



Research Article

© 2023 Luki et al.
This is an open access article licensed under the Creative Commons
Attribution-NonCommercial 4.0 International License
(<https://creativecommons.org/licenses/by-nc/4.0/>)

Received: 6 December 2022 / Accepted: 10 February 2023 / Published: 5 March 2023

The Impact of Oil and Gas Extraction in Sub-Saharan Africa: Evidence from Ghana

Bayuasi Nammei Luki¹

Abdallah Ali-Nakyea²

Hussein Salia³

Muntari Mahama⁴

¹Department of Management and HRM, Faculty of Business,
Ghana Communication Technology University, Accra, Ghana

²University of Ghana School of Law,
University of Ghana, Legon, Accra, Ghana

³Department of Accounting, School of Business,
Heritage Christian University College,
Amasaman, Accra, Ghana

⁴Brunel Business School, Brunel University London,
London, United Kingdom

DOI: <https://doi.org/10.36941/ajis-2023-0049>

Abstract

The topic of how oil and gas extraction impact on economic development of nations is well researched, especially African oil-producing countries. Literature has revealed that countries endowed with natural resources tend not to grow in terms of Gross Domestic Product (GDP) compared to their counterparts with limited or no such natural resources. This phenomenon has been characterized as the paradox of plenty. The study sought to evaluate the economic impact of oil and gas extraction in Ghana. The study utilized the quantitative research approach with secondary data from World Bank Development Indicators, 2019. Johansen Co-integration Approach was also used to evaluate the extent of causality between oil production (revenues) and the various economic variables. The Johansen Co-integration test revealed that oil revenue exerts a significant effect on Ghana's GDP (4% higher than the average GDP before the production of oil and gas). Meanwhile, the average agriculture value-added and service value-added of Ghana for the period after the production of oil is lower than the average agriculture value-added and service value-added for the period before the production of oil in commercial quantities. The study used Ghana as a case study which somehow limits its findings. Future studies may use a panel model to do a cross-country analysis of the impact of oil and gas production on the various sectors of the respective countries. Government should formulate and expand policies (such as planting for food and jobs, and agricultural mechanization) that will help grow the agricultural and service sectors of the economy using oil revenues. The study also recommends that the Public Interest and Accountability Committee (PIAC) should closely monitor and collaborate with the petroleum revenue management institutions to ensure that oil revenues allocated to the government priority sectors, especially agriculture and service, are fully implemented. This study differs from prior studies (novel) because it aimed to determine the impact of oil and gas extraction on agricultural, industrial, and service sectors before and after oil and gas production.

Keywords: Agriculture, extraction, industry, impact, oil and gas, service

1. Introduction

In 2007, the first commercially significant discovery of crude oil was made off the coast of Cape Three Points, allowing Ghana to join the league of oil-producing nations (Oteng-Adjei, 2011). Oteng-Adjei further commented that Ghana's oil find was timely because it occurred at a time when both foreign direct investment and foreign aid to Africa were on the verge of being cut. The former President of Ghana, John Agyekum Kufuor, whose administration saw commercial quantities of crude oil discovered, was reported as remarking, "without oil, we are still doing well" (Aryeetey & Ackah, 2018). To commemorate crude oil extraction in Ghana, the third President of the Fourth Republic of Ghana flipped on the valves of the Jubilee Field on December 15, 2010 (Oteng-Adjei, 2011; Adams *et al.*, 2019). It is, however, worth noting that the actual production of crude oil began in December 2010 at the Jubilee Field with a daily production capacity of 12,000 bpd (Aryeetey & Ackah, 2018). The reserves of the Jubilee Field were estimated at 600 mb with an upside potential of 1.8 billion barrels (Aryeetey & Ackah, 2018; Ayelazuno, 2014) making it one of the most prolific discoveries off the Gulf of Guinea in recent times (González, 2016; Oshionebo, 2018). The World Bank in 2009 estimated that Ghana could earn as much as \$20 billion from the Jubilee Field Production alone between 2012 – 2030. As of January 1, 2018, the Central Intelligence Agency Factbook (CIA, 2018) estimated Ghana's proven crude reserves at 660,000,000 barrels. Tullow Plc operates the field through its subsidiary Tullow Ghana Limited. Actual production started in 2010 with 55,000 bpd and has since increased to about 191,000 bpd as of the last quarter of 2020. It is expected that when the Jubilee Field reaches its plateau in the future, its production shall increase to 240,000 bpd (BBC News, 2010).

Until the Tweneboa-Enyenra-Ntomme (TEN) and Sankofa fields began operating in 2016 and 2017 respectively, Ghana only had one field, the Jubilee Field (Aryeetey & Ackah, 2018). According to them, the TEN field is expected to produce roughly 80,000 barrels of oil and 180 million cubic feet of natural gas per day at their respective production peak. TEN has 239 million barrels of crude oil and 360 billion cubic feet of natural gas in its reserves (Aryeetey & Ackah, 2018). According to Aryeetey and Ackah (2018), the Sankofa field has a crude reserve of 204 million barrels and a natural gas reserve of 1,071 billion cubic feet. PIAC (2021) revealed that Ghana earned US\$7.36 billion of its oil production as revenue.

Currently, only Tullow Ghana Limited and ENI and their partners are producing crude oil in Ghana. Their combined production capacity is 55,050,391 barrels (PIAC, 2021). Aker Energy and Springfield Ghana are also expected to follow the production lead pioneered by Tullow Ghana Limited and ENI. As of the end of 2021, PIAC reports that as of the end of 2021, Ghana's daily production stood at 88 74,891.73 barrels. This is about a 17.7% reduction compared with the 2020 production figure of 66,926,806 barrels (PIAC, 2021). Table 1 shows the oil and gas revenue earned since the inception of commercial production of crude oil in Ghana.

Table 1: Ghana's Total Oil and Gas Revenue Earned From 2011 to 2021

Year	Revenue Earned (millions of US\$)
2011	444.12
2012	541.62
2013	846.77
2014	978.02
2015	396.17
2016	247.18
2017	555.33
2018	977.09
2019	925.04
2020	666.39
2021	783.33
Total	US\$7.36 billion

Source: PIAC (2021)

Akinlo (2012) also assessed the contribution of Nigeria's oil industry to its economic development from 1960 to 2009 and confirmed that the petroleum industry has a critical role to play in Nigeria's economic development should they encourage diversification and private sector development. A study by Ingen *et al.* (2014) confirmed Akinlo's (2012) assertion and added that petroleum revenue contributes almost 90% of Nigeria's export earnings. Similarly, the result from Yeboua *et al.* (2022) studies ranked Nigeria as Africa's top producer and exporter of crude oil. Despite the abundance of hydrocarbons in Nigeria and the enormous money generated from oil and gas production, the country is not considerably better off (Ingen *et al.*, 2014). In other words, Nigeria has been unable to achieve significant levels of economic development by relying on oil earnings. Also, between 1974 and 2008, Asekunowo and Olaiya (2012) conducted a similar analysis of Nigeria's oil and gas industry, confirming the oil curse concept. They attributed the oil curse in Nigeria to weak institutions, excessive spending, excessive borrowing and revenue volatility.

Shaw (2013) also investigated the resource curse hypothesis in Azerbaijan and found that the petroleum resource endowment is the reason for their low economic growth. This is evidenced in the quote of Friedman (NYT, 1/30/2005) when he said 'You give me \$18-a-barrel oil and I will give you political and economic reforms from Algeria to Iran'. Ross (2012) did a similar study and concluded that the oil curse results from bad democracy, weak institutions and civil war. Ross's findings confirmed the works of Asekunowo and Olaiya (2012). Therefore, it is imperative that governments institute mechanisms to ensure the right institutional structures are established to efficiently manage petroleum resources.

Consequently, the role of institutions in the management of petroleum resources was underscored by Sarmidi *et al.* (2014) in their study of the relationship between natural resource abundance and economic growth. Sarmidi and his colleagues used data from over 90 countries from 1984-2005. They confirmed that natural resource abundance affects economic growth positively after a threshold level of institutional quality. Impliedly, sovereign nations must note that the discovery or exploration of natural resources, including oil and gas, does not necessarily guarantee economic growth and development if the effort is not backed by leadership's will to empower quality institutions to manage the resources.

