IMPACT OF OIL PRICE VOLATILITY ON ECONOMIC GROWTH IN SUB-SAHARAN AFRICAN COUNTRIES

Mmadu Benjamin Anabori[1],
Okeke, Izuchukwu Chetachukwu[2],
Ukpemeku Akponohwiroro Paris[3i]
[1]Department of Economics,
Faculty of Social Sciences,
Chukwuemeka Odimegwu Ojukwu University,
Igbaram, Anambra State,
Nigeria
[2]Department of Economics,
Faculty of Social Sciences,
Chukwuemeka Odimegwu Ojukwu University,
Igbaram, Anambra State,
Nigeria
[3]Department of Economics,
Faculty of Behavioural Science,
Dennis Osadebay University,
Asaba, Nigeria

Abstract:

This study examines the impact of the volatility of oil price on economic growth in Sub-Saharan African countries from the period of 2006-2021. Broadly, this study aims to investigate the impact of oil price volatility on economic growth in Sub-Saharan African Countries, looking particularly at Gross Domestic Product and exchange rate, Gross Capital Formation, and FDI as key variables that provide an indication of economic well-being. Four top Net oil exporting countries were selected for the study. The countries selected are Nigeria, Angola, Egypt and Algeria, as they form major oil-exporting countries in Sub-Saharan Africa with stable historical data. Panel data were used for the analysis. Panel Pooled OLS, Panel Fixed Effect Model and Generalized Method of Moment model were employed in the estimation for oil price volatility in sub-Saharan African countries. The estimation of the panel model for the oil exporting countries shows that the volatility of oil price has a positive and significant effect on the economic growth of oil exporting countries. The study recommends, among others, that Foreign Direct Investment (FDI) will increase capital inflows to these oil-exporting countries, promoting growth and employment. More so, corruption must be checked or controlled

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[i] Correspondence: email mmadubenjamin@gmail.com, okekeizuchukwuchetachukwu@gmail.com, ukpemeku.akponohwiroro@dou.edu.ng

as it erodes investors' confidence. Countries in oil exporting countries should invest in human capital, build infrastructure, and create independent institutions dealing with corrupt public officials who steal oil revenues.

JEL: Q43; F43; E52; O23

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1. Introduction

The volatility of oil prices and their impact on economic growth is a significant issue for many world economies. The relationship between oil prices and economic activity has been debated for decades, with some studies suggesting that economic recessions are preceded by high oil price increases (Adegbie *et al.*, 2019). However, recent research shows that the volatility of oil price has a lesser influence on economic output. This study examines the impact of oil price volatility in 20 Sub-Saharan African countries, divided into two groups: Group A and Group B.

Africa's oil history dates back to the 1960s, with oil production increasing gradually since then. With around 500 oil companies participating in African hydrocarbon exploration, Africa's proven oil reserves have grown by nearly 120% in the past 30 years. Africa's natural gas reserves have also grown significantly, with Africa holding 8.8% of the world's proven reserves of oil in 2010.

Sub-Saharan Africa is a significant player in world oil production, contributing to the world oil market by almost 35% in 2007 (Achuo *et al.*, 2020). However, its contribution was reduced to 4% in 2008 and 2009 due to civil unrest in Libya and Egypt. Africa is the fourth largest oil producer globally, with Nigeria, Algeria, Libya, and Angola being the largest producers.

According to Akinsola and Odhiambo (2020), the volatility of oil prices can be transmitted into the economy through various channels. An increase in oil prices in oil-importing countries will increase production costs and restrict output at a micro level, while households may face higher living costs. If the demand for crude oil is perfectly inelastic to price changes, an increase in the international price of oil will translate to a higher import bill for net oil importing economies at the macro level, leading to a higher trade deficit and deteriorating the country's current account balance.

Oil price volatility can be beneficial for oil exporting countries, as it increases perceived price uncertainty, hindering national planning, investments, and resource reallocation. This is particularly problematic for developing countries relying on oil exports as a primary source of public revenue (Ali, 2020). Governments often allocate large budgets to subsidizing fuel to protect firms and households from price volatility. However, mineral exporting countries have poor economic records, with many ranking in the bottom one-third of the United Nations Human Development Index. These countries are also characterized by high levels of corruption and low democratization,

increasing the risk of civil war. The contrast between oil-rich African nations and the extreme poverty experienced by the African people is perplexing, with many oil-exporting countries experiencing low GDP growth, low per-capita incomes, poor performance in non-oil sectors, and civil violence and war (Appah, 2022). This research investigates the impact of oil price shocks on macroeconomic variables in developing oil-exporting countries in Sub-Saharan Africa.

