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Examining the Role of Oil and Non-Oil Revenues, and Oil Price Fluctuations on Economic Growth in African Oil Exporting Countries

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ABSTRACT

This study investigates the complex relationships between oil revenues, non-oil revenues, oil price fluctuations, and economic growth in African oil-exporting countries. Targeting Nigeria, Angola, Algeria, Libya, and Egypt, the research analyzed a comprehensive dataset spanning 1970-2023 using advanced second-generation panel econometric techniques. The cross-sectional Autoregressive Distributed Lag (ARDL) model examined the long-run and short-run dynamics of economic growth determinants. The sample comprised five leading African oil-producing countries, with data sourced from the World Bank Development Database. Results demonstrated significant positive relationships between GDP and oil revenue, non-oil revenue, oil prices, capital, and labor. The research revealed the critical importance of economic diversification, human capital investment, and strategic revenue management in driving sustainable economic growth. The study offers substantial implications for policymakers, economists, and development practitioners by providing insights into economic transformation mechanisms in resource-dependent economies. It contributes to resource economics literature by offering empirical evidence of complex economic interactions in African contexts. The originality of the research lies in its comprehensive approach, innovative methodological techniques, and detailed exploration of economic growth dynamics in African oil-exporting countries.

Introduction

Over the last decades, oil-exporting African countries have experienced significant economic volatility driven by global oil market dynamics and price fluctuations (Adenomon & Songhaili, 2020; Okonkwo et al., 2022). The persistent dependency on oil revenues has exposed these economies to substantial macroeconomic risks, with some countries experiencing extreme economic vulnerability. For instance, Nigeria, Africa's largest oil producer, witnessed a dramatic 70% decline in oil revenues between 2014 and 2016, highlighting the precarious nature of resource-dependent economies (World Bank, 2017). Similarly, Angola experienced a 40% reduction in GDP growth during the 2016 oil price crisis, demonstrating the profound impact of oil price volatilities on national economic performance (International Monetary Fund [IMF], 2018). The structural economic challenges in African oil-producing countries are deeply rooted in their heavy reliance on hydrocarbon exports. Research indicates that countries like Algeria and Libya derive approximately 95% of their export earnings from oil revenues, making them extraordinarily susceptible to international market fluctuations (Brahimi & Kadri, 2019; El-Montasser et al., 2014). This extreme dependence creates significant macroeconomic

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instabilities, characterized by boom-and-bust economic cycles that undermine sustainable development strategies. Empirical studies reveal that a 10% decline in global oil prices can potentially reduce economic growth rates in these countries by up to 3-5 percentage points, demonstrating the direct correlation between oil market dynamics and national economic performance (Nchor & Abdulrahman, 2016; Siddig et al., 2018).

The intricate relationship between oil revenues, economic diversification, and growth trajectories presents multifaceted challenges for African oil-exporting nations. Extensive literature suggests that countries with limited economic diversification experience more pronounced economic vulnerabilities. For example, Nigeria's over-reliance on oil sector revenues, which constitute approximately 70% of government budget revenues, has hindered comprehensive economic development and structural transformation (Iwayemi & Fowowe, 2011; Osuji et al., 2022). The persistent economic model characterized by mono-product export strategies has perpetuated systemic inefficiencies, preventing meaningful investments in critical sectors such as manufacturing, agriculture, and technology. Moreover, the geopolitical landscape and global energy transitions have further complicated the economic strategies of oil-producing African countries. The increasing global shift towards renewable energy sources and climate change mitigation strategies pose significant challenges to traditional hydrocarbon-dependent economies. Studies have consistently highlighted the urgent need for comprehensive economic restructuring and diversification strategies to ensure long-term economic sustainability (Nwani, 2020; Omoju et al., 2019). The volatility of global oil markets, exemplified by dramatic price fluctuations during events like the 2016 crude oil crisis and the COVID-19 pandemic, underscores the critical importance of developing resilient and adaptable economic frameworks.

Despite extensive research on oil-dependent economies, significant knowledge gaps persist in comprehensively understanding the nuanced interactions between oil revenues, non-oil economic sectors, and sustainable growth strategies in African contexts. Previous studies by Adenomon and Songhaili (2020), Okonkwo et al. (2022), and Brahimi and Kadri (2019) have predominantly focused on individual country analyses, limiting the potential for comprehensive regional insights. Limited empirical research exists that systematically examines the longitudinal impacts of oil price fluctuations across multiple African oil-exporting countries. Scholars like El-Montasser et al. (2014), Nchor and Abdulrahman (2016), and Siddig et al. (2018) have conducted isolated investigations, but comprehensive cross-country comparative analyses remain scarce. The existing literature predominantly emphasizes macroeconomic indicators without adequately exploring the intricate relationships between oil revenues, economic diversification strategies, and long-term growth potential. Furthermore, most studies have not comprehensively integrated second-generation panel econometric techniques to provide nuanced understanding of complex economic interactions.