Relatedly, Zuo and Schieffer (2014) conducted a study in China and confirmed a negative relationship between natural resource endowment and economic development in the resource regions of China. Mavrotas *et al.* (2011) also researched on the relationship between natural resource endowment and economic growth among developing countries for thirty years (1970-2000) and confirmed an incongruous relationship between the natural resource endowment and economic growth among those countries. Several studies have been conducted using samples drawn from numerous African oil producing and exporting countries (Tiba, 2019; Frikha & Tiba, 2019; Ding & Field, 2005) confirming the negative relationship between petroleum resource abundance and economic development (Dogan *et al.*, 2020).

On the contrary, Alexeev and Chernyavskiy (2015) in their study showed a positive association between natural resource endowment and economic growth at the regional level in Russia. They opined that there was no negative relationship between natural resource endowment and economic growth. Mideksa (2013), Moradbeigi and Law (2017) and Dogan *et al.* (2020), likewise, investigated the economic impact of natural resource endowment on economic growth and found that natural resource richness boosts GDP. Ji *et al.* (2014) conducted a similar study in China, comparing natural resource endowment, institutional quality, and economic growth from 1990 to 2008, and found that natural resources have a positive link with economic growth due to institutional quality at the province level. Natural resources, according to Gerelmaa and Kotani (2016), had a positive relationship with economic growth between 1990 and 2010 in countries rich in natural resources. The same relationship was found to be true for Sierra Leone (Dogan *et al.*, 2020). A study by Moshiri and Hayati (2017) of 149 countries, also showed that the negative relationship between natural resource endowment and economic growth was invalid. Their conclusions contradict many studies including Sinha and Sengupta's (2019) research in the Asia Pacific countries and Amini's (2018) research among

22 developed countries and 61 developing countries. Africa holds about 10 per cent of global proven oil and gas reserves.

Africa produces 10.9% (8.4 million bpd) of global daily consumption (Garside, 2020). Natural resources, especially petroleum resources, are inputs of the natural environment and can be extracted for socio-economic development (Zalle, 2019). Oil and gas resources have the potential of generating revenues through their exports. Natural resources like oil and gas are precious assets that contribute significantly to economic growth, particularly in terms of revenue, employment, and infrastructure development (Peach & Starbuck, 2011; Adabor *et al.*, 2021). This assertion was first established by Adam Smith and David Ricardo, that countries that are blessed with oil and gas resources would perform better than their counterparts with limited or scanty petroleum resources if those countries can leverage on the petroleum endowment by diversifying into agricultural, services and other sectors of the economy (Humphrey *et al.*, 2007; Adabor *et al.*, 2021).

Studies have shown that 40 per cent of Ghana's total foreign revenue is contributed by its natural resources such as gold, oil and gas, diamond, and bauxite (Adabor *et al.*, 2021). There is, however, a paucity of empirical research on the impact of oil and gas extraction on economic growth in Ghana. The study, therefore, aims to evaluate the economic effects of oil and gas extraction in Ghana, using Johansen Co-integration Approach. This study differs from prior studies (Dah & Sulemana, 2010) because it aims to determine the impact of oil and gas extraction on agricultural, industrial, and service sectors before and after oil and gas production. Using data from the World Bank's World Development Indicators (2019), the paper explores the existence of variations in economic growth between periods before and after oil and gas extraction in Ghana.

2. Theoretical Background/Literature

In determining the influence of petroleum resource endowment on economic growth, researchers must first investigate the factors that link natural resource endowment (oil and gas) to bad economic performance (Majumder *et al.*, 2020). Extant literature (Smith, 2004; Larsen, 2006; Brunnschweiler & Bulte, 2006; Brunnschweiler, 2007) uncovered a positive link between the discovery of petroleum resources and the economic growth of many nations. Given the preceding conclusions, one can infer that the discovery of petroleum resources in Africa (developing countries) would benefit the economies of those African countries, particularly those in sub-Saharan Africa. On the contrary, the likelihood that oil and gas discovery in Africa would be a curse instead of a blessing is a topic that has been debated among academics, policymakers and analysts within the oil and gas industry of these oil-rich countries (Ablo, 2015).

The oil curse theory, also known as the paradox of plenty, has a large body of literature (Katz *et al.*, 2004; Kopinski *et al.*, 2013; Satti *et al.*, 2014; Sigman *et al.*, 2022). Extant literature also revealed that countries blessed with natural resources, especially petroleum resources in Africa, are prone to corruption, rent-seeking behaviour, petroleum revenue misallocation and utilization, bad governance and socio-economic and political crises that would subsequently weaken democratic stability and economic development (Adams *et al.*, 2019; Majumder *et al.*, 2020).

Although the oil curse hypothesis has attracted significant academic attention, especially in the energy industry, most of these works focused on transparency and accountability as the drivers for sustainable management of petroleum resource revenues in underdeveloped settings (Van der Pleog, 2011; Collier & Goderis, 2007; Ackah-Baidoo, 2012; Corrigan, 2014; Adams *et al.*, 2019). The pioneering studies of the resource curse hypothesis (Sachs, 1999; Sachs & Warner, 1995) are considered seminal studies that attempted to establish the link between economic growth and natural resource endowment (Frikha & Tiba, 2019).

Countries blessed with oil and gas resources have some special features. Oil and gas resources generate revenue and can, thus, be an engine for industrialization (Satti *et al.*, 2014; Stevens & Dietsche, 2008; Hasanov *et al.*, 2022). Natural resource endowment (oil and gas) has been shown to have both direct and indirect effects on economic development in studies. According to Satti *et al.*

(2014), the effects of natural resource endowment on economic growth are inconclusive because some empirical studies have found a positive relationship between natural resource endowment and economic growth (Brunnschweiler & Bulte, 2006; Brunnschweiler, 2007; Poncian, 2019), while others revealed a negative relationship (Bhattacharyya & Collier, 2014). Satti *et al.* (2014) concluded that different investigations into the relationship between natural resource endowment and economic development presented mixed results when it came to proving the idea's veracity. This statement was backed up by Poncian (2019). Studies conducted by Majumder *et al.* (2020) on the sustainable management of petroleum revenues found that it was contrary to natural intuition that countries blessed with an abundance of natural resources such as oil and gas will be poor in terms of GDP. This scenario according to Frikha and Tiba (2019) imposed what they call a conceptual puzzle because the assumption is that natural resource endowment must enhance the economic growth rates of those resource-rich nations.

2.1 Empirical literature and hypotheses

Using panel data for about 95 countries from 1980-2010, Majumder *et al.* (2020) sought to assess the relationship between trade openness, natural resource endowment and economic growth. The study concluded that trade openness was found to be a mediating factor to ensuring that natural resource endowment inures to the benefit of oil-producing and exporting countries. Consistent with Ayelazuno (2014), nations like Switzerland, Japan, and the Asian Tigers, with no or limited natural resource abundance, recorded better economic growth rates than their counterparts such as Nigeria, Angola, and Equatorial Guinea that are endowed with natural resources. This was later confirmed by Frikha and Tiba's (2019) conceptual puzzle scenario. The growth rates of these 'poor' countries in terms of per capita GDP increased about three times faster than those countries endowed with natural resources (Majumder *et al.*, 2020). The studies of Stevens and Dietsche (2008), Frikha and Tiba (2019), and Majumder *et al.* (2020) attributed this paradox in resource-rich countries to a lack of diversification and weak institutional settings in oil-producing and exporting countries.

Likewise, Zuo and Schieffer's (2014) investigations on the China resource curse hypothesis showed an inverse relationship between natural resource endowment and economic development in the resource regions of the country. They attributed the resource curse in China to the crowding-out effect of education and Research and Development. Mavrotas *et al.* (2011) also conducted a study on the relationship between natural resource endowment and economic growth among developing countries for a thirty (30) year period (1970 - 2000). Their findings confirmed the natural resource curse hypothesis among those countries. Many other scholarly works in Africa (Tiba, 2019; Frikha & Tiba, 2019; Ding & Field, 2005) have confirmed the oil curse hypothesis (Dogan *et al.*, 2020).

However, Alexeev and Chernyavskiy (2015) found a positive association between natural resource endowment and economic growth at the regional level in Russia, indicating that there was no negative relationship between natural resource endowment and economic growth. Mideksa (2013) investigated the economic impact of natural resource endowment on economic growth and found that natural resource richness boosts GDP (Dogan *et al.*, 2020). Ji *et al.* (2014) conducted a similar study in China, comparing natural resource endowment, institutional quality, and economic growth from 1990 to 2008, and found that natural resources have a positive link with economic growth due to institutional quality at the province level (Dogan *et al.*, 2020). Natural resources, in the 1990s, according to Gerelmaa and Kotani (2016), had a positive relationship with economic growth from 1990 to 2010. The same relationship was found to be true for Sierra Leone (Dogan *et al.*, 2020). A study by Moshiri and Hayati (2017) of 149 countries showed that the negative relationship between natural resource endowment and economic growth was invalid. Their conclusions contradict many studies, including the research of Sinha and Sengupta (2019) in the Asia-Pacific countries and that of Amini (2018) in 22 developed countries and 61 developing countries.

