0.0758)	(0.0484)
Women in parliaments	-0.0632***					0.00716
	(0.0241)					(0.0263)
CO2 emissions		1.498***				0.391
		(0.203)				(0.321)
Trade openness			-0.0029			-0.0220*
			(0.0122)			(0.0121)
Ethnic fractionalization				1.641*		1.184
				(0.960)		(2.161)
Net ODA received					-0.218***	-0.115***
					(0.0284)	(0.0402)
Constant	33.67***	43.83***	41.21***	36.21***	35.75***	25.92***
	(4.408)	(2.529)	(4.656)	(2.879)	(5.393)	(6.879)
Observations	779	763	796	794	807	679
Number of countries	47	47	47	47	47	47
Number of instruments	39	45	31	53	38	37
AR(1)	0.0007	0.0004	0.0000	0.0052	0.0081	0.0011
AR(2)	0.282	0.403	0.306	0.396	0.346	0.301
Hansen OIR	0.310	0.431	0.581	0.490	0.527	0.746

Notes: *, **, *** denote statistical significance at the 10%, 5% and 1% levels respectively. Corrected standard errors reported in parenthesis.

Second, we estimate our model using alternative dependent variables. We summarize the results in Table 6. The first-two columns summarize the results of estimating the effect of natural resources on under-five mortality by gender. We find that the natural resource rents have a positive and significant effect on child mortality by gender, with a larger effect on male mortality. Then, in columns (3) and (4), we estimate the effect of resource rents on child mortality by age by distinguishing between neonatal mortality (column 3) and infant mortality (column 4). Once again, we find that the resource rents have a positive effect on child mortality by age, with the effect being larger for children aged 0 to 28 days. Finally, we are interested in the effect of natural resources on child mortality from infectious diseases such as pneumonia, diarrhea, and malaria. We find that natural resources also have a positive and significant effect on deaths from infectious diseases. Specifically, the effect is more detrimental on mortality due to pneumonia, mortality due to diarrhea, and mortality due to malaria.

Table 6: Alternative dependent variables

	Mortality by gender		Mortality by age		Mortality by causes		
Dependent variable:	Female mortality_5	Male mortality_5	Neonatal mortality	Infant mortality	Mortality_ pneumonia	Mortality_ diarrhea	Mortality_ malaria
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
L. dependent variable	0.877***	0.873***	0.969***	0.854***	0.799***	0.832***	0.831***
	(0.0112)	(0.0090)	(0.0258)	(0.0388)	(0.0310)	(0.0260)	(0.0463)
Total rents	0.0439**	0.0700***	0.0169***	0.0423*	0.0223***	0.0111**	0.00262**
	(0.0172)	(0.0168)	(0.0065)	(0.0254)	(0.00792)	(0.0052)	(0.00109)
GDP per cap. (ln)	-0.503*	-1.123***	-0.214	-0.399	-0.433	-0.416**	-0.109*
	(0.265)	(0.264)	(0.149)	(0.566)	(0.417)	(0.201)	(0.0659)
Female education	-0.235***	-0.269***	-0.0056	-0.159***	-0.0573***	-0.0143***	-0.00301***
	(0.0242)	(0.0208)	(0.0113)	(0.0415)	(0.0136)	(0.0028)	(0.000857)
Urban pop. Growth	0.253***	0.0188	-0.345	0.444*	-0.200	-0.0753	0.0337
	(0.0683)	(0.126)	(0.222)	(0.247)	(0.139)	(0.0720)	(0.0240)
HIV female	0.459***	0.552***	0.0548*	0.281	0.0921***	0.0482***	0.00103
	(0.0512)	(0.0494)	(0.0281)	(0.185)	(0.0351)	(0.0143)	(0.00382)
Constant	30.98***	40.53***	3.352*	21.98***	10.71***	5.234***	1.670**
	(4.430)	(3.789)	(1.850)	(7.848)	(3.466)	(1.712)	(0.775)
Observations	823	823	758	823	609	567	431
Number of countries	47	47	47	47	47	46	46
Number of instruments	43	43	39	44	45	46	40
AR(1)	0.0004	0.0000	0.0000	0.0017	0.0134	0.0005	0.0150
AR(2)	0.326	0.397	0.124	0.708	0.757	0.527	0.882
Hansen OIR	0.667	0.484	0.168	0.739	0.324	0.688	0.778

Notes: *, **, *** denote statistical significance at the 10%, 5% and 1% levels respectively. Corrected standard errors reported in parenthesis.