Critical research gaps include insufficient exploration of non-oil revenue generation mechanisms, limited understanding of structural economic transformations, and inadequate analytical frameworks for assessing economic resilience. Researchers such as Iwayemi and Fowowe (2011), Omoju et al. (2019), and Nwani (2020) have highlighted these limitations, emphasizing the need for more sophisticated, multidimensional research approaches that transcend traditional economic modeling techniques. The study critically examines the complex interactions between oil revenues, non-oil economic sectors, and economic growth in leading African oil-producing countries. This research contributes significant theoretical insights into resource-dependent economies by providing comprehensive empirical evidence. The study advances existing literature through innovative methodological approaches, offering critical perspectives on economic diversification strategies and sustainable development pathways for oil-exporting African nations.

Literature Review

African Leading Oil Producing Countries

Nigeria represents Africa's largest oil producer, accounting for approximately 40% of the continent's total oil production (Adenomon & Songhaili, 2020; Okonkwo et al., 2022). The country's petroleum sector contributes nearly 95% of its export earnings and approximately 70% of government revenue. Despite significant oil reserves estimated at 37 billion barrels, Nigeria struggles with systemic challenges including infrastructure deficiencies, political instability, and limited economic diversification (World Bank, 2019; Iwayemi & Fowowe, 2011; Ahmad, et al., 2021). Algeria ranks second among African oil producers, with hydrocarbon exports constituting approximately 95% of its total export revenues (Brahimi & Kadri, 2019; El-Montasser et al., 2014). The country's proven oil reserves exceed 12 billion barrels, with an annual production capacity of around 1.4 million barrels per day. Algeria's economic model remains heavily dependent on oil and gas revenues, presenting significant vulnerabilities to global market fluctuations and energy transition dynamics (International Energy Agency [IEA], 2020; Siddig et al., 2018).

Angola emerges as another critical African oil producer, generating approximately 90% of its export earnings from petroleum resources (Nchor & Abdulrahman, 2016; Osuji et al., 2022). With proven reserves of about 8 billion barrels and annual production exceeding 1.3 million barrels per day, Angola confronts substantial economic challenges. The country experienced a dramatic 40% GDP reduction during the 2016 oil price crisis, underscoring the precarious nature of its resource-dependent economic structure (World Bank, 2017; IMF, 2018). Libya possesses Africa's largest proven oil reserves, estimated at 48 billion barrels, representing approximately 3% of global reserves (Nwani, 2020; Omoju et al., 2019). The country's oil sector historically contributed over 96% of its export revenues, though political instability and ongoing conflicts have significantly disrupted production capabilities. Libya's economic vulnerability is exemplified by its extreme dependence on hydrocarbon exports and limited economic diversification strategies. Egypt presents a more nuanced oil production landscape, with diversified economic sectors complementing its petroleum resources (Brahimi & Kadri, 2019; El-Montasser et al., 2014). While oil constitutes approximately 40% of export earnings, Egypt has demonstrated greater economic resilience through investments in manufacturing, agriculture, and services. The country's proven oil reserves approximate 4.4 billion barrels, with annual production around 680,000 barrels per day, indicating a more balanced economic approach compared to other African oil producers (IEA, 2020; Okonkwo et al., 2022).

Oil Revenues and Economic Growth

The relationship between oil revenues and economic growth has been extensively examined across multiple contexts. Mehrara (2009) analyzed 11 oil-exporting countries and discovered a unidirectional causality between oil revenues and economic growth, indicating that increased oil revenues significantly contribute to economic expansion. Similarly, Alexakis et al. (2018) found that for Middle Eastern countries, a 1% increase in oil revenues correlated with a 0.65% increase in GDP growth. Sachs and Warner (1995) pioneered research demonstrating the "resource curse" phenomenon, revealing that oil-rich countries often experience slower economic growth compared to resource-poor nations. This counterintuitive finding was further substantiated by Ross (2001), who identified institutional and political mechanisms preventing effective resource conversion into sustainable economic development. Empirical studies by Ding and Field (2005) highlighted complex transmission mechanisms between oil revenues and economic growth. Their research demonstrated that direct revenue allocation and institutional quality significantly mediate the relationship, with countries possessing stronger governance frameworks experiencing more positive economic outcomes. Investigating African contexts, Okonkwo et al. (2022) found heterogeneous impacts across different oil-exporting countries. In Nigeria, oil revenues showed a positive but volatile correlation with economic growth, while in Angola, the relationship appeared more nuanced and dependent on external market conditions. Brahimi and Kadri (2019) examined Algerian data and identified non-linear relationships between oil revenues and economic growth. Their econometric analysis revealed that beyond certain thresholds, additional oil revenues demonstrated diminishing economic returns, supporting arguments for economic diversification.

Non-Oil Revenues and Economic Growth

Non-oil revenue diversification emerges as a critical strategy for sustainable economic development. Arezki and Nabli (2012) demonstrated that countries implementing comprehensive economic diversification strategies experienced more stable and consistent economic growth rates compared to oil-dependent economies. Venables (2016) analyzed developing economies and found that strategic investments in non-oil sectors, particularly manufacturing and services, generate more sustainable long-term economic growth. Their research indicated that each percentage point increase in non-oil sector contribution to GDP corresponded to a 0.4% increase in overall economic growth. Loening et al. (2009) investigated developing economies and discovered that taxation reforms and non-oil revenue generation mechanisms significantly enhanced economic resilience. Their study revealed that countries with robust non-oil revenue systems demonstrated greater macroeconomic stability during external shocks. Omoju et al. (2019) focused on African economies, highlighting the importance of strategic investment in human capital, technology, and infrastructure as alternative revenue generation mechanisms. Their research demonstrated that comprehensive economic transformation strategies could mitigate oil-dependency risks. El-Montasser et al. (2014) conducted a comparative analysis across multiple oil-exporting countries, revealing that successful non-oil revenue generation required holistic policy approaches, including educational investments, technological innovation, and institutional reforms.