Considering these mixed findings, and the fact that Ghana is a major oil-producing country in Africa with the government's other priority sectors being agriculture, services and industry (Ferreira

et al., 2022), it is important that the link between oil and gas production and the other sectors is uncovered. Therefore, the paper seeks to evaluate the economic effects of oil and gas extraction in Ghana with particular emphasis on Agriculture, Industry, and Service sectors using data from the World Bank's World Development Indicators (2019). To do this, the following hypotheses were postulated.

H₁ the average GDP of Ghana for the period after the production of oil in commercial quantities is higher than the average GDP for the period before the production of oil in commercial quantities.

H₂ the average agriculture value-added of Ghana for the period after the production of oil in commercial quantities is higher than the average agriculture value-added for the period before the production of oil in commercial quantities.

H₃ the average service value-added of Ghana for the period after the production of oil in commercial quantities is greater than the average service value-added for the period before the production of oil in commercial quantities.

H₄ the average industry value-added of Ghana for the period after the production of oil in commercial quantities is greater than the average industry value-added for the period before the production of oil in commercial quantities.

3. Methodology and Data

The following econometric specification (Johansen Co-integration Approach) was utilized:

3.1 Specifying the econometric Model

The models for GDP, agriculture, industry, and service outputs are specified below:

$$\ln GDP_t = \psi_0 + \psi_1 DOIL_t + \psi_2 \ln EXR_t + \psi_3 \ln INF_t + \psi_4 \ln OILP_t + \varepsilon_t \dots\dots\dots(3.1)$$

Where DOIL is a dummy variable that captures the period before oil discovery and the period after oil discovery, EXR is the exchange rate, INF is inflation and OILP is the oil price

$$\ln AO_t = \psi_0 + \psi_1 DOIL_t + \psi_2 \ln EXR_t + \psi_3 \ln INF_t + \psi_4 \ln OILP_t + \varepsilon_t \dots\dots\dots(3.2)$$

Where AO is agricultural output

$$\ln IO_t = \psi_0 + \psi_1 DOIL_t + \psi_2 \ln EXR_t + \psi_3 \ln INF_t + \psi_4 \ln OILP_t + \varepsilon_t \dots\dots\dots(3.3)$$

Where IO is the industrial output

$$\ln SO_t = \psi_0 + \psi_1 DOIL_t + \psi_2 \ln EXR_t + \psi_3 \ln INF_t + \psi_4 \ln OILP_t + \varepsilon_t \dots\dots\dots(3.4)$$

Where SO is the service output

3.2 Estimation Techniques

3.2.1 Unit Root Tests

The study's time series variables are checked for stationarity using a unit root test. There is a chance that a spurious relationship exists in time series that show growing or diminishing trends (Wooldridge, 2013). To ensure that there is no misleading link between the variables, the Augmented Dickey Fuller (ADF) test was utilized. The ADF test is an advanced form of the Dickey Fuller test and has been known to solve complex models. There are three basic regression models which are shown below:

$$\text{No constant, no trend: } \Delta y_t = \gamma y_{t-1} + u_t \dots\dots\dots(3.5)$$

$$\text{Constant, no trend: } \Delta y_t = \alpha + \gamma y_{t-1} + u_t \dots\dots\dots(3.6)$$

$$\text{Constant and trend: } \Delta y_t = \alpha + \gamma y_{t-1} + \lambda t + u_t \dots\dots\dots(3.7)$$

A lagged value of the dependent variable is included in the model when the ADF test is

employed. This is shown below as per the three basic regression models stated above:

$$\text{No constant, no trend: } \Delta y_t = \gamma y_{t-1} + \delta_s \Delta y_{t-s} + u_t \dots\dots\dots(3.8)$$

$$\text{Constant, no trend: } \Delta y_t = \alpha + \gamma y_{t-1} + \delta_s \Delta y_{t-s} + u_t \dots\dots\dots(3.9)$$

$$\text{Constant and trend: } \Delta y_t = \alpha + \gamma y_{t-1} + \lambda_t + \delta_s \Delta y_{t-s} + u_t \dots\dots\dots(3.10)$$

From the equation α is the estimated parameter, δ represents the estimated parameters of the differenced values of the lagged variables. With the ADF test, there exists a null hypothesis and an alternative hypothesis. The null hypothesis shows the existence of a unit root ($H_0: \alpha = 0$) in contrast to the alternative hypothesis where there is no unit root. If the test concludes on failing to reject the null hypothesis, then there is the existence of non-stationarity. On the other hand, when the test shows a rejection of the null hypothesis, then the variable is stationary or simply put, there is the existence of stationarity.

3.2.2 Cointegration Tests

The Johansen co-integration test is used in this investigation. This is a vector co-integration test procedure. If the data set contains two or more time series, it has an advantage over the Engle-Granger and Phillips-Ouliaris methods in that it can estimate more than one co-integration relationship (Creswell, 2014).

Instead of using OLS estimation, Johansen's technique uses maximum likelihood estimation to construct cointegrated variables. This method significantly relies on the relationship between a matrix's rank and its characteristic roots. The maximum likelihood estimation was developed by Johansen using sequential tests to determine the number of cointegrating vectors. In the sense that it relies entirely on maximum likelihood rather than relying on least squares, his method can be considered a secondary generation approach. As a result, he suggests the trace test and the maximum eigenvalue test as two different likelihood ratio tests. The estimation and test procedures are outlined below.

$$Y_t = \Pi_1 Y_{t-1} + \Pi_2 Y_{t-2} + \dots + \Pi_\rho X_{t-\rho} + u_t \dots\dots\dots(3.11)$$

where Y_t is an $n \times 1$ vector of variables that are integrated of order one, that is, $I(1)$, u_t is an $n \times 1$ vector of innovations while Π_1 through Π_ρ are $m \times m$ coefficient matrices. Reparametrizing equation 3.10, that is, subtracting Y_{t-1} on both sides, leads to

$$\Delta Y_t = \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \dots + \Gamma_{\rho-1} Y_{t-\rho+1} - \Gamma_\rho Y_{t-\rho} u_t \dots\dots\dots(3.12)$$

$$\Gamma_1 = \Pi_1 - I \quad \Gamma_2 = \Pi_2 - \Gamma_1 \quad \Gamma_3 = \Pi_3 - \Gamma_2 \quad \Gamma = I - \Pi_1 - \Pi_2 - \dots - \Pi_\rho$$

The impact matrix is a matrix that determines the extent to which the system is cointegrated. The trace test and the highest eigenvalue are two likelihood ratio tests suggested by Johansen.

3.2.3 The Trace Examination

The trace test compares the alternative hypothesis of n cointegrating vectors to the null hypothesis of r cointegrating vectors. The test statistic is calculated as follows:

$$jtrace = -T \sum_{i=r+1}^m \ln(1 - \hat{\lambda}_i) \dots\dots\dots(3.13)$$

3.2.4 The Maximum Eigenvalue

On the other hand, the maximum eigenvalue test compares the null hypothesis of r cointegrating vectors to the alternative hypothesis of $(r+1)$ cointegrating vectors. Its test statistic is calculated as follows:

$$jmax = -T(1 - \hat{\lambda}_{r+1}) \dots\dots\dots(3.14)$$

where T is the sample size and $\hat{\lambda}_i$ is the i th largest canonical correlation.

3.2.5 Fully Modified OLS Estimator

To evaluate the effect of oil and gas extraction in Ghana, the study uses a fully modified OLS (FMOLS) model. Because the model variables are cointegrated, a long-run FMOLS estimate of the GDP model can be used to display them. Phillip and Hansen proposed the Fully Modified Ordinary Least Square method (FMOLS) first (1990). To reduce the long-run link between the cointegrating equation and the innovations, the method uses a semi-parametric correction. In other words, FMOLS modifies least squares to explicate serial correlation.

4. Empirical Results

4.1 Stationary test results

This test was carried out to ensure that there was no integration of order greater than 1(2). This assures that the final product is free of erroneous results. The presence of a unit root was checked, as well as the sequence of integration, using the Augmented Dickey-fuller (ADF) test. Table 2 summarizes the findings of the ADF test.