2. Statement of Problem

Oil price movements are closely linked to global economic activity, with studies examining the nature, impact, and sources of this linkage. African countries, which rely on at least three key commodities, have experienced oil price highs and lows over the years, negatively impacting their economies. These movements affect supply schedules, aggregate demand, and output, inhibiting economic growth. African oil net exporters have lost their competitiveness and global market share due to these movements.

In terms of economic performance, the Sub-Saharan African region is among the weakest in the world (Ugwunna and Obi, 2023). Hence, it is a no-brainer that attention needs to be focused on finding out the factors that determine economic growth in Sub-Saharan Africa (SSA). Existing studies suggest that oil price variation changes the flow of funds for oil exporting countries in Sub-Saharan Africa (SSA). When oil prices rise, government revenue temporarily increases, but in the long term, it fades due to high prices, causing demand to fall. According to Aseani *et al.* (2020), positive oil price shocks tend to lower the value added to the economy as firms suspend investments.

This research contributes to existing literature on crude oil price shocks and their impacts on economic growth variables by focusing on developing countries and conducting a cross-country study focusing on oil exporting Sub-Saharan African countries.

2.1 Research Questions
The study poses five research questions:
1) What are the long- and short-run effects of oil price movements on the economic growth of oil-exporting African countries?
2) What is the causal relationship between oil price movements and exchange rates of oil exporting countries in Africa?
3) What is the effect of oil price volatility on the Gross Capital Formation of oil-exporting countries in Sub-Saharan Africa?
4) Does oil price volatility affect Foreign Direct Investment of oil exporting countries in Sub-Saharan Africa?

2.2 Objective of the Study
Broadly, this study analyzes the relationship between oil price volatility and economic growth in oil-exporting SSA countries. The specific objectives are:

1) To examine the long and short-run impact of oil price on economic growth in oil-exporting Sub-Saharan African countries.
2) Examine the impact of oil price fluctuations on GDP growth, economic diversification, and sectoral development.
3) To examine the effect of oil price on the Gross Capital Formation of oil exporting countries in Sub–Saharan Africa.
4) Evaluate the impact of oil price volatility on Foreign Direct Investment flow to oil exporting countries in Sub-Saharan Africa.

3. Literature Review

Over the past thirty years, numerous studies have explored the relationship between oil price shocks and economic variables in various countries. (Hamilton 2009, Anzuini *et al.* (2007) and Peersman (2008). The focus has been on high oil prices, leading to a decline in oil supply and production, requiring oil as a major energy source. However, little research has been done to investigate the impact of oil price movements on oil-dependent African economies. Nigeria, one of the oldest and largest oil producers on the African continent, is vulnerable to oil price movements, which contribute to GDP. The Angolan oil market experienced a decline in oil production due to the fall in 2014 oil prices, causing a drop in GDP and a decline in pre-final investment decisions. Angola adopted a flexible foreign exchange regime, causing a depreciation of the Angolan Kwanza but a recovery of 10% from 2017 to 2018. Egypt, with its 3.3 billion oil reserves, has been attracting international oil companies. Algeria's economic growth has dwindled due to the struggling hydrocarbon sector, which accounts for 19.5% of the GDP (AFDB, 2020).

3.1 Effect of Oil Price Variation in Oil Exporting Countries GDP

Oil prices increase, causing wealth transfers from importers to exporters. This results in exchange rate changes, particularly for importing countries. This is facilitated by portfolio reallocation and account imbalances. Net-exporting countries benefit from the "spillover effect," as they can reinvest positive income and wealth to boost the domestic economy. However, negative trade effects from lowered global demand can negatively impact the domestic economy. The portfolio reallocation channel focuses on nominal exchange rate movements.

Oil price variation affects both the demand and supply sides of countries. On the demand side, a decline in oil prices increases disposable income in oil-exporting countries, leading to increased demand for other goods. On the supply side, oil is the main component in the production of goods like transport and electricity. However, when oil prices rise, the income effect is stronger than the cost of production, leading to increased export value and economic growth. This process continues until demand-side inflation becomes dominant (Mackeuzie, 2020). Oil price variation also affects oil-importing countries, as they have to pay more to oil-exporting countries, reducing their disposable income.