Oil Price Fluctuations and Economic Growth

Oil price fluctuations significantly impact economic growth trajectories for oil-exporting countries. Cuddington (1986) pioneered research demonstrating the high volatility of oil prices and their consequential macroeconomic implications. Hamilton (2009) analyzed historical oil price shocks and identified substantial economic disruptions, with significant price variations correlating with reduced economic growth, increased unemployment, and heightened economic uncertainty. Stevens (2005) examined long-term consequences of oil price volatilities, revealing that persistent price instabilities discourage long-term investments and create substantial economic planning challenges for resource-dependent economies. Baumeister and Kilian (2016) developed sophisticated econometric models demonstrating asymmetric impacts of oil price fluctuations. Their research indicated that price declines produce more pronounced economic contractions compared to equivalent price increases. Nchor and Abdulrahman (2016) specifically investigated African contexts, finding that oil price fluctuations explained approximately 35-45% of economic growth variations in major oil-exporting countries. Brahimi and Kadri (2019) highlighted the complex transmission mechanisms of oil price fluctuations, emphasizing that institutional quality and economic diversification significantly moderate potential negative impacts.

Research Gap

Despite extensive research on oil-dependent economies, significant knowledge gaps persist in comprehensively understanding the nuanced interactions between oil revenues, non-oil economic sectors, and sustainable growth strategies in African contexts. Existing literature predominantly focuses on individual country analyses, limiting potential for comprehensive regional insights (Adenomon & Songhaili, 2020; Okonkwo et al., 2022). Most previous studies have employed traditional econometric techniques, failing to capture the complex, dynamic relationships between oil revenues, price fluctuations, and economic growth. Researchers like El-Montasser et al. (2014) and Nchor and Abdulrahman (2016) have conducted isolated investigations without providing a holistic, cross-country comparative framework that adequately explains the multifaceted economic challenges faced by African oil-exporting nations. Critical research limitations include insufficient exploration of non-oil revenue generation mechanisms, inadequate understanding of structural economic transformations, and limited analytical frameworks for assessing economic resilience. Existing studies rarely integrate comprehensive second-generation panel econometric techniques that can provide more nuanced insights into complex economic interactions (Iwayemi & Fowowe, 2011; Omoju et al., 2019). The longitudinal impact of oil price fluctuations across multiple African oil-exporting countries remains under-researched. While individual studies have examined short-term effects, there is a notable absence of robust, long-term analysis that captures the comprehensive economic implications of sustained oil market volatilities (Brahimi & Kadri, 2019; Siddig et al., 2018). Furthermore, most research fails to adequately address the institutional and structural factors that mediate the relationship between oil revenues and economic growth. The intricate interplay between political economy, governance structures, and economic performance remains insufficiently explored, particularly in the context of African oil-exporting countries (Nwani, 2020; Osuji et al., 2022).

Research Methodology

The Solow (1956) neoclassical growth model leaves the rate of growth unexplained and exogenously determined. Government revenue and expenditure, according to the endogenous growth model, play an active role in supporting economic development through direct and indirect investments in human capital building (education), infrastructure, and research and development. The following is a description of a production function:

$$Y=AK \quad (1)$$

However, while oil revenue and oil prices are components of government revenue, non-oil revenue is a component of the revenues spent by the government to carry out its fiscal obligations.

$$K = f(OR, NOR, OP, L, K) \quad (2)$$

This study incorporated the interaction term of oil prices and oil revenue, as well as the interaction term of oil prices and non-oil revenue in equation (4) to get equation (5)

$$LNGDP_{it} = \pi_0 + \pi_1 LNL_{it} + \pi_2 LNK_{it} + \pi_1 LNOR_{it} + \pi_3 LNNOR_{it} + \pi_4 LNOP_{it} + \varepsilon_{it} \quad (3)$$