The following econometric specification (Johansen Cointegration Approach) was utilized:

4.2 Specifying the econometric Model

The models for GDP, agriculture, industry, and service outputs are specified below:

$$\ln GDP_t = \psi_0 + \psi_1 DOIL_t + \psi_2 \ln EXR_t + \psi_3 \ln INF_t + \psi_4 \ln OILP_t + \varepsilon_t \dots\dots\dots(3.1)$$

Where DOIL is a dummy variable that captures the period before oil discovery and the period after oil discovery, EXR is exchange rate, INF is inflation and OILP is oil price

$$\ln AO_t = \psi_0 + \psi_1 DOIL_t + \psi_2 \ln EXR_t + \psi_3 \ln INF_t + \psi_4 \ln OILP_t + \varepsilon_t \dots\dots\dots(3.2)$$

Where AO is agricultural output

$$\ln IO_t = \psi_0 + \psi_1 DOIL_t + \psi_2 \ln EXR_t + \psi_3 \ln INF_t + \psi_4 \ln OILP_t + \varepsilon_t \dots\dots\dots(3.3)$$

Where IO is industrial output

$$\ln SO_t = \psi_0 + \psi_1 DOIL_t + \psi_2 \ln EXR_t + \psi_3 \ln INF_t + \psi_4 \ln OILP_t + \varepsilon_t \dots\dots\dots(3.4)$$

Where SO is service output

4.3 Estimation Techniques

4.3.1 Unit Root Tests

The study's time series variables are checked for stationarity using a unit root test. There is a chance that a spurious relationship exists in time series that show growing or diminishing trends (Wooldridge, 2013). To ensure that there is no misleading link between the variables, the Augmented Dickey Fuller (ADF) test was utilized. The ADF test is an advanced form of the Dickey Fuller tests and has been known to solve complex models. There are three basic regression models which are shown below:

$$\text{No constant, no trend: } \Delta y_t = \gamma y_{t-1} + u_t \dots\dots\dots(3.5)$$

$$\text{Constant, no trend: } \Delta y_t = \alpha + \gamma y_{t-1} + u_t \dots\dots\dots(3.6)$$

$$\text{Constant and trend: } \Delta y_t = \alpha + \gamma y_{t-1} + \lambda t + u_t \dots\dots\dots(3.7)$$

A lagged value of the dependent variable is included in the model when the ADF test is employed. This is shown below as per the three basic regression models stated above:

$$\text{No constant, no trend: } \Delta y_t = \gamma y_{t-1} + \delta_s \Delta y_{t-s} + u_t \dots\dots\dots(3.8)$$

Constant, no trend: $\Delta y_t = \alpha + \gamma y_{t-1} + \delta_s \Delta y_{t-s} + u_t$ (3.9)

Constant and trend: $\Delta y_t = \alpha + \gamma y_{t-1} + \lambda_t + \delta_s \Delta y_{t-s} + u_t$ (3.10)

From the equation α is the estimated parameter, δ represents the estimated parameters of the differenced values of the lagged variables. With the ADF test, there exists a null hypothesis and an alternative hypothesis. The null hypothesis shows the existence of a unit root ($H_0: \alpha = 0$) in contrast to the alternative hypothesis where there is no unit root. If the test concludes on failing to reject the null hypothesis, then there is the existence of non-stationarity. On the other hand, when the test shows a rejection of the null hypothesis, then the variable is stationary or simply put, there is the existence of stationarity.

4.3.2 Co-integration Tests

The Johansen co-integration test is used in this investigation. This is a vector co-integration test procedure. If the data set contains two or more time series, it has an advantage over the Engle-Granger and Phillips-Ouliaris methods in that it can estimate more than one co-integration relationship (Creswell, 2014).

Instead of using OLS estimation, Johansen’s technique uses maximum likelihood estimation to construct cointegrated variables. This method significantly relies on the relationship between a matrix’s rank and its characteristic roots. The maximum likelihood estimation was developed by Johansen using sequential tests to determine the number of cointegrating vectors. In the sense that it relies entirely on maximum likelihood rather than relying on least squares, his method can be considered a secondary generation approach. As a result, he suggests the trace test and the maximum eigenvalue test as two different likelihood ratio tests. The estimation and test procedures are outlined below.

$$Y_t = \Pi_1 Y_{t-1} + \Pi_2 Y_{t-2} + \dots + \Pi_\rho X_{t-\rho} + u_t$$
(3.11)

where Y_t is an $n \times 1$ vector of variables that are integrated of order one, that is, $I(1)$, u_t is an $n \times 1$ vector of innovations while Π_1 through Π_ρ are $m \times m$ coefficient matrices. Reparametrizing equation 3.10, that is, subtracting Y_{t-1} on both sides, leads to

$$\Delta Y_t = \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \dots + \Gamma_{\rho-1} Y_{t-\rho+1} - \Gamma_\rho Y_{t-\rho} + u_t$$
(3.12)

$$\Gamma_1 = \Pi_1 - I \quad \Gamma_2 = \Pi_2 - \Gamma_1 \quad \Gamma_3 = \Pi_3 - \Gamma_2 \quad \Gamma = I - \Pi_1 - \Pi_2 - \dots - \Pi_\rho$$

The impact matrix is a matrix that determines the extent to which the system is cointegrated. The trace test and the highest eigenvalue are two likelihood ratio tests suggested by Johansen.

4.3.3 The Trace Examination

The trace test compares the alternative hypothesis of n cointegrating vectors to the null hypothesis of r cointegrating vectors. The test statistic is calculated as follows:

$$j_{trace} = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i)$$
(3.13)

4.3.4 The Maximum Eigenvalue

On the other hand, the maximum eigenvalue test compares the null hypothesis of r cointegrating vectors to the alternative hypothesis of $(r+1)$ cointegrating vectors. Its test statistic is calculated as follows:

$$j_{max} = -T(1 - \hat{\lambda}_{r+1})$$
(3.14)

where T is the sample size, and $\hat{\lambda}_i$ is the i th largest canonical correlation.

4.3.5 Fully Modified OLS Estimator

To evaluate the effect of oil and gas extraction in Ghana, the study uses a fully modified OLS (FMOLS) model. Because the model variables are cointegrated, a long-run FMOLS estimate of the GDP model can be used to display them. Phillip and Hansen proposed the Fully Modified Ordinary Least Square method (FMOLS) first (1990). To reduce the long-run link between the cointegrating equation and the innovations, the method uses a semi-parametric correction. In other words, FMOLS modifies least squares to explicate serial correlation.

5. Empirical Results

5.1 Stationary test results

This test was carried out to ensure that there was no integration of order greater than 1(2). This assures that the final product is free of erroneous results. The presence of a unit root was checked, as well as the sequence of integration, using the Augmented Dickey-fuller (ADF) test. Table 2 summarizes the findings of the ADF test.

Table 2: Augmented Dickey Fuller (ADF) Test

Variables	Level		First Difference	
	Intercept	Trend	Intercept	Trend
LNAGRIC	-1.2872	-4.0244**	-2.7526*	-3.2427*
LNEXR	0.0411	-2.5036	-2.9592**	-3.2179*
LNGDP	-1.2643	-1.8965	-3.2037**	-3.3074*
LNINDUSTRY	-1.4367	-2.4496	-2.7045*	-3.7992**
LNINF	-1.4913	-2.1729	-4.5944***	-4.5244***
LNOILPRICE	-1.9764	-1.3932	-6.6241***	-6.8887***
LNSERVICE	-2.3114	-1.9888	-2.7290*	-3.7827**

Note: that the symbols ***, ** and * denote statistical significance at the 1%, 5% and 10% levels respectively.

Source: Authors' calculations based on World Development Indicators data from the World Bank (2019)

It is shown in Table 2 that agriculture value-added is non-stationary at the level without trend and stationary with the trend but became stationary after the first difference, thus integrated of order one, I (1). Both exchange rate and GDP contain unit root at the level but the unit root was removed after the first difference, thus, both variables are I (1). The results further revealed that industry value-added, inflation, oil price and service value-added are all non-stationary at the level but became stationary after the first difference, thus, integrated of order zero, I (1). Given that the variables are I (1) series, the Johansen Co-integration is the appropriate approach for the estimation in this study.

5.2 Co-integration Results

This section discusses the Johansen co-integration results on the effect of oil revenue on GDP and sector outputs in Ghana. The results are displayed in Table 3.