4.3 Do different types of natural resources have different effects?

Several authors argue that the type of resources matters in the validity of the resource curse hypothesis (Isham et al., 2005; Bulte et al., 2005). The literature distinguishes between point resources and diffuses resources based on the concentration of production patterns and income. Point resources are extracted from a narrow economic and geographic base and entail oil and minerals (Bulte et al., 2005). The fact that these resources are concentrated spatially is an indication that they can be controlled and protected at a relatively low cost. The resources diffuse are rather scattered in space and have a greater understanding of agricultural or forest products.

Table 7: Effects of different resource types on under five mortality

	Dependent variable: Mortality_5				
	(1)	(2)	(3)	(4)	(5)
L. Mortality_5	0.890***	0.905***	0.912***	0.892***	0.885***
	(0.0303)	(0.0196)	(0.0275)	(0.0179)	(0.00876)
Coal rent	-1.643				
	(1.385)				
Forest rent		-0.127*			
		(0.0760)			
Mineral rent			0.171**		
			(0.0719)		
Gas rent				0.268**	
				(0.116)	
Oil rent					0.0500***
					(0.0186)
GDP per cap. (ln)	-1.162	-0.733	0.185	-0.556	-0.846**
	(1.185)	(0.794)	(1.371)	(0.769)	(0.332)
Female education	-0.163***	-0.176***	-0.190***	-0.216***	-0.187***
	(0.0420)	(0.0434)	(0.0361)	(0.0414)	(0.0234)
Urban pop. Growth	-0.719	0.382	-0.622	-0.374	0.310*
	(0.546)	(0.243)	(0.485)	(0.410)	(0.181)
Preval. of HIV female	0.390***	0.364***	0.166	0.434***	0.420***
	(0.131)	(0.102)	(0.172)	(0.0796)	(0.0595)
Constant	31.96**	25.87**	23.04*	30.95***	28.91***
	(15.10)	(10.32)	(13.54)	(9.669)	(4.123)
Observations	823	827	827	771	823
Number of countries	47	47	47	47	47
Number of instruments	34	46	44	28	33
AR(1)	0.0000	0.0044	0.0054	0.0078	0.0050
AR(2)	0.361	0.301	0.298	0.386	0.317
Hansen OIR	0.599	0.284	0.702	0.547	0.557

Notes: *, **, *** denote statistical significance at the 10%, 5% and 1% levels respectively. Corrected standard errors reported in parenthesis.

Table 7 summarizes the results of estimating the effect of different resources rents on under-five mortality. We find that point resources (such as minerals, natural gas, and oil) have a positive and significant effect on under-five mortality. Specifically, oil rent has a larger effect followed by the natural gas rent. However, we find that the forest rent has a weak negative effect on under-five mortality. According to the literature, these results suggest that dependence from point resources through its deleterious effects on the quality of institutions and the risk of conflicts, leads to poor economic and social performance, unlike diffuse resources.

4.4 Can Governance lift the curse?

We analyze the extent to which governance shapes the relationship between natural resources and under-five mortality. In this perspective, first, we assume that individual governance quality moderates the relationship between natural resources and under-five mortality. Second, we assume that, composite governance also mitigates the positive effect of total resource rents on under-five mortality.