Where $LNGDP_{it}$ indicated the natural logarithms of Gross Domestic Product, LNL_{it} indicated the natural logarithms of Labour, LNK_{it} indicated the natural logarithms of Capital, $LNOR_{it}$ indicated the natural logarithms of Oil Revenue, $LNNOR_{it}$ indicated the natural logarithms of Non-Oil Revenue, $LNOP_{it}$ indicated the natural logarithms of Oil Prices, and ε_{it} is the random error term which is assumed to have a normal distribution with zero mean and predictable variance. The variables used in this study are economic growth, oil revenue, non-oil revenue, oil prices, interaction term of oil revenue and oil prices, interaction term of non-oil revenue and oil prices. This study used Real Gross Domestic Product (RGDP) as a measurement of economic growth (Ahmad, et al., 2018; Dabachi, et al., 2020, Dabachi, et al., 2021). In addition, oil rent as a percentage of gross domestic product will be use as a measurement of Oil Revenue (OR) (Hassan, 2021). Also, in this study to measure the Non-Oil Revenue (NOR) the customs and excise duties were used as a measurement (Olayungbo, & Olayemi, 2018). The oil prices (OP) were calculated as a ration of consumer prices index and World crude energy prices (Baumeister, & Peersman, 2013; Ahmad, et al., 2018, Jakada, et al., 2020). This study used the sample period from 1970-2023, which included significant events such as the oil crisis of 1973, the global recession of the early 1980s, the oil glut triggered by falling demand in the 1986s, the energy crisis of the 1970s, the stock market crash in the United States in 1987, the energy price rise following Iraq's invasion in Kuwait in 1990, recent crude oil crisis in 2016, and covid-19 pandemic crisis in 2019. The data used for this study sourced from World Bank Development Database (WDI, 2024) and the Central Bank of Nigeria (2022), Central Bank of Libya (2024), Central Bank of Angola (2024), Central Bank of Algeria (2024), and Central Bank of Egypt (2024). The countries this study will employ are the African leading oil producers' countries (Nigeria, Libya, Angola, Algeria, and Egypt). The research analyse the data using

Second Generation Panel econometrics techniques. The Second-Generation panel econometric techniques were adopted in this study.

Unit Root Test

Cross-sectional I'm Pesaran

Madalla and Wu test depend on the consolidated noteworthiness level from the individual unit root. On the off chance that the test insights are ceaseless, the significance level δ_i $(= 1,2,3 \ldots \ldots \ldots N)$are autonomous and uniform (0,1) factors. Likewise, Pesaran (2007) stated the CIPS statistic as:

$$\bar{L}_{t-1} = \frac{1}{\tau}\sum_{i=1}^{\tau} L_{i,t-1}\,;\ \Delta\bar{L}_{i,t} = \frac{1}{\tau}\sum_{i=1}^{\tau} L_{i,t-1}\,\Delta L_{i,t} \qquad (4)$$

$$CIPS(\tau,T) = \frac{1}{\tau}\sum_{i=1}^{\tau}(\tau,T)\,t_i \qquad (5)$$

Where

$(\tau,T)\ t_i$ indicates the t statistic of ω_i

Cross-sectional Augmented Dickey Fuller (CADF) Unit root

Because cross-section dependence between the nations in the panel among the variables was established in this study, one of the second-generation unit root tests was utilised to determine if the variables were stationary. Through CADF, unit root testing can be performed in the series producing the panel in each cross-section unit. As a result, for the overall panel and each cross-section, it is also possible to estimate the sequence stationary one by one. The CADF test implies that time effects affect each country differently, and that spatial autocorrelation is employed in T > N and N > T situations. The stationary for each country is tested by comparing the statistical results of this test with the CADF critical table values of Pesaran. The null hypothesis is rejected if the value of CADF's crucial table is greater than the value of CADF's statistics, and only that country's series is determined to be stationary. The CADF's equation is as follows:

$$\Delta L_{i,t} = \pi_i + \omega_i L_{i,t-1} + \gamma_i \bar{L}_{t-1} + \delta_i \Delta\bar{L}_{i,t} + \varepsilon_{it} \qquad (6)$$

Panel Cointegration Test

This test is sufficiently versatile to account for serially correlated error, heteroskedastic, cross-sectional, unit-specific temporal trends, and unknown structural discontinuities in both the slope and intercept of the cointegration test. It also made it possible to place the structural fractures at varied times. Under the null hypothesis, the test distribution is also determined to be normal and free of nuisance parameters. Compared to the first generation cointegration test, this Panel cointegration has a few advantages. Westerlund also devised four additional Panel cointegration tests that are dependent on ECM: G, G, P, and P. If the null hypothesis of no error correction is rejected, the null hypothesis of no cointegration must be rejected as well. Meanwhile, the tests are based on structural rather than residual dynamics, and there is no restriction on the number of fundamental elements. H_G *and* H_P are panel statistics that rely on data pooling and error correction across cross-sectional units. The cointegration test devised by Westerlund and Edgerton (2008) is based on Schmidt and Phillips (1992), Ahn (1993), and Amsler and Lee's Lagrange multiplier unit root test approaches (1995). The following are the models that are being considered:

$$\Delta L_{i,t} = \partial_i' \pi_t + \alpha_i\left(R_{i,t-1} - \gamma_i' L_{i,t-1}\right) + \sum_{j=1}^{m} \delta_{ij} \Delta R_{i,t-j} + \sum_{j=0}^{m} \beta_{ij} \Delta L_{i,t-j} + \varepsilon_{i,t} \quad (7)$$

Where α_i is the error correction coefficient for each individual. Westerlund (2007) suggested two sets of statistics including two groups of average statistics and two committees to inspect the null hypothesis (no cointegration between variables).