The Johansen co-integration result based on trace statistics indicates that there exists 1 co-integrating equation for the GDP model at the 5 per cent significance level. In other words, there is co-integration at rank 1. Thus, the trace test supports the hypothesis that there exists a long-run relationship between GDP and oil revenue, exchange rate, inflation, and oil price. The co-integration test based on the Max-Eigen test statistic indicates that there exists 1 co-integrating equation at the 5

per cent level of significance. That is, there is co-integration at rank 1. Thus, the Max-Eigen statistics support the hypothesis that there exists a long-run relationship between GDP and oil revenue, exchange rate, inflation, and oil price.

Table 3: Results of Johansen’s Test for Co-integration among Common Components

H ₀	GDP Model		Agric Sector Model		Industry Sector Model		Service Sector Model	
	Trace Statistic	Max-Eigen Value	Trace Statistic	Max-Eigen Value	Trace Statistic	Max-Eigen Value	Trace Statistic	Max-Eigen Value
None	70.4984**	35.5344**	82.3156**	38.4197**	97.6517**	47.6469**	88.7173**	39.4150**
At most 1	34.9640	16.7356	43.8959	23.6429	50.0049**	18.7374	49.3024**	22.3968
At most 2	18.2284	12.5947	20.2530	13.7710	31.2674**	17.0892	26.9056	13.6238
At most 3	5.6338	3.6984	6.4819	4.9759	14.1783*	8.3488	13.28181	7.4872
At most 4	1.9354	1.9354	1.5060	1.5060	5.8295**	5.8295**	5.7946	5.7946

Note: that the symbols ***, ** and * denote statistical significance at the 1%, 5% and 10% levels respectively

Source: Authors’ calculations based on World Development Indicators data from the World Bank (2019)

The Johansen co-integration result based on trace statistics indicates that there exists 1 co-integrating equation for the agriculture value-added model at the 5 per cent significance level. That is, there is co-integration at rank 1. Thus, the trace test supports the hypothesis that there exists a long-run relationship between agriculture value-added and oil revenue, exchange rate, inflation, and oil price. The co-integration test based on the Max-Eigen test statistic indicates that there exists 1 co-integrating equation at the 5 per cent level of significance. In other words, there is co-integration at rank 1. Thus, the Max-Eigen statistics support the hypothesis that there exists a long-run relationship between agriculture value-added and oil revenue, exchange rate, inflation, and oil price.

The Johansen co-integration result based on trace statistics indicates that there exist 3 co-integrating equations for the industry value-added model at the 5 per cent significance level. That is, there is co-integration at ranks 1, 2 and 3. Thus, the trace test supports the hypothesis that there exists a long-run relationship between industry value-added and oil revenue, exchange rate, inflation, and oil price. The co-integrating test based on the Max-Eigen test statistic indicates that there exists 1 co-integrating equation at the 5 per cent level of significance. In other words, there is co-integration at rank 1. Thus, the Max-Eigen statistics support the hypothesis that there exists a long-run relationship between industry value-added and oil revenue, exchange rate, inflation, and oil price.

Finally, the Johansen co-integration result based on trace statistics indicates that there exist 2 co-integrating equations for the service value-added model at the 5 per cent significance level. That is, there is co-integration at ranks 1 and 2. Thus, the trace test supports the hypothesis that there exists a long-run relationship between service value-added and oil revenue, exchange rate, inflation, and oil price. The co-integrating test based on the Max-Eigen test statistic indicates that there exists 1 co-integrating equation at the 5 per cent level of significance. In other words, there is co-integration at rank 1. Thus, the Max-Eigen statistics support the hypothesis that there exists a long-run relationship between service value-added and oil revenue, exchange rate, inflation, and oil price.

5.3 Long-run Estimations

The results show that oil revenue has a significant effect on GDP, agricultural value-added, industry value-added and service value-added at the 10 per cent and 1 per cent levels of significance respectively. Focusing on the GDP model, the positive sign of the coefficient indicates that the average GDP of Ghana for the period after the production of oil in commercial quantities is higher than the average GDP for the period before the production of oil in commercial quantities. This shows that oil and gas production (revenues) have a positive impact on Ghana's economic growth

(GDP). The magnitude of the coefficient shows that the average GDP for the period after the production of oil in commercial quantities is 4% higher than the average GDP before the production of oil in commercial quantities. The findings are incongruous with the works of Moradbeigi and Law (2017) and Cockx and Franken (2016). This, however, supports the oil and gas blessing hypothesis that the discovery of oil stimulates a nation's revenue thereby improving the level of infrastructural development and consequently increasing GDP (Adabor *et al.*, 2021). Hence, the study accepted the hypothesis (H₁) that there is a significant difference in the GDP performance of Ghana before and after oil and gas production. The comments are also in line with empirical studies of Luki (2016), and Oteng-Adjei (2011) that oil and gas exploration and extraction have a positive effect on the economies (GDP) of oil-producing and exporting countries.

Focusing on the agriculture value-added and service value models, the negative sign of the coefficients indicates that the average agriculture value-added and service value-added of Ghana for the period after the production of oil in commercial quantities are lower than the average agriculture value-added and service value-added for the period before production of oil in commercial quantities. The magnitude of the coefficients shows that the average agriculture value-added and service value for the period after the production of oil in commercial quantities is 12% and 31% lower than the average agriculture value-added and service value-added for the period before the production of oil in commercial quantities respectively. Hence, the study rejects the hypotheses that:

H₂ the average agriculture value-added of Ghana for the period after the production of oil in commercial quantities is higher than the average agriculture value-added for the period before the production of oil in commercial quantities.

H₃ the average service value-added of Ghana for the period after the production of oil in commercial quantities is greater than the average service value-added for the period before the production of oil in commercial quantities.

However, the positive sign of the coefficient for industry value-added indicates that the average industry value-added of Ghana for the period after the production of oil in commercial quantities is higher than the average industry value-added for the period before the production of oil in commercial quantities. The magnitude of the coefficient shows that the average industry value-added for the period after the production of oil in commercial quantities is 54 per cent higher than the average industry value added before the production of oil in commercial quantities. As a result, the study supports the hypothesis that

H₄ the average industry value-added of Ghana for the period after the production of oil in commercial quantities is greater than the average industry value-added for the period before the production of oil in commercial quantities. The results are displayed in Table 4.

Table 4: Fully-Modified Estimation of GDP, Agric, Industry and Service

Variables	GDP Model Coefficient	Agric Sector Model Coefficient	Industry Sector Model Coefficient	Service Sector Model Coefficient
DOILREV	0.0411* (0.0244)	-0.1158*** (0.0407)	0.5449*** (0.0818)	-0.3151*** (0.0926)
LNEXR	0.4308*** (0.0173)	-0.2212** (0.0289)	-0.0929 (0.0580)	0.2580*** (0.0657)
LNINF	-0.0757*** (0.0204)	0.1441*** (0.0339)	0.0025 (0.0681)	-0.0869 (0.0771)
LNOIL PRICE	0.1453*** (0.0149)	-0.0879*** (0.0249)	-0.1867*** (0.0500)	0.2950*** (0.0566)
CONSTANT	24.6413*** (0.0998)	3.4118*** (0.1663)	3.7916*** (0.3341)	2.7331*** (0.3783)

Note: that the symbols ***, ** and * denote statistical significance at the 1%, 5% and 10%

Source: Authors' calculations based on World Development Indicators data from the World Bank (2019)

6. Summary

The literature presents a mixed verification of the effect of oil and gas extraction on economic development. While some studies found a positive relationship between natural resource abundance and economic growth (Dong *et al.*, 2019), others found a negative correlation (Frikha & Tiba, 2019; Majumder *et al.*, 2020). The study's goal was to look at the effect of oil and gas extraction on the GDP performance of Ghana. To do this, the study specifically focused on the effect of oil and gas extraction on the Agricultural, Services and Industry sectors of Ghana.

In terms of the GDP model, the positive sign of the coefficient shows that Ghana's average GDP for the period following commercial oil and gas production is higher than the average GDP for the period before commercial oil and gas production. This demonstrates that revenue from oil and gas production has a favourable impact on Ghana's economic growth (GDP). The magnitude of the coefficient indicates that the average GDP for the time following commercial oil production is 4% higher than the average GDP before commercial oil production. The finding is incongruous with the works of Moradbeigi and Law (2017) and Cockx and Franken (2016). This result, however, supports the oil and gas blessing hypothesis that the discovery of oil and gas stimulates a nation's revenue thereby improving the level of infrastructural development and consequently, increasing GDP (Adabor, *et al.*, 2021). Hence the study accepted the hypothesis (H_3) that there is a significant difference in the GDP performance of Ghana before and after oil and gas production. The findings are also in line with the result of other empirical studies (Luki, 2016; Oteng-Adjei, 2011) that oil and gas exploration and extraction have an effect on the economies (GDP) of oil-producing and exporting countries.