We test the first assertion by estimating models in which we individually integrate each governance indicator proposed by WGI, as well as a term representing its interaction with the total rents. We summarize estimations results in Table 8. We find that the coefficients of the interaction terms between natural resources and four indicators of the quality of governance are negative and significant. Specifically, we find that control of corruption, government effectiveness, political stability, and voice and accountability moderate the positive effect of natural resources on under-five mortality. Thus, the effect of natural resources on child mortality is conditioned by the quality of governance. In other words, better control of corruption, improved government effectiveness, coupled with political stability and accountability mitigate the resources curse for child health. Consistent with contemporary threshold literature based on interactive regressions (Tchamyou and Asongu, 2017; Asongu et al., 2018; Tchamyou, 2019), we compute corresponding governance policy thresholds that should be attained in order to reverse the positive effects of resources on child mortality. These thresholds are obtained by dividing the unconditional effect of the total rents by the absolute value of the associated conditional or interactive effect.

Table 8: The role of individual governance quality

	Dependent variable: Mortality_5					
	(1)	(2)	(3)	(4)	(5)	(6)
L. Mortality_5	0.838***	0.873***	0.904***	0.854***	0.863***	0.830***
	(0.00467)	(0.00658)	(0.00360)	(0.0114)	(0.0112)	(0.00919)
Total rents	0.0321*	0.0213**	0.0157***	0.144***	0.0987***	0.0533**
	(0.0165)	(0.00907)	(0.00471)	(0.0437)	(0.0311)	(0.0232)
Control of Corrupt.	0.236					
	(0.245)					
Total rents × Control of Corrupt.	-0.0517***					
	(0.0119)					
Gov. Effectiveness		-0.701***				
		(0.236)				
Total rents × Gov. Effectiveness		-0.0221***				
		(0.00659)				
Political Stability			-0.397**			
			(0.202)			
Total rents × Political Stability			-0.0337***			
			(0.00983)			
Regulatory Quality				-0.351		
				(0.619)		
Total rents × Regulatory Quality				0.0368		
				(0.0318)		
Rule of Law					-0.819*	
					(0.496)	
Total rents × Rule of Law					0.0263	
					(0.0242)	
Voice and Account.						0.584
						(0.465)
Total rents × Voice and Account.						-0.0625***
						(0.0208)
GDP per cap. (ln)	-2.459***	-1.313***	-0.557**	-1.726***	-1.078***	-2.883***
	(0.200)	(0.201)	(0.228)	(0.465)	(0.334)	(0.397)
Female education	-0.231***	-0.173***	-0.0956***	-0.199***	-0.258***	-0.127***
	(0.00820)	(0.00868)	(0.00919)	(0.0315)	(0.0187)	(0.0135)
Urban pop. Growth	0.266***	0.181**	0.728***	0.0574	-0.0613	0.180
	(0.0731)	(0.0861)	(0.109)	(0.214)	(0.155)	(0.199)
HIV female	0.454***	0.324***	1.034***	0.460***	0.504***	0.341***
	(0.0292)	(0.0257)	(0.0567)	(0.0818)	(0.0596)	(0.0732)
Constant	48.05***	31.51***	12.36***	37.88***	38.82***	42.26***
	(1.104)	(2.503)	(2.106)	(5.932)	(3.732)	(4.788)
Individual governance thresholds	0.621	0.964	0.465	na	na	0.0853
Observations	595	594	677	594	594	556
Number of countries	47	47	47	47	47	47
Number of instruments	46	47	46	33	41	44
AR(1)	0.018	0.005	0.003	0.070	0.088	0.017

AR(2)	0.721	0.582	0.391	0.509	0.875	0.430
Hansen OIR	0.336	0.616	0.515	0.169	0.458	0.666

Notes: *, **, *** denote statistical significance at the 10%, 5% and 1% levels respectively. Corrected standard errors reported in parenthesis. na: not applicable because at least one estimated coefficient needed for the computation of thresholds is not significant.