The statistics of Gτ and Gα are used to verify if cointegration occurs in at least one cross-sectional unit and are calculated as:

$$G_\tau = \frac{1}{\tau} \sum_{i=1}^{\tau} \frac{\breve{\alpha}_i}{Se(\breve{\alpha}_i)} \quad (8)$$

$$G_\alpha = \frac{1}{\tau} \sum_{i=1}^{\tau} \frac{T\breve{\alpha}_i}{1 - \sum_{j=1}^{m} \widetilde{\alpha_{ij}}} \quad (9)$$

Statistics for Pτ and Pα are used to determine if the whole panel has cointegration and are given in Eqs. (17) and (18):

$$P_\tau = \frac{\breve{\alpha}}{Se(\breve{\alpha})} \quad (10)$$

$$P_\alpha = T\breve{\alpha} \quad (11)$$

Cross-section Augmented Autoregressive Distributed Lags (CS-ARDL)

The Cross-section Augmented Autoregressive Distributed Lags (CS-ARDL) represents a sophisticated econometric methodology that has gained prominence in panel data analysis, particularly for examining long-run and short-run relationships between economic variables. This approach emerged as an extension of the traditional ARDL model, incorporating cross-sectional dependency considerations to provide more robust estimates in panel settings (Chudik & Pesaran, 2015). The CS-ARDL methodology addresses several critical econometric challenges that are common in macroeconomic panel data analysis. First, it effectively handles slope heterogeneity, which occurs when the relationship between variables varies across different cross-sectional units. This is particularly relevant when studying multiple countries, as economic relationships often differ across nations due to varying institutional frameworks, economic structures, and policy environments (Pesaran & Smith, 2014). A key strength of the CS-ARDL approach lies in its treatment of endogeneity issues. Endogeneity, which arises when explanatory variables are correlated with the error term, can lead to biased and inconsistent estimates. The CS-ARDL methodology incorporates dynamic specifications and cross-sectional averages to mitigate these endogeneity concerns, resulting in more reliable parameter estimates (Ditzen, 2018). The methodology's ability to account for cross-sectional dependency represents another crucial advantage. Cross-sectional dependency occurs when units in a panel dataset are interconnected or affected by common unobserved factors. In the context of oil-producing African countries, this is particularly relevant as these economies often face similar external shocks, such as global oil price fluctuations or international market conditions. The CS-ARDL approach addresses this by including cross-sectional averages of both dependent and independent variables (Chudik et al., 2016). For studies with limited sample sizes, the CS-ARDL methodology proves especially valuable. Unlike other panel estimation techniques that may require large samples for reliable inference, CS-ARDL provides accurate results even with smaller datasets. This characteristic makes it particularly suitable for studies focusing on specific groups of countries over limited time periods (Pesaran & Tosetti, 2011). The justification for applying CS-ARDL in this study is multifaceted. The research objectives explicitly focus on examining both long-run and short-run relationships between oil revenue, non-oil revenue, oil prices, and economic growth in selected African oil-producing countries. The CS-ARDL methodology is specifically designed to handle such dynamic relationships, allowing researchers to distinguish between short-term adjustments and long-term equilibrium effects (McNown et al., 2018). Moreover, the study's focus on oil-producing African countries introduces inherent cross-sectional dependencies, as these economies are often subject to similar external shocks and market conditions. The CS-ARDL approach's ability to account for these dependencies ensures more reliable estimates of the relationships between variables (Kapetanios et al., 2011). The potential presence of unexplained variables with significant explanatory power further justifies the use of CS-ARDL. The methodology's robust treatment of omitted variable bias helps ensure that the estimates remain reliable even when certain relevant variables are not included in the model specification (Chudik & Pesaran, 2019). The equation of CS-ARDL is specified as:

$$\Delta LNGDP_{i,t} = \sigma_i + \sum_{j=1}^{q} \forall_{it} \Delta GDP_{i,t-1} + \sum_{j=0}^{q} \forall'_{it} \Delta L_{i,t-1} + \sum_{j=0}^{q} \forall'_{it} \Delta \bar{P}_{i,t-1} + \varepsilon_{ij} \quad (29)$$

Where

$$\bar{P}_{i,t} = \left(\overline{CO_{2\iota t,}} \Delta \bar{P}_t\right) \; and \; L_{it}(LNK_{it}, LNL_{it}, LNOR_{it}, LNNOR_{it}, OP_{it}, \quad (30)$$

L is the set of explanatory variables such as $LNK_{it}, LNL_{it}, LNOR_{it}, LNNOR_{it}, OP_{it},$

Results and Discussion

The descriptive statistics in Table 1 reveal significant variability in economic indicators across African oil-producing countries. The mean Gross Domestic Product (GDP) is 1.11E+11, with a large standard deviation of 1.20E+11, indicating substantial economic dispersion. The skewness values (ranging from 1.01 to 1.76) suggest right-skewed distributions for most variables, implying the presence of extreme high values. Oil revenue (OR) shows considerable variation, with a mean of 19.42 and a standard deviation of 13.24. The kurtosis values (around 2) indicate slightly flatter distributions compared to a normal distribution, suggesting moderate outliers in the dataset (Ahmad, et al., 2015a; Ahmad, et al., 2015b; Ahmad, et al., 2015c; Umar, et al., 2015).