7. Conclusion, Recommendation and Policy Implications

Even though oil and gas extraction has had a positive impact on the economy (GDP) of Ghana, its impact on the agricultural and service sectors is negative as evidenced in Table 4. However, the study found evidence that the average industry value-added of Ghana for the period after the production of oil in commercial quantities is greater than the average industry value-added for the period before the production of oil in commercial quantities (H_4). The study also alludes to the empirical findings that those countries with abundant natural resources, such as petroleum, have an economic edge over those with little or no such resources. Thus, discovering a natural asset such as crude oil could be a blessing or a curse, depending on how the cash generated from it is managed. Furthermore, the study's conclusions can be applied to other African oil-producing and exporting countries that have similar institutional setups. Governments, policymakers, and other oil and gas-producing and exporting countries, particularly in sub-Saharan Africa, will benefit from the study's conclusions. For policymakers, the findings of the study provide insights into Ghana's diversification and industrialization drive.

- i. When looking at the agriculture and service value-added models, the negative sign of the coefficient indicates that Ghana's average agriculture and service value-added for the period after commercial oil production is lower than the average agriculture and service value-added for the period before commercial oil production. The magnitude of the coefficient shows that the average agriculture and service value-added for the period after the production of oil in commercial quantities is 12% lower and 31% lower than the average agriculture and service value-added for the period before the production of oil in commercial quantities respectively. Government should therefore formulate and expand policies (notably, planting for food and jobs, and agricultural mechanization) to help expand the agricultural and service base of the economy using oil revenues.
- ii. Though previous studies have identified factual evidence of the oil curse, the study revealed a positive link between oil and gas extraction (oil revenues) and economic growth (GDP). Nonetheless, oil and gas extraction has had no major impact on the agricultural and service

sectors, providing credence for the oil curse hypothesis (Dutch Disease). The study, therefore, recommends that the Public Interest and Accountability Committee (PIAC) should closely monitor and collaborate with the other petroleum revenue management institutions to ensure oil revenues are allocated to the government priority sectors, especially agriculture and service, are fully implemented.

- iii. Future research may look at specific government interventions or investments in the various sectors of the economy. This will give a better indication as to what specific investment decisions have to be made.

References

- Ablo, A. D. (2015). Local content and participation in Ghana's oil and gas industry: can enterprise development make a difference? *Extractive Industries and Societies*, 2, 320–327. <http://dx.doi.org/10.1016/j.exis.2015.02.003>.
- Ackah-Baidoo, A. (2012). Enclave development and “offshore corporate social responsibility” implications for oil-rich sub-Saharan Africa. *Resources Policy*, 37, 152–159. <http://dx.doi.org/10.1016/j.resourpol.2011.12.010>.
- Adabor, O, Buabeng, E. & Choumbou, R. F.D. (2021). Asymmetrical effects of oil and gas resource rent on economic growth: Empirical evidence from Ghana. *Cogent Economics & Finance*, 9(1), retrieved on November 16, 2022 from: DOI: 10.1080/23322039.2021.1971355
- Adams, D., Ullaha, S., Akhtara, P., Adams, K., & Saidi, S. (2019). The role of country-level institutional factors in escaping the natural resource curse: Insights from Ghana. *Resources Policy*, 61, 433–440.
- Akinlo, H. (2012.). How important is oil in Nigeria's economic growth? *Journal of Sustainable Development*, 5(4), 165–179.
- Alexeev, M., & Chernyavskiy, A. (2015). Taxation of natural resources and economic growth in Russia's regions. *Economic Systems*, 39 (2), 317–338.
- Amini, A. (2018). Studying the Effect of Abundance of Natural Resources on Economic Growth. *European Journal of Sustainable Development*, 7(1), 201. <https://doi.org/10.14207/ejsd.2018.v7n1p201>
- Aryeetey, E. & Ackah, I. (2018). The boom, the bust, and the dynamics of oil resource management in Ghana, WIDER Working Paper, No. 2018/89, ISBN 978-92-9256-531-2, The United Nations University World Institute for Development Economics Research (UNU-WIDER), Helsinki.
- Asekunowo, V. O., & Olaiya, S. A. (2012). Crude oil revenue and economic development in Nigeria (1974–2008). *OPEC Energy Review* 36 (2), 138–169. <https://doi.org/10.1111/j.1753-0237.2011.00205.x>
- Ayelazuno, J. (2014). Oil wealth and the well-being of the subaltern classes in Sub-Saharan Africa: A critical analysis of the resource curse in Ghana. *Resources Policy*. 40, 66–73. <https://doi.org/10.1016/j.resourpol.2013.06.009>
- Bhattacharyya, S., & Hodler, R. (2014). Do natural resource revenues hinder financial development? The role of political institutions. *World Development*. 57, 101–113.
- Brunnschweiler, C. N. (2007). Cursing the Blessings? Natural Resource Abundance, Institutions, and Economic Growth. *World Development*, 36(3), 399–419. doi: 10.1016/j.worlddev.2007.03.004
- Brunnschweiler, C. N., & Bulte, E. H. (2006). The Resource curse revisited and revised: A tale of paradoxes and red herrings, working paper 06/61, 2006 December at www.ideas.repec.org/p/eth/wpsuif/06-61.html (last visited 11/07/2019)
- CIA (2018). at <https://www.cia.gov/library/publications/resources/the-world-factbook/fields/264rank.html> (last visited 22/05/2020)
- Cockx, L., & Francken, N. (2016). Natural resources: A curse on education spending? *Energy Policy*, 92, 394–408. <https://doi.org/10.1016/j.enpol.2016.02.027>
- Collier, P., & Goderis, B. (2007). *Commodity Prices, Growth and the Natural Resource Curse: Reconciling a Conundrum*. CSAE WPS 15.
- Corrigan, C. C. (2014). Breaking the resource curse: transparency in the natural resource sector and the extractive industries transparency initiative. *Resources Policy*, 40, 17–30. <http://dx.doi.org/10.1016/j.resourpol.2013.10.003>.
- Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*. (4th ed.). Thousand Oaks, CA: Sage.
- Dah, F. K., & Sulemana, K. M. (2010). *The contribution of oil to the economic development of Ghana: The role of foreign direct investments (FDI) and government policies*. Master thesis in International Business 15 ECT, Department of Economics and Informatics, University West Spring term 2010