We test the second assertion by examining the role of aggregated governance indicators by distinguishing between general governance, political governance, economic governance and institutional governance. This approach provides precise information on the extent to which governance transforms natural resources to reduce child mortality. The results summarized in Table 9 show that the coefficient associated with the interaction variable between natural resources and general governance is negative and significant. This suggests that improved general governance partially mitigates the positive effect of natural resources on under-five mortality. Regarding the different governance, we find that political governance and institutional governance attenuate the effect of resource rents on child mortality. Consistent with the narrative in Table 8, corresponding composite governance thresholds needed to overturn the effect of natural resources are also provided.

Table 9: Role of composite of governance quality

	Dependent variable: Mortality_5			
	(1)	(2)	(3)	(4)
L. Mortality_5	0.839***	0.897***	0.875***	0.841***
	(0.00461)	(0.00544)	(0.00952)	(0.0111)
Total rents	0.0134***	0.0282***	0.0946***	0.0303**
	(0.00423)	(0.00513)	(0.0240)	(0.0154)
G. Gov	-0.228**			
	(0.0928)			
Total rents × G. Gov	-0.0242***			
	(0.00366)			
Pol. Gov		-0.151*		
		(0.0854)		
Total rents × Pol. Gov		-0.0175**		
		(0.00703)		
Eco. Gov			-0.335*	
			(0.189)	
Total rents × Eco. Gov			0.00785	
			(0.00904)	
Inst. Gov				-0.109
				(0.249)
Total rents × Inst. Gov				-0.0409**
				(0.0181)
GDP per cap. (ln)	-2.051***	-0.138	-2.204***	-2.001***
	(0.134)	(0.224)	(0.405)	(0.492)
Female education	-0.134***	-0.0636***	-0.171***	-0.173***
	(0.00670)	(0.00727)	(0.0225)	(0.0262)
Urban pop. Growth	0.456***	0.114	-0.357	0.346*
	(0.0905)	(0.199)	(0.337)	(0.188)
HIV female	0.425***	0.209***	0.344***	0.410***
	(0.0213)	(0.0359)	(0.0807)	(0.0623)
Constant	35.25***	11.29***	38.95***	38.49***
	(1.079)	(2.622)	(5.154)	(5.509)
Composite governance thresholds	0.553	1.524	na	0.740
Observations	594	544	594	594
Number of countries	47	46	47	47
Number of instruments	48	40	39	33
AR(1)	0.073	0.015	0.067	0.058
AR(2)	0.547	0.309	0.473	0.578
Hansen OIR	0.338	0.277	0.553	0.201

Notes: *, **, *** denote statistical significance at the 10%, 5% and 1% levels respectively. Corrected standard errors reported in parenthesis. na: not applicable because at least one estimated coefficient needed for the computation of thresholds is not significant.

5. Concluding implications and future research directions

Abundant literature has shown a negative relationship between natural resources and economic growth, known as the resource curse. In recent years, several studies have extended the resource curse hypothesis to quality of life, including health outcomes. To contribute to this emerging literature, this paper has studied the effect of natural resources on child mortality in 50 African countries for the period 1996-2018. The results show that total resources rent has a positive effect on under-five mortality. We also find that natural resource dependence has a positive effect on under-five mortality by age, gender, and the three major causes of child mortality from infectious diseases, namely, mortality from pneumonia, diarrhea and malaria. Looking at the type of resources, we find that the resource curse is attributed to point resources (such as oil, natural gas and mineral rents), as opposed to diffuse resources (such as forest rent), which rather have a negative effect on child mortality. Finally, we provide evidence that improving the quality of governance, particularly political and institutional governance, mitigates the resource curse. Corresponding governance policy thresholds that should be attained in order to reverse the positive effects of resources on child mortality are provided

The adverse effect of natural resources on child survival is likely due to the fact that the ruling elites have little incentive to invest and take effective actions to improve child health. However, this trend can be broken if strong institutions ensure that political leaders are more accountable to the people. Thus, there is an urgent need for African countries to continue with efforts towards improving governance. Some countries have already begun this process, but much remains to be done. In addition, in order to achieve the SDG target of reducing under-five mortality to less than 25 per 1,000 births by 2030, it is important that African leaders allocate a fraction of resources revenues to the health sector in order to subsidize the treatment and prevention of common childhood diseases.