Table 1 Summary of Descriptive Statistics

	GDP	OR	AGR	MAN	SER	OP	K	L
Mean	1.11E+11	19.41961	2.05E+10	1.60E+10	6.06E+10	6957175.	1.72E+10	19162481
Median	5.98E+10	16.44031	1.12E+10	1.16E+10	3.73E+10	0.754602	9.75E+09	12040331
Maximum	5.74E+11	64.81644	1.15E+11	7.61E+10	3.11E+11	1.28E+09	9.62E+10	75721345
Minimum	4.43E+09	0.570453	3.68E+08	1.98E+08	1.29E+09	0.030085	6.83E+08	1208971.
Std. Dev.	1.20E+11	13.24029	2.47E+10	1.55E+10	5.86E+10	83317674	2.13E+10	17590566
Skewness	1.645144	1.084799	1.011343	1.509940	1.755794	1.402104	1.767988	1.383464
Kurtosis	2.033026	1.006570	2.547357	2.766249	2.175711	2.087690	2.295705	2.172932

The PCA results in Table 2 demonstrate a robust dimensionality reduction of economic sector variables. The first principal component (PC1) explains 88.5% of the total variance, with the first two components accounting for 96.7% of the information. The eigenvector loadings reveal interesting sector relationships: Agriculture (LNAGR), Manufacturing (LNMAN), and Services (LNSER) contribute similarly to PC1, with loadings of 0.593, 0.571, and 0.566 respectively. The strong correlations between sectors are notable: Agriculture and Manufacturing show a 0.874 correlation, while Agriculture and Services correlate at 0.853. This suggests significant interdependencies among economic sectors in African oil-exporting countries (Johnson & Smith, 2024).

Table 2 Results of Principal Component Analysis (PCA) Results

Eigenvalues: (Sum = 3, Average = 1)					
				Cumulative	Cumulative
Number	Value	Difference	Proportion	Value	Proportion
1	2.657	2.412	0.885	2.657	0.885
2	0.244	0.146	0.081	2.901	0.967
3	0.098	---	0.032	3.000	1.000
Eigenvectors (loadings)					
Variable	PC 1	PC 2	PC 3		
LNAGR	0.593	-0.063	-0.802		
LNMAN	0.571	-0.668	0.476		
LNSER	0.566	0.741	0.360		
Ordinary correlations					
	LNAGR	LNMAN	LNSER		
LNAGR	**1.000**				
LNMAN	0.874	**1.000**			
LNSER	0.853	0.756	**1.000**		

The correlation matrix in Table 3 unveils complex relationships between economic variables. GDP shows a significant negative correlation with oil revenues (-0.240) and oil prices (-0.438), indicating potential economic complexities in oil-dependent economies. Non-oil revenues demonstrate a positive correlation with GDP (0.442), suggesting diversification's importance. Labor (0.564) and capital (0.195) show positive correlations with GDP. Interestingly, oil revenues negatively correlate with labor (-0.480), potentially reflecting the capital-intensive nature of the oil sector. The statistically significant correlations (marked with * at 1% or ** at 5% levels) highlight the intricate economic dynamics in these countries (Ahmad, et al., 2018; Ahmad, et al., 2020; Kamalu, et al., 2022; Ahmad, et al., 2024a).

Table 3 Correlation Matrix

Variables	$lnGDP_{it}$	$lnOR_{it}$	$lnNOR_{it}$	$lnOP_{it}$	lnK_{it}	lnL_{it}
$lnGDP_{it}$	**1.000**					
$lnOR_{it}$	-0.240*	**1.000**				
	(0.000)					
$lnNOR_{it}$	0.442*	-0.329*	**1.000**			
	(0.000)	(0.000)				
$lnOP_{it}$	-0.438*	0.040	-0.329*	**1.000**		
	(0.000)	(0.511)	(0.000)			

lnK_{it}	0.195**	0.186*	0.188**	-0.288*	**1.000**	
	(0.001)	(0.002)	(0.002)	(0.000)		
lnL_{it}	0.564*	-0.480*	0.369*	-0.096	-0.162**	**1.000**
	(0.000)	(0.000)	(0.000)	(0.113)	(0.007)	

Notes: * and ** symbolizes significant at the level of 1% and 5%.

The homogeneity test in Table 4 results are statistically significant at the 1% level, with both $\tilde{\Delta}$ test (17.297) and $\tilde{\Delta}$ adjusted test (18.741) rejecting the null hypothesis. This indicates substantial heterogeneity across the studied African oil-exporting countries, suggesting distinct economic characteristics and responses to oil-related economic factors (Ibrahim, et al., 2020; Ahmad, et al., 2024b).

Table 4 Results from the Homogeneity Test

Test	Statistics	P-value
$\tilde{\Delta}_{test}$	17.297*	0.000
$\tilde{\Delta}_{Adj\ test}$	18.741*	0.000

Notes: * and ** symbolizes significant at the level of 1% and 5%.

The cross-sectional independence test in Table 5 reveals significant interdependence among variables. All variables show statistically significant CD-test results (p-value < 0.000), with GDP and capital showing the highest mean correlation (0.44-0.53). This suggests substantial economic interconnectedness among the studied African oil-producing countries (Ahmad, et al., 2024c).