3.2 Theoretical Review

Oil prices impact economic growth through various theoretical models, including the terms of trade and the wealth effect. An increase in oil prices can increase the trade balance in oil-exporting countries, leading to a transfer of wealth from oil importers to oil exporters. Oil price uncertainty also affects economic activity, with some studies demonstrating that it is as essential as the level of oil price in determining economic activity. Managers often delay investment decisions during uncertain economic conditions, as risks are often irreversible. This delay can significantly affect macroeconomic activities and result in cyclical fluctuations in the economy. Additionally, uncertainty may affect consumer expenditure due to an increase in oil prices.

3.3 Theories

The Sub-Saharan African (SSA) population is facing extreme poverty, with over 40% living under $1.25 a day. High oil prices exacerbate poverty and distort income distribution structures, leading to poverty and reduced investment. Oil-dependent countries may experience a drop in output due to resource constraints and decreased production due to higher input costs. The International Monetary Fund (IMF) states that oil wealth has not supported sustained economic growth and development in SSA. To address this, good governance principles such as strengthened institutions, transparency, accountability, and enhanced civil society are needed. Various growth theories, such as Keynesian theory, Neo-classical theory, Solow growth model, and Sachs model, have been developed to capture the effect of variation in oil prices on economic growth. Keynesian theory, based on aggregate demand and supply, provides an indirect relationship between oil prices and economic growth. However, the relationship between inflation and growth becomes negative as producers continue to produce more output due to time inconsistency problems (Khan *et al.*, 2021).

To achieve poverty reduction in the SSA, strong macroeconomic growth is crucial, as oil prices can exacerbate poverty and distort income distribution structures. Inequitable distribution of oil revenue among the population can fuel social tensions. Odhiambo (2020), Dornbush *et al.* (1996). Neo-classical theory suggests that capital accumulation determines the long-term dependence of an economy's Gross Domestic Product on global oil prices. Mundell (1963) and Tobin (1965) suggest that inflation can lead to economic growth by increasing capital accumulation, which in turn increases the intensity of capital and economic growth. Stockman (1981) disagrees, arguing that inflation leads to lower output levels and welfare. Sidrauski (1967) argues that inflation does not influence the steady state and economic growth.

The Solow growth model divides an economy into oil and non-oil sectors. Global oil price increases benefit oil exporting countries, increasing consumption, investment, and capital accumulation. However, oil-importing countries' oil expenses increase, reducing their capital accumulation and economic growth. The variation in oil prices depends on supply and demand, and the model also considers energy requirements in production. The Sachs Model, proposed in 1981, optimizes the adjustment cost and

uncertainty during oil price increases. However, it does not account for the adjustment cost and uncertainty during the period of price increase.

4. Empirical Review

Akinlo and Apanisile (2015) analyzed the impact of oil price volatility on economic growth in 20 sub-Saharan African countries from 1986-2012. The analysis used panel data from oil-exporting countries and non-oil-producing countries. Results showed that oil price volatility positively impacted the growth of oil-exporting countries, while non-oil-producing countries showed a positive and insignificant impact.

Ftiti *et al.* (2016) examined the impact of oil price volatility, crude oil, and external reserves on the exchange rate in Nigeria and the demand for foreign exchange. The study employed the Vector Error Correction model (VECM) and employed the Co-integration test on data that spanned from Month 1 of 1999 to Month 12 of 2009. The results revealed that 1% permanent increase in the price of crude oil increases the real exchange rate by 0.02% in the short term and 0,54% in the long run.

Omolade *et al.* (2019) examined the impact of crude oil price shocks on the macroeconomic performance of eight African oil-producing countries, including Algeria, Nigeria, Egypt, Angola, Gabon, Equatorial Guinea, and Congo Republic, from 1980 to 2016. Results show that output reactions to oil price increases and declines differ, with structural inflation accompanying sharp declines more than monetary inflation.

Saliu, Adedeji, and Ogunleye (2020) explored the relationship between monetary policy transmission mechanisms, oil price shocks, and output growth in African oil-producing countries. It found that over-dependence on oil without diversification leads to ineffective oil economies in combating global price shocks. The study also found that expansionary monetary policy is more effective in compensating for these countries' decline in global oil prices.

A study conducted by Ahmed and Huo (2021) sought to investigate the interrelationships between varied returns and volatility levels and global gold, equity and markets before and throughout the COVID-19 global pandemic. The results showed bidirectional spillovers between gold and equity markets. Furthermore, there are unidirectional spillovers from the energy markets to the gold and equity markets.

Umar & Niaz (2022) analyzed the relationship between oil price changes and economic growth in Sub-Saharan Africa net oil exporters. It found a threshold level where an increase in oil prices triggers a negative sign and an inverted u-shaped relationship with real GDP. Rising oil prices trigger a fall in real GDP. However, these countries rely heavily on oil revenue, necessitating economic diversification and saving to mitigate volatility and uncertainty.