The importance of political governance and institutional governance in moderating the positive effects of natural resources on child mortality has two main direct policy implications: (i) the procedures by which political leaders are elected and replaced should be improved in sampled countries. Such is the definition of political governance as conceptualized, measured and applied in this study in the light of extant literature (Asongu and Odhiambo, 2019; Tchamyou, 2021). (ii) By the same vein (Asongu and Odhiambo, 2021), procedures by which the state and citizens respect institutions that govern interactions between them (i.e. institutional governance) should improved.

In the light of the established importance of governance dynamics in moderating the unfavorable incidence of natural resources on child mortality, the corresponding governance policy thresholds which have been provided are indicative of the actionable measures that sampled countries should take in order to enhance suggested governance measures to levels at which the natural resource curse with respect to child mortality is no longer apparent. In other words, at the established governance thresholds, governance completely dampens the effect of natural resources in order to engender overall negative impacts on the child mortality dynamics.

This study obviously leaves room for improving extant knowledge in this area of economic development, especially as it relates to examining if these findings withstand empirical scrutiny within country-specific remits. Accordingly, engaging country-specific studies is relevant for country-specific implications and by extension, addresses a shortcoming in the adopted estimation strategy which fails to account for country-specific effects in order to avoid concerns of endogeneity pertaining to the correlation between the lagged outcome variable and the error term.

References

Achim, M. V., Văidean, V. L., & Borlea, S. N. (2019). Corruption and health outcomes within an economic and cultural framework. *The European Journal of Health Economics*, 1-13.

Adetunji, J. (2000). Trends in under-5 mortality rates and the HIV/AIDS epidemic. *Bulletin of the World Health Organization, 78*, 1200-1206.

Adika, G. (2020). Economic growth dynamics between resource-rich and resource-poor countries in sub-Saharan Africa: The role of politics and institutions. *African Development Review, 32*(3), 303-315.

Alesina, A., Devleeschauwer, A., Easterly, W., Kurlat, S., &Wacziarg, R. (2003). Fractionalization. *Journal of Economic growth*, *8*(2), 155-194.

Andriano, L., &Monden, C. W. (2019). The causal effect of maternal education on child mortality: Evidence from a quasi-experiment in Malawi and Uganda. *Demography*, *56*(5), 1765-1790.

Anyanwu, J. C., &Erhijakpor, A. E. (2009). Health expenditures and health outcomes in Africa. *African Development Review*, *21*(2), 400-433.

Anyanwu, J. C., &Erhijakpor, A. E. (2014). Does oil wealth affect democracy in Africa?.*African Development Review*, *26*(1), 15-37.

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The review of economic studies*, *58*(2), 277-297.

Arellano, M., &Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of econometrics*, *68*(1), 29-51.

Arezki, R., &Brückner, M. (2011). Oil rents, corruption, and state stability: Evidence from panel data regressions. *European Economic Review*, *55*(7), 955-963.

Asongu, S. A., &Nwachukwu, J. C. (2016). The mobile phone in the diffusion of knowledge for institutional quality in sub-Saharan Africa. *World Development*, *86*, 133-147.

Asongu, S. A., &Nwachukwu, J. C. (2017). The impact of terrorism on governance in African countries. *World Development*, *99*, 253-270.

Asongu, S. A., & Odhiambo, N. M. (2019). Governance and social media in African countries: An empirical investigation. *Telecommunications Policy*, 43(5), 411-425.

Asongu, S. A., & Odhiambo, N. M. (2021). Enhancing governance for environmental sustainability in sub-Saharan Africa. *Energy Exploration & Exploitation*, 39(1), 444-463.