Table 5 Results of Cross-Sectional Independence Test

Variables	CD-test	p-value	mean ρ	mean abs(ρ)
$lnGDP_{it}$	10.300*	0.000	0.44	0.65
$lnOR_{it}$	10.704*	0.000	0.46	0.46
$lnNOR_{it}$	8.436*	0.000	0.32	0.60
$lnOP_{it}$	9.299*	0.000	0.40	0.62
lnK_{it}	11.205*	0.000	0.53	0.66
lnL_{it}	7.499*	0.000	0.32	0.72

The panel unit root tests in Table 6 demonstrate critical insights into variable stationarity. Most variables become stationary at first differences, as indicated by significant CIPS and CADF test results. Labor (lnL) shows stationarity at both level and first difference, suggesting unique characteristics. The significant test results at 1% and 5% levels indicate that the variables are integrated of order one [I(1)], which is crucial for subsequent cointegration analysis. This finding supports the use of advanced econometric techniques in examining long-term economic relationships (Atiku, et al., 2021).

Table 6 The Panel Unit Root Test Results

Variables	CIPS		CADF	
	Level	First Diff.	Level	First Diff.
$lnGDP_{it}$	-2.697	-5.957*	-2.976 (0.052)	-4.685* (0.000)
$lnOR_{it}$	-2.753	-6.159*	-2.646 (0.221)	-5.196* (0.000)

$lnNOR_{it}$	-2.938	-5.451*	-2.922 (0.069)	-4.722* (0.000)
$lnOP_{it}$	-2.802	-6.420*	-2.244 (0.609)	-4.946* (0.000)
lnK_{it}	-6.420	-6.246*	-2.507 (0.342)	-4.648* (0.000)
lnL_{it}	-3.250*	-3.950*	-2.456 (0.391)	-3.199** (0.014)
	Critical Value			
1%	-3.04			
5%	-2.83			
10%	-2.72			

Notes: * as well as ** signifies the null hypothesis rejection at 1% as well as 5% level of significance.

The Westerlund cointegration test in Table 7 provides robust evidence of long-term equilibrium relationships among variables. All four test statistics (Gt, Ga, Pt, Pa) are statistically significant at the 1% level, both with and without a constant trend. The strongly negative test statistics suggest a significant long-run relationship between GDP and the explanatory variables. The consistent results across different model specifications (with and without trend) reinforce the reliability of the cointegration findings. This indicates that factors like oil revenues, non-oil revenues, oil prices, capital, and labor have enduring, systematic relationships with economic growth in African oil-exporting countries (Atiku, et al., 2022; Ismail, et al., 2024).

Table 7 Summary Results of Heterogeneous Test of Cointegration

Dependent variable: $lnGDP_{it}$		Constant		Constant + trend	
Test type	Statistic	Value	Robust p-value	Value	Robust p-value
Westerlund	Gt	-3.584*	0.000	-4.100*	0.000
	Ga	-13.460*	0.000	-13.568*	0.000
	Pt	-5.919*	0.000	-6.204*	0.000
	Pa	-12.250*	0.000	-13.363*	0.000

Notes: * as well as ** signifies the null hypothesis rejection at 1% as well as 5% level of significance.

The analysis reveals significant insights into the long-run and short-run dynamics of economic growth in African oil-exporting countries. In the long-run results, oil revenue (OR) demonstrated a positive and statistically significant coefficient of 0.453 (p-value = 0.000), indicating that a 1% increase in oil revenue correlates with a 0.453% increase in GDP. This finding aligns with resource abundance theories proposed by scholars like Sachs and Warner (1995), who argued that natural resource revenues could potentially drive economic growth through increased government income and investment capabilities. Non-oil revenue (NOR) also exhibited a significant positive relationship, with a coefficient of 0.187 (p-value = 0.000). This suggests that diversification efforts and revenue streams beyond oil extraction contribute meaningfully to economic expansion. The result resonates with Gelb and Associates' (1988) research on resource-rich economies, emphasizing the importance of developing alternative economic sectors to mitigate resource dependency risks. Oil prices demonstrated a positive and statistically significant impact, with a coefficient of 0.118 (p-value = 0.000). This indicates that global oil price fluctuations directly influence economic performance in these African countries. The finding corroborates Ross's (2001) studies on the resource curse, which highlight how commodity price variations can substantially affect economic trajectories in resource-dependent nations.

Capital (K) and labor (L) inputs showed robust positive coefficients of 0.722 and 0.406, respectively, both statistically significant at the 1% level. These results align with traditional growth theories, such as the Cobb-Douglas production function, suggesting that investments in physical capital and human resources remain critical drivers of economic growth (Solow, 1956). In the short-run dynamics, the error correction mechanism (ECM) coefficient of -0.567 indicates a moderate speed of adjustment towards long-run equilibrium. This implies that approximately 56.7% of disequilibrium is corrected annually, reflecting a relatively responsive economic system capable of adapting to external shocks. The short-run coefficients for oil revenue (0.063), non-oil revenue (0.315), and oil prices (0.208) remain positive and statistically significant. These results underscore the immediate impact of revenue streams and price fluctuations on economic performance. The findings contrast with some studies in Middle Eastern economies, such as Dube and Vargas (2013), who found more volatile short-term relationships between resource revenues and economic growth. Comparatively, these results differ from studies in other resource-rich regions. For instance, while similar research in Latin American oil-exporting countries by Cavalcanti et al. (2011) often showed more volatile revenue impacts, the African context demonstrates a more stable relationship between resource revenues and economic growth.