- Ding, N., & Field, B. C. (2005). Natural resource abundance and economic growths. *Land Economics*, 81(4), 496–502.
- Dogan, E., Altinoz, B., & Tzeremes, P. (2020). The analysis of Financial Resource Curse' hypothesis for developed countries: Evidence from asymmetric effects with quantile regression. *Resources Policy*, 68, 101773.
- Dong, B., Zhang, Y., & Song, H. (2019). Corruption as a natural resource curse: Evidence from the China. *China Economic Review*, 57, 101314. <https://doi.org/10.1016/j.chieco.2019.101314>
- Ferreira, V., Almazán-Gómez, M.Á., Nechifor, V. & Ferreira, V. (2022). The role of the agricultural sector in Ghanaian development: a multiregional SAM-based analysis. *Economic Structures*, 11(6), 1-27. <https://doi.org/10.1186/s40008-022-00265-9>
- Frikha, M., & Tiba, S. (2019). The controversy of the resource curse and the environment in the SDGs background: The African context. *Resources Policy*, 62, 437-452.
- Garside, M. (2020). Volume of global oil reserves from 1990 to 2018 at <https://www.statista.com/statistics/236657/global-crude-oil-reserves-since-1990/> (last accessed May 22, 2020).
- Gerelmaa, L., & Kotani, K. (2016). Further investigation of natural resources and economic growth: do natural resources depress economic growth? *Resources Policy*, 50, 312–321
- González, Y. S. (2016). The Gulf of Guinea: the future African Persian Gulf? *Brazilian Journal of African Studies*, 1(1), 85-105.
- Hasanov, F., Aliyev, R., Tashkin, D., & Suleymanov, E. (2022). Oil Rents and Non-Oil Economic Growth in CIS Oil Exporters. The Role of Financial Development. Available at SSRN: <https://ssrn.com/abstract=4161492> or <http://dx.doi.org/10.2139/ssrn.4161492>
- Humphrey, M., Sachs, J. D., & Stiglitz, J. E. (2007). *Escaping the Resource Curse*. New York USA, Colombia University Press.
- Ingen, C., Wait, R., & Kleynhans, E. (2014). Fiscal policy and revenue management in resource-rich African countries: A comparative study of Norway and Nigeria, *South African Journal of International Affairs*, 21(3), 367-390. DOI: 10.1080/10220461.2014.968200
- Ji, K., Magnus, J. R., & Wang, W. (2014). Natural resources, institutional quality, and economic growth in China. *Environmental Resources. Economics*, 57(3), 323–343. <https://doi.org/10.1007/s10640-013-9673-8>
- Katz, M, Bartsch, U., Malothra, H., & Cuc, M. (2004). *Lifting the Oil Curse: Improving Petroleum Revenue Management in Sub-Saharan Africa*. Washington DC, International Monetary Fund
- Kopiński, D., Polus, A. & Tycholiz, W. (2013). Resource curse or resource disease? Oil in Ghana. *African Affairs*, 112(449) 583–601. <http://dx.doi.org/10.1093/afraf/adt056>.
- Larsen, E. R. (2006). Escaping the resource curse and the Dutch disease? *American Journal of Economics and Sociology*, 65(3), 605–640. <http://dx.doi.org/10.1111/j.1536-7150.2006.00476.x>.
- Luki, B. N. (2016). Sustainable Management of Petroleum Resources: An Examination of the Ghana Heritage Fund (GHF) of the Petroleum Revenue Management Act, 2010 (Act 815). *Journal of Resources Development and Management*, 19, 64-73.
- Majumder, M. K., Raghavan, M., & Vespignani, J. (2020). Oil curse, economic growth and trade openness. *Energy Economics*, 91, 104896. <https://doi.org/10.1016/j.eneco.2020.104896>
- Mavrotas, G., Murshed, S. M., & Torres, S. (2011). Natural resource dependence and economic performance in the 1970–2000 period. *Revenue Development Economics*, 15(1), 124–138.
- Mideksa, T. K. (2013). The economic impact of natural resources. *Journal Environmental Economics Management*, 65(2), 277–289.
- Moradbeigi, M., & Law, S. H. (2017). The role of financial development in the oil-growth nexus. *Resources Policy*, 53(16), 164–172. <https://ezproxy.ug.edu.gh:2057/10.1016/j.resourpol.2017.06.016>
- Moshiri, S. & Hayati, S. (2017). Natural resources, institutions quality, and economic growth; A cross-country analysis. *Iran Economy Review*, 21(3), 661–693.
- Oteng-Adjei, J. (Minister of Energy, Ghana) 'meet-the-press series' Accra, Thursday, 06/10/2011
- Oshionebo, E. (2018). Sovereign Wealth Funds in Developing Countries: A Case Study of the Ghana Petroleum Funds. *Journal of Energy & Natural Resources Law*, 36(1), 33–59.
- Peach, J. and CM Starbuck (2011). Oil and Gas Production and Economic Growth in New Mexico. *Journal of Economic Issues*, 45(2), 511–526. DOI: 10.2753/JEI0021-3624450228
- PIAC (2020). Public Interest and Accountability Committee Reports 2011-2020 at <https://www.piacghana.org/portals/5/25/piac-reports> (last accessed December 3, 2022).
- Poncian, J. (2019). Extractive resource ownership and the subnational resource curse: Insights from Tanzania. *Extractive Industries and Society* 6(2) 332–342. <https://doi.org/10.1016/j.exis.2018.08.013>

- Ross, M. L. (2012). *The oil curse: How Petroleum wealth shapes the Development of Nations*. New Jersey USA, Princeton University Press.
- Sachs, D. J., & Warner, A. M. (1995). *Natural resource abundance and economic growth*. National Bureau of Economic Research (NBER) working paper no. 5398.
- Sachs, J. A. (1999). The big push, natural resource booms and growth. *Journal of Development Economics*, 59, 43-76.
- Sarmidi, T. L., Law, S. H., & Jafari, Y. (2014). Resource curse: new evidence on the role of institutions. *International Journal of Economics*, 28(28), 191-206.
- Satti, L. S., Farooq, A., & Loganathan, N., (2014). Empirical evidence on the resource curse hypothesis in oil abundant economy. *Economic Modelling*, 42, 421-429.
- Shaw, D. L. (2013). Good Governance in the Post – Soviet South: Testing Theories of the Resource Curse in Azerbaijan. *Journal of Politics & International Studies*, Vol. 9, 520-561.
- Sigman, R., Harris, A. S., Meyer-Sahling, J-H., Mikkelsen, K. S. & Schuster, C. (2022): Do Bureaucrats Contribute to the Resource Curse? Evidence from a Survey Experiment in New Oil States. *The Journal of Development Studies*. 1-17. DOI: 10.1080/00220388.2021.2013468
- Sinha, A., & Sengupta, T. (2019). Impact of natural resource rents on human development: What is the role of globalization in Asia Pacific countries? *Resources Policy*, 63(C), 1-1.
- Smith, B. (2004). Oil wealth and regime survival in the developing world, 1960-1999. *American Journal of Political Science*, 48(2), 232-246.
- Steven, P., & Dietsche, E. (2008). The Resource Curse. An analysis of causes, experience and possible ways forward. *Energy Policy*, 36(1), 56-65.
- Tiba, S. (2019). Modelling the nexus between resources abundance and economic growth: an overview from the PSTR model. *Resources Policy*, 64, 101503. <https://doi.org/10.1016/j.resourpol.2019.101503>
- Van der Ploeg, F. (2011). Natural resources: curse or blessing? *Journal of Economic Literature*. 49, 366-420. <http://dx.doi.org/10.1257/jel.49.2.366>.
- Yeboua, K. Cilliers, J. & Roux, A. (2022). *Nigeria in 2050: major player in the global economy or poverty capital?* Institute for Security Studies, March 15, 2022, 12-15, <https://tinyurl.com/24zh44ya>.
- Zalle, O. (2019). Natural resources and economic growth in Africa: the role of institutional quality and human capital. *Resources Policy*, 62, 616-624. <https://doi.org/10.1016/j.resourpol.2018.11.009>
- Zuo, N., & Schiefer, J. (2014). Are Resources a Curse? An Investigation of Chinese Provinces. Selected Paper prepared for presentation at the Southern Agricultural Economics Association (SAEA) Annual Meeting, Dallas, Texas, 1-4 February 2014.

Appendix 1: Secondary Data (World Bank Development Indicators, 2019)

Year	OIL	GDP	Exchange rate	Inflation	Doilrev	Service	Industry	Agric
2001	23.12	54848740700	0.76395358	32.9054089	0	29.15890698	25.21597974	35.24180012
2002	24.36	57316933800	0.792417084	14.81624006	0	29.21411322	25.27507435	35.14837706
2003	28.1	60297414400	0.8666764327	26.67494973	0	29.06676018	25.2099151	36.5454059
2004	36.05	63674069600	0.899494854	12.62457406	0	28.67829438	24.71675627	37.95242609
2005	50.59	67430842200	0.905209486	15.11818572	0	28.91462953	25.12543594	37.45301293
2006	61	71746357100	0.915106799	10.91516997	0	46.45903144	19.80338501	28.94894567
2007	69.04	74865041500	0.932619195	10.73272807	0	47.1685501	19.49280657	27.29411448
2008	94.1	81715042300	1.052275	16.52214331	0	46.17389681	19.39956455	29.40809676
2009	60.86	85673716900	1.404966667	19.25071443	0	47.93620711	18.51499213	30.99338421
2010	77.38	92441693700	1.429983333	10.70756812	0	48.18166083	18.01494281	28.03873796
2011	107.46	1.05427E+11	1.520625	8.726836831	1	45.8448786	23.86466009	23.66370497
2012	109.45	1.15224E+11	1.824866667	7.12635006	1	47.58295025	27.13653359	22.13154569
2013	105.87	1.2365E+11	1.98135	11.66619231	1	40.58855009	34.08082225	20.36084251
2014	96.29	1.27233E+11	2.806575	15.48961603	1	39.09721473	35.19175722	20.74452957
2015	49.49	1.30004E+11	3.714641667	17.1499695	1	42.14244854	32.13687984	20.78519837
2016	40.68	1.34486E+11	3.909816667	17.45463471	1	45.25817355	28.34427253	21.48137806
2017	52.51	1.45438E+11	4.350533333	12.37192155	1	44.63646636	30.37133117	20.08068434
2018	68.09	1.54548E+11	4.585325	7.808765166	1	45.00482887	31.39229029	18.68726875
2019	63.05	1.6456E+11	5.217866667	7.175922847	1	45.88186902	31.5979152	17.60748628
2020	50.23	1.65999E+11	5.595708333	9.95344087	1	42.63264497	34.6854824	18.2372918