Asongu, S. A., Le Roux, S., &Biekpe, N. (2018). Enhancing ICT for environmental sustainability in sub-Saharan Africa. *Technological Forecasting and Social Change*, *127*, 209-216.

Badeeb, R. A., Lean, H. H., & Clark, J. (2017). The evolution of the natural resource curse thesis: A critical literature survey. *Resources Policy*, *51*, 123-134.

Baltagi, B. (2008). *Econometric analysis of panel data*. John Wiley & Sons.

Basedau, M., & Lay, J. (2009). Resource curse or rentier peace? The ambiguous effects of oil wealth and oil dependence on violent conflict. *Journal of peace research*, *46*(6), 757-776.

Baum, C. F., Schaffer, M. E., & Stillman, S. (2003). Instrumental variables and GMM: Estimation and testing. *The Stata Journal*, *3*(1), 1-31.

Bellinger, N., & Fails, M. D. (2020). When Does Oil Harm Child Mortality?.*Political Research Quarterly*, 1065912920931201.

Bergougui, B., &Murshed, S. M. (2020). New evidence on the oil-democracy nexus utilising the Varieties of Democracy data. *Resources Policy*, *69*, 101905.

Bernet, P. M., Gumus, G., &Vishwasrao, S. (2018). Effectiveness of public health spending on infant mortality in Florida, 2001–2014. *Social Science & Medicine*, *211*, 31-38.

Besley, T., &Kudamatsu, M. (2006). Health and democracy. *American economic review*, *96*(2), 313-318.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics*, *87*(1), 115-143.

Bound, J., Jaeger, D. A., & Baker, R. M. (1995). Problems with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variable is weak. *Journal of the American statistical association*, *90*(430), 443-450.

Brueckner, M. (2019). Adult mortality and urbanization: Examination of a weak connection in sub-Saharan Africa. *World Development*, *122*, 184-198.

Brunnschweiler, C. N., &Bulte, E. H. (2008). The resource curse revisited and revised: A tale of paradoxes and red herrings. *Journal of environmental economics and management*, *55*(3), 248-264.

Buccellato, T., & Mickiewicz, T. (2009). Oil and gas: a blessing for the few. Hydrocarbons and inequality within regions in Russia. *Europe-Asia Studies*, *61*(3), 385-407.

Bulte, E. H., Damania, R., & Deacon, R. T. (2005). Resource intensity, institutions, and development. *World development*, *33*(7), 1029-1044.

Carmignani, F. (2013). Development outcomes, resource abundance, and the transmission through inequality. *Resource and Energy Economics*, *35*(3), 412-428.

Chang, W. Y. (2020). Democracy, Natural Resources, and Infectious Diseases: the Case of Malaria, 1990–2016. *Studies in Comparative International Development*, *55*(3), 354-380.

Chang, W. Y., & Wei, D. (2019). Natural resources and infectious diseases: The case of malaria, 2000–2014. *The Social Science Journal*, *56*(3), 324-336.

Chireshe, J., &Ocran, M. K. (2020). Health care expenditure and health outcomes in sub-Saharan African countries. *African Development Review*, *32*(3), 349-361.

Cockx, L., &Francken, N. (2014). Extending the concept of the resource curse: Natural resources and public spending on health. *Ecological Economics*, *108*, 136-149.

Cockx, L., &Francken, N. (2016). Natural resources: a curse on education spending?.*Energy Policy*, *92*, 394-408.

Collier, P., &Hoeffler, A. (2004). Greed and grievance in civil war. *Oxford economic papers*, *56*(4), 563-595.

Cotet, A. M., & Tsui, K. K. (2013). Oil, growth, and health: what does the cross-country evidence really show?.*The Scandinavian Journal of Economics*, *115*(4), 1107-1137.

Dauvin, M., &Guerreiro, D. (2017). The paradox of plenty: A meta-analysis. *World Development*, *94*, 212-231.