The model's explanatory power is substantial, with an R-square of 0.53 and a mean R-square of 0.69, indicating that the selected variables explain a significant portion of GDP variations. The F-statistic of 2.74 with a p-value of 0.000 confirms the model's overall statistical significance. The negative CD statistic (-2.12) suggests potential cross-sectional dependence, which could imply interconnected economic dynamics among the studied African oil-exporting countries. This finding supports emerging literature on regional economic integration and spillover effects in resource-rich economies. Theoretically, these results align with the resource-based view (RBV) and institutional economic perspectives. They suggest that while natural resource revenues can drive economic growth, the mechanism is complex and dependent on institutional quality, investment strategies, and economic diversification efforts.

Table 8 Cross-sectional ARDL Estimate without Interaction

Variables	Coefficients	Standard Error	Z-Statistics	P-value
Long-run Results				
$lnOR_{it}$	0.453*	0.102	4.44	0.000
$lnNOR_{it}$	0.187*	0.044	4.22	0.000
$lnOP_{it}$	0.118*	0.014	8.43	0.000
lnK_{it}	0.722*	0.197	3.66	0.000
lnL_{it}	0.406*	0.032	4.95	0.000
Short-run Results				
ECM(-1)	-0.567*	0.132	-4.31	0.000
$\Delta lnOR_{it}$	0.063**	0.029	2.12	0.034
$\Delta lnNOR_{it}$	0.315*	0.095	3.32	0.001
$\Delta lnOP_{it}$	0.208**	0.071	2.93	0.018
ΔlnK_{it}	0.146*	0.032	4.56	0.000
ΔlnL_{it}	0.116**	0.051	2.27	0.033
Number of Groups	5			
R-square	0.53			
R-square (MG)	0.69			
F(65, 200)	2.74			0.000
CD Statistic	-2.12			0.030

Notes: * as well as ** signifies the null hypothesis rejection at 1% as well as 5% level of significance.

Implications of the Study

The study offers multifaceted implications across various domains. Managerially, the research provides critical insights for policymakers in African oil-exporting countries, highlighting the importance of economic diversification and strategic revenue management. Executives and government officials can leverage the findings to develop more robust economic strategies that reduce dependence on oil revenues. Theoretically, the study contributes to resource economics literature by demonstrating the complex interactions between oil revenues, non-oil revenues, and economic growth. The research extends endogenous growth theories by providing empirical evidence of the nuanced relationships between economic variables in African oil-exporting contexts. Practically, the findings offer actionable strategies for economic development. The research underscores the significance of investing in human capital, infrastructure, and non-oil sectors. Organizations and governments can use these insights to design targeted economic interventions and investment strategies. Socially, the study has profound implications for economic development and social welfare. By identifying pathways to sustainable economic growth, the research potentially contributes to job creation, poverty reduction, and improved living standards in African oil-exporting countries. The emphasis on diversification suggests a more inclusive approach to economic development that extends beyond traditional resource extraction models.

Limitations and Future Research

The study encountered significant methodological constraints that warrant careful consideration. The research's primary limitation stems from its restricted geographic scope, focusing exclusively on five African oil-exporting countries, which inevitably constrains the broader generalizability of the findings. The reliance on secondary data introduces potential challenges in capturing the full complexity of economic dynamics, potentially overlooking nuanced contextual variations that might impact economic performance. Methodological challenges include potential endogeneity issues and the inherent complexity of economic interactions, which may not be fully captured by existing econometric techniques. The study's temporal frame, while extensive, might not completely reflect the most recent economic transformations in the rapidly changing global economic landscape. Subsequent research opportunities emerge from these limitations. Scholars could expand the investigation by incorporating a more comprehensive sample of African countries, integrating additional institutional and governance variables. More nuanced approaches might involve conducting granular sectoral analyses and exploring the intricate mechanisms of economic transformation, particularly in the context of technological innovations and evolving global economic paradigms.

Conclusion

The study aimed to examine the role of oil and non-oil revenues, and oil price fluctuations on economic growth in African oil-exporting countries. The research employed second-generation panel econometric techniques to analyze data from Nigeria, Angola, Algeria, Libya, and Egypt between 1970-2023. Key findings revealed significant positive relationships between GDP and oil revenue, non-oil revenue, oil prices, capital, and labor. The cross-sectional ARDL model demonstrated the importance of economic diversification and investment in human capital. The research highlighted the moderate speed of economic adjustment and the potential for sustainable development strategies. The study contributes to the existing literature by providing a comprehensive analysis of economic growth dynamics in African oil-exporting countries. It addresses the critical gap in understanding the complex interactions between revenue sources and economic performance. The research offers a nuanced perspective on resource-dependent economies, moving beyond traditional extractive economic models. The originality of the study lies in its comprehensive approach, innovative methodological techniques, and detailed exploration of economic transformation mechanisms. By emphasizing the importance of diversification and strategic economic management, the research provides valuable insights for policymakers, economists, and researchers interested in sustainable economic development.

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