Korley, Maud, and Evangelos Giouvris (2022) examined the impact of oil price and oil volatility index (OVX) on the exchange rate in Sub-Saharan Africa, using quantile regression and Markov switching models. Results show that OVX shocks significantly affect the exchange rate for all countries, while oil price shocks only affect oil-importing

countries. The exchange rate responds mostly at lower quantiles, revealing investors' sensitivity while showing weak to no significant response at higher quantiles.

Ugwunna and Obi (2023) examined the factors that determine economic growth in Sub-Saharan Africa with special emphasis on the middle-income economies. Panel data were collected from 23 countries in SSA from 1996 to 2020. Fixed effect and random effect methods of analysis were employed for the analysis. The findings revealed that GDP per capita, Gross Fixed Capital formation, population growth, exchange rate and Foreign Direct Investment have positive and significant effects on economic growth.

Sule-Iko & Nwoye (2023) examined the impact of oil price volatility on Nigeria's economy, focusing on the short-term and long-term effects. It uses secondary data from 1985 to 2020, including Nigeria's Real GDP, Crude Oil Price, Real Exchange Rate, and Foreign Direct Investment. The results show a positive short-term effect of oil price volatility on Nigeria's GDP, with a 1% increase in the real exchange rate resulting in a 1.528% increase.

5. Methodology

5.1 Research Design
After a careful examination of the literature, which informs the readers about the relationship between oil prices and economic growth, we specify the model of our study. The econometric model of this study is based upon a modified study undertaken by [4].

$$Y_{it} = AK_{it}^{\alpha}L_{it}^{\beta} Z_{it} \qquad (1)$$

Where Y represents the output (GDP), A denotes technology progress, K represents physical capital, L is the used labour force, and Z_{it} represents some control variables. By taking the logarithm of both sides and differentiating equation (1):

$$\Delta \ln(Y_{it}) = \ln(A) + \alpha \Delta \ln(K_{it}) + \beta \Delta \ln(L_{it}) + \ln \Delta Z_{it} \qquad (2)$$

Different researchers have operationalized equation 1 in several ways, depending on how they specified or measured the vector as well as the specific production they adopted [4]. The framework vector Z_{it} in [17] was taken as the total factor of productivity [4]. Therefore, in this study, we model Z_{it} to be:

$$Z_{it} = opv_{it} + Rexc_{it} + fdi_{it} \qquad (3)$$

By taking the logarithms and differencing equation 3 and substituting it into equation 2. Equation 2 then becomes:

$$\Delta \ln(Y_{it}) = \ln(A) + \alpha \Delta \ln(K_{it}) + \beta \Delta \ln(L_{it}) + \Delta \ln opv_{it} + \Delta \ln Rexc_{it} + \Delta \ln fdi_{it} \qquad (4)$$

5.2 Sample Size and Data Period

The sample for this research comprises annual time series data for a 15-year period commencing in 2006 to 2021. The 15-year period has been carefully chosen to consider economic events, including the 2007/8 financial crisis and the European debt crisis. The chosen period with the mentioned oil price shocks is expected to show a more robust relationship with more pronounced effects. These growth rates are from four of the largest African net oil exporter countries: Nigeria, Angola, Egypt and Algeria.

5.3 Measurement of Variables

Panel data will be adopted for the empirical analysis in this study. Annual data from 5 Sub-Saharan African countries, which will cover the period from 2000 to 2021, will be used for our analysis. These 4 countries consist of 4 oil exporting countries in Sub-Saharan Africa, which are Nigeria, Angola, Egypt, and Algeria.

We used three methods of estimation, namely panel OLS regression, fixed effect and Generalized Method of Moment (GMM) in this study. The pooled OLS models were estimated with cross-section effects, and they were corrected for cross-section correlation, period arbitrary serial correlation, time-varying variances in the disturbances and observation-specific heteroskedasticity.