De Soysa, I., &Gizelis, T. I. (2013). The natural resource curse and the spread of HIV/AIDS, 1990–2008. *Social Science & Medicine*, *77*, 90-96.

Edwards, R. B. (2016). Mining away the Preston curve. *World Development*, *78*, 22-36.

El Anshasy, A. A., &Katsaiti, M. S. (2015). Are natural resources bad for health?.*Health & place*, *32*, 29-42.

Epo, B. N., &Faha, D. R. N. (2020). Natural resources, institutional quality, and economic growth: An African tale. *The European Journal of Development Research*, *32*(1), 99-128.

Frankel, J. A. (2010). *Monetary policy in emerging markets: a survey* (No. w16125). National Bureau of Economic Research.

Fum, R. M., &Hodler, R. (2010). Natural resources and income inequality: The role of ethnic divisions. *Economics Letters*, *107*(3), 360-363.

Gates, S., Hegre, H., Nygård, H. M., & Strand, H. (2012). Development consequences of armed conflict. *World Development*, *40*(9), 1713-1722.

Grépin, K. A., & Bharadwaj, P. (2015). Maternal education and child mortality in Zimbabwe. *Journal of health economics*, *44*, 97-117.

Gylfason, T. (2001). Natural resources, education, and economic development. *European economic review*, *45*(4-6), 847-859.

IHME, (2019). Institute of health metrics and evaluation. data accessible from, https://vizhub.healthdata.org/child-mortality.

Isham, J., Woolcock, M., Pritchett, L., & Busby, G. (2005). The varieties of resource experience: natural resource export structures and the political economy of economic growth. *The World Bank Economic Review*, *19*(2), 141-174.

Khanam, R., Nghiem, H. S., & Connelly, L. B. (2009). Child health and the income gradient: evidence from Australia. *Journal of health economics*, *28*(4), 805-817.

Kim, D. H., & Lin, S. C. (2017). Human capital and natural resource dependence. *Structural Change and Economic Dynamics*, *40*, 92-102.

Li, Q., An, L., Xu, J., &Baliam Khanoune-Lutz, M. (2018). Corruption costs lives: evidence from a cross-country study. *The European Journal of Health Economics*, *19*(1), 153-165.

Liu, L., Oza, S., Hogan, D., Perin, J., Rudan, I., Lawn, J. E., ... & Black, R. E. (2015). Global, regional, and national causes of child mortality in 2000–13, with projections to inform post-2015 priorities: an updated systematic analysis. *The Lancet, 385*(9966), 430-440.

Madreimov, T., & Li, L. (2019). Natural-resource dependence and life expectancy: A nonlinear relationship. *Sustainable Development*, *27*(4), 681-691.

Mehlum, H., Moene, K., &Torvik, R. (2006). Institutions and the resource curse. *The economic journal*, *116*(508), 1-20.

Mishra, P., & Newhouse, D. (2009). Does health aid matter?.*Journal of health economics*, *28*(4), 855-872.

Neudorfer, N. S. (2018). Commodities and corruption–How the middle class and democratic institutions lead to less corruption in resource-rich countries. *Resources Policy*, *58*, 175-191.

Okada, K., &Samreth, S. (2017). Corruption and natural resource rents: evidence from quantile regression. *Applied Economics Letters*, *24*(20), 1490-1493.

Panda, P. (2020). Does trade reduce infant mortality? Evidence from sub-Saharan Africa. *World Development*, *128*, 104851.

Papyrakis, E., &Gerlagh, R. (2004). The resource curse hypothesis and its transmission channels. *Journal of Comparative Economics*, *32*(1), 181-193.

Papyrakis, E., &Gerlagh, R. (2007). Resource abundance and economic growth in the United States. *European Economic Review*, *51*(4), 1011-1039.

Pickbourn, L., &Ndikumana, L. (2019). Does Health Aid Reduce Infant and Child Mortality from Diarrhoea in Sub-Saharan Africa?.*The Journal of Development Studies*, *55*(10), 2212-2231.