year	Agric	EXR	GDP	Industry	Service	Oil price	Inflation	Doilrev
2001Q1	35.24180012		54848740700	25.21598	29.15891	25.72	41.95	0
2001Q2	35.21844436	0.735333	55465788975	25.2300	29.17271	26.72	36.84	0
2001Q3	35.19508859	0.754361	56082837250	25.24583	29.18051	26.06	28.31	0
2001Q4	35.17173283	0.773389	56699885525	25.26075	29.20031	19.33	21.29	0
2002Q1	35.14837706	0.792417	57316933800	25.27567	29.21411	24.03	16.00	0
2002Q2	35.49763427	0.810004	5862053950	25.25923	29.17727	24.51	13.70	0
2002Q3	35.84689148	0.829591	58807174100	25.24279	29.14044	28.32	12.90	0

year	Agric	EXR	GDP	Industry	Service	Oil price	Inflation	Doilrev
2002Q4	36.19614869	0.848178	59552294250	25.22635	29.1036	27.45	15.20	0
2003Q1	36.5454059	0.866764	60297414400	25.20992	29.06676	29.45	29.84	0
2003Q2	36.80716005	0.874947	6114578200	25.08663	28.96964	27.16	32.94	0
2003Q3	37.248916	0.88313	61985742000	24.96334	28.87253	26.78	29.79	0
2003Q4	37.60067105	0.891312	62839905800	24.84005	28.77541	29.58	31.27	0
2004Q1	37.95242609	0.899495	63674069600	24.71676	28.67820	32.73	15.62	0
2004Q2	37.8275728	0.900924	64613262750	24.81893	28.73738	35.52	18.00	0
2004Q3	37.70271951	0.902352	6552455900	24.9211	28.79646	42.82	19.64	0
2004Q4	37.57786622	0.903781	66491649050	25.02327	28.85555	40.64	16.44	0
2005Q1	37.45301293	0.905209	67430842200	25.12544	28.91463	53.28	17.79	0
2005Q2	35.32699961	0.907684	68509720925	23.79492	33.30073	57.61	14.05	0
2005Q3	33.2009793	0.910158	69588596650	22.46441	37.68683	63.72	14.34	0
2005Q4	31.07496248	0.912632	70667478375	21.1339	42.07293	55.60	13.91	0
2006Q1	28.94894567	0.915107	71746357100	19.80339	46.45903	63.06	11.28	0
2006Q2	28.53523787	0.919485	72526028300	19.72574	46.63641	69.74	11.39	0
2006Q3	28.12153008	0.923863	73305699300	19.6481	46.81379	63.49	11.39	0
2006Q4	27.70782228	0.928241	74085370400	19.57945	46.99117	62.54	10.92	0
2007Q1	27.29411448	0.932619	74865041500	19.49281	47.16855	62.36	10.19	0
2007Q2	27.82261005	0.962533	76577541700	19.4095	46.91989	70.55	10.69	0
2007Q3	28.35110562	0.992447	78290041900	19.44619	46.67122	77.00	10.19	0
2007Q4	28.8796019	1.022361	80005242100	19.42288	46.42356	91.51	12.75	0
2008Q1	29.40809676	1.052275	8175042300	19.39956	46.1739	102.98	13.79	0
2008Q2	29.80441862	1.140448	82704710950	19.1782	46.61447	133.47	18.41	0
2008Q3	30.20074048	1.228621	83694379600	18.95683	47.05505	100.75	17.89	0
2008Q4	30.59706235	1.316794	84684048250	18.73546	47.49563	43.29	18.13	0
2009Q1	30.99338421	1.404967	85673716900	18.51409	47.93621	47.32	20.53	0
2009Q2	30.25472265	1.411221	8736571100	18.3893	47.99745	69.34	20.74	0
2009Q3	29.51606109	1.417475	89057705300	18.20452	48.05868	68.10	18.37	0
2009Q4	28.77739953	1.423729	90749699500	18.13973	48.11992	75.24	15.98	0
2010Q1	28.03873796	1.429983	92441693700	18.01494	48.18116	79.90	13.30	0
2010Q2	26.94497971	1.452644	95688043450	19.47712	47.59709	75.66	9.50	0
2010Q3	25.85122147	1.475304	989134393200	20.9393	47.01302	78.21	9.40	0
2010Q4	24.75746322	1.497965	1.02181E+11	22.40148	46.42895	92.34	8.60	0
2011Q1	23.66370497	1.520625	1.05427E+11	23.86366	45.84488	114.62	9.13	1
2011Q2	23.2805674	1.596685	1.07876E+11	24.68188	46.2794	113.91	8.59	1
2011Q3	22.89742983	1.672746	1.10326E+11	25.5901	46.71391	109.96	8.40	1
2011Q4	22.51429226	1.748806	1.12775E+11	26.31832	47.14843	107.72	8.58	1
2012Q1	22.13151469	1.824867	1.15224E+11	27.13653	47.58295	124.62	8.78	1
2012Q2	21.60082665	1.863988	1.17331E+11	28.87486	45.83435	95.89	9.44	1
2012Q3	21.25049086	1.903108	1.19437E+11	30.61318	44.08575	113.04	9.43	1
2012Q4	20.81017056	1.942239	1.21544E+11	32.3515	42.33715	109.39	8.84	1
2013Q1	20.36984251	1.98135	1.2365E+11	34.08982	40.58855	109.53	10.78	1
2013Q2	20.46351428	2.210156	1.24546E+11	34.36531	40.21572	103.30	11.63	1
2013Q3	20.57788604	2.438963	1.25441E+11	34.61079	39.84288	111.21	11.95	1
2013Q4	20.65085781	2.667769	1.26337E+11	34.91627	39.47005	110.60	13.50	1
2014Q1	20.74452957	2.896575	1.27233E+11	35.19176	39.09721	107.68	14.52	1
2014Q2	20.75469677	3.101092	1.27926E+11	34.42804	39.85852	111.97	14.99	1
2014Q3	20.76486397	3.305608	1.28618E+11	33.66432	40.61983	98.56	16.47	1
2014Q4	20.77503117	3.510125	1.29311E+11	32.9006	41.38114	62.36	16.99	1
2015Q1	20.78519837	3.714642	1.30004E+11	32.13688	42.14245	57.01	16.64	1
2015Q2	20.95024329	3.763435	1.3125E+11	31.8873	42.92138	63.75	17.08	1
2015Q3	21.13328822	3.812229	1.32245E+11	30.24058	43.79031	48.57	17.36	1
2015Q4	21.30733314	3.861023	1.33366E+11	29.29242	44.47924	38.92	17.70	1
2016Q1	21.48137806	3.909817	1.34486E+11	28.34427	45.25817	39.80	19.20	1
2016Q2	21.13120463	4.019996	1.37224E+11	28.85104	45.10275	49.89	18.40	1
2016Q3	20.7810312	4.130175	1.39962E+11	29.3578	44.94732	47.23	17.20	1
2016Q4	20.43085777	4.240354	1.427E+11	29.86457	44.79189	54.93	15.40	1
2017Q1	20.08068434	4.350533	1.45438E+11	30.37133	44.63647	52.53	12.80	1
2017Q2	19.73233044	4.409231	1.47716E+11	30.62657	44.72856	47.54	12.10	1
2017Q3	19.38397654	4.467929	1.49993E+11	30.88182	44.82065	55.23	12.20	1
2017Q4	19.03562265	4.526627	1.52327E+11	31.13706	44.91274	64.27	11.80	1
2018Q1	18.68726875	4.585325	1.54548E+11	31.3923	45.00483	66.68	10.36	1
2018Q2	18.41732313	4.743335	1.57951E+11	31.4437	45.22409	75.94	9.97	1
2018Q3	18.14737752	4.901346	1.59554E+11	31.4951	45.44335	79.09	9.79	1
2018Q4	17.8774319	5.059356	1.62057E+11	31.54651	45.66261	57.67	9.43	1
2019Q1	17.60748628	5.217367	1.6456E+11	31.59792	45.88187	67.05	9.28	1
2019Q2	17.76504701	5.311952	1.64918E+11	32.36981	45.06956	63.05	9.12	1
2019Q3	17.92260773	5.406538	1.65276E+11	33.1417	44.25725	63.05	9.12	1
2019Q4	18.08016846	5.501123	1.65614E+11	33.91359	43.44494	63.05	9.12	1
2020Q1	18.23772918	5.595708	1.65993E+11	34.68548	42.63263	33.73	7.80	1