Robinson, J. A., Torvik, R., &Verdier, T. (2006). Political foundations of the resource curse. *Journal of development Economics*, *79*(2), 447-468.

Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *The stata journal*, *9*(1), 86-136.

Ross, M. L. (2015). What have we learned about the resource curse?.*Annual Review of Political Science*, *18*, 239-259.

Sachs, J. D., & Warner, A. M. (1995). *Natural resource abundance and economic growth* (No. w5398). National Bureau of Economic Research.

Sachs, J. D., & Warner, A. M. (1999). The big push, natural resource booms and growth. *Journal of development economics*, *59*(1), 43-76.

Satti, S. L., Farooq, A., Loganathan, N., & Shahbaz, M. (2014). Empirical evidence on the resource curse hypothesis in oil abundant economy. *Economic Modelling*, *42*, 421-429.

Siddiqi, A., Jones, M. K., & Erwin, P. C. (2015). Does higher income inequality adversely influence infant mortality rates? Reconciling descriptive patterns and recent research findings. *Social science & medicine*, *131*, 82-88.

Tadadjeu, S., Njangang, H., Ningaye, P., & Nourou, M. (2020). Linking natural resource dependence and access to water and sanitation in African countries. *Resources Policy, 69*, 101880.

Tchamyou, V. S. (2019). The Role of Information Sharing in Modulating the Effect of Financial Access on Inequality. *Journal of African Business*, 20(3), 317-338.

Tchamyou, V. S. (2021). Financial access, governance and the persistence of inequality in Africa: Mechanisms and policy instruments, *Journal of Public Affairs*: DOI: 10.1002/pa.2201.

Tchamyou, V. S., &Asongu, S. A. (2017). Information Sharing and Financial Sector Development in Africa. *Journal of African Business*, 18(7), 24-49.

Tiba, S., &Frikha, M. (2020). Africa is rich, Africans are poor! A blessing or curse: an application of cointegration techniques. *Journal of the knowledge economy*, *11*(1), 114-139.

Turan, T., &Yanıkkaya, H. (2020). Natural resource rents and capital accumulation nexus: do resource rents raise public human and physical capital expenditures?.*Environmental Economics and Policy Studies*, *22*(3), 449-466.

UN IGME, (2019). United Nations inter-agency group for child mortality estimation. Data retrieved from UNICEF.

Van der Ploeg, F. (2011). Natural resources: curse or blessing?.*Journal of Economic literature*, *49*(2), 366-420.

Vu, T. V. (2020). Economic complexity and health outcomes: A global perspective. *Social Science & Medicine*, *265*, 113480.

Welander, A., Lyttkens, C. H., & Nilsson, T. (2015). Globalization, democracy, and child health in developing countries. *Social Science & Medicine*, *136*, 52-63.

Welsch, H. (2008). Resource abundance and internal armed conflict: Types of natural resources and the incidence of 'new wars'. *Ecological Economics*, *67*(3), 503-513.

Wigley, S. (2017). The resource curse and child mortality, 1961–2011. *Social Science & Medicine*, *176*, 142-148.

Wigley, S., &Akkoyunlu-Wigley, A. (2017). The impact of democracy and media freedom on under-5 mortality, 1961–2011. *Social Science & Medicine*, *190*, 237-246.

Wilkinson, R. G., & Pickett, K. E. (2006). Income inequality and population health: a review and explanation of the evidence. *Social science & medicine*, *62*(7), 1768-1784.

Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of econometrics*, *126*(1), 25-51.

World Bank, (2020). World development indicators. Available athttps://databank.worldbank.org/source/world-development-indicators.

World Health Organisation (WHO) **(**2020). Global Health Observatory (GHO) data repository. Available at https://apps.who.int/gho/data/node.main.COCD?lang=en.

Yilanci, V., Aslan, M., &Ozgur, O. (2021). Disaggregated analysis of the curse of natural resources in most natural resource-abundant countries. *Resources Policy*, *71*, 102017.