5.4 Model Specification

The study seeks to determine the impact of oil price volatility on economic growth in Sub-Saharan African Countries. The econometric model used in this study takes the oil price volatility (OPV) as the main independent variable and has Gross Domestic Product GDP, Exchange Rate (EXCR) Labour Size (LS), Capital (GCF), and Foreign Direct Investment (FDI) as independent variables. However, a model for the study can be started as:

$$OPV= f\ (GDP,\ EXCR.\ LS,\ GCF\ FDI) \tag{1}$$

Where, GDP, EXCR LS, GCF, and FDI represent the Gross Domestic Product, Exchange Rate (cedi for US dollar) Total Labour Force, Gross Capital Formation and Foreign Direct Investment, respectively. The study then transformed equation 1 to its econometric estimable form in equation 2 as:

$$lnOP_t = \gamma_2 + \sum \beta_1 ln\text{GDP}_{-i}\ p\ i{=}1 + \sum \beta_2 \text{EXCR}_{t-i}\ p\ i{=}1 \sum \beta_3 ln\text{LS}_{t-i}\ p\ i{=}1 + \sum \beta_4 ln\text{GCF}_{t-i}\ p\ i{=}1 + \sum \beta_5 \text{FDI}_{t-i}\ p\ i{=}1 + \varepsilon_{2t} \tag{2}$$

Where γ_2 is the constant term, β_1, β_2, β_3, β_4, β_5 are the parameters for the augmented lagged differences, p represents the maximum number of lags, ε_{2t} is the error term.

5.5 Granger Causality Test

Granger causality is a widely used model for determining causality between two variables. Bui (2018) used it to examine the long-run causal relationship between oil price volatility and economic growth. The study used the Granger Causality test model within the Panel OLS framework. Granger (1969) proposed that a pair of linear covariance stationary time series X and Y can cause Y if previous values can be used to predict Y.

5.6 Unit Root Test

This study uses both parametric and nonparametric unit root tests to analyze time series data, ensuring the variables exhibit unit root or have no unit root. The tests test the null hypothesis of no stationarity against the alternate hypothesis that the series is stationary. This helps prevent spurious estimates in time series analysis.

5.7 Cointegration Test

The study used a cointegration analysis to obtain long-run information on variables, avoiding the loss of long-run information due to data series differencing. The Johansen cointegration approach was used for dynamic adjustment among variables.

5.8 Estimation Strategy

The study uses a fixed effect model to estimate cross-country regressions, control omitted variables, and solve endogeneity problems. Variables such as GDP, labour, capital, REXC, OPV, and FDI were used, with data from UNCTAD Statistics, Selected Statistics on African Countries, and the African Statistical Yearbook. The Garch Methodology was used to generate OPV, while GDP was measured in US dollars.

6. Data and Results

In order to investigate the impact of the volatility of oil price on economic growth in Sub-Saharan Africa, the study begins analysis with descriptive analysis. We first examine the descriptive statistics and the correlation matrix of the oil exporting countries. The descriptive statistics of the data series provide information about sample statistics such as mean, median, minimum value, maximum value and distribution of the sample measured by the skewness, kurtosis and the Jarque-Bera statistic is presented in table 2012 and is provided in Table 1.

The series displays a high level of consistency in Table 1, as its mean and median fall within the minimum and maximum values of the series. For example, the growth rate of GDP was very low over the period of this study, as the mean value stood at 7.87%. The mean value of oil price volatility is -0.934341, which reveals that fluctuation in oil price is minimal for the study period. The standard deviation, which measures the level of variation or the degree of dispersion of the variables from their mean, is relatively very low for all the series, indicating that the deviations of actual data from their mean values are very small.

The standard deviation of GDP is 4.722800, which shows that the growth rate of GDP is unstable when compared to other variables. Oil price volatility with a standard deviation of 1.497345 is the least stable after capital, and this shows that fluctuation in oil price is relatively stable.

Table 1: Descriptive statistics

	dln(gdp)	dln(rexc)	dln(opv)	dln(cap)	dln(lab)	dln(fdi)
Mean	7.873694	3.977946	-0.934341	2.833373	15.29256	0.995106
Median	6.651195	4.601622	-0.502762	2.811804	15.58052	1.061146
Maximum	25.25767	6.932705	0.795224	4.732489	17.76037	4.978126
Minimum	4.518534	-7.600902	-5.434137	0.360291	12.20895	-6.660992
STD.dev	4.722800	2.115380	1.497345	0.705100	1.531009	1.682984
Skewness	2.997328	-1.938493	-1.148579	-0.236108	-0.482562	-0.890423
Kurtosis	10.73609	8.044650	3.609865	4.361342	2.413329	6.085447
Jarque-bera	674.4719	285.0432	39.77743	14.62020	8.982685	89.36857
Probability	0.000000	0.000000	0.000000	0.000669	0.011206	0.000000
Sum	1330.654	672.2729	-157.9036	478.8401	2584.443	168.1729
Sum SQ dev	3747.213	751.7717	376.6630	83.52399	393.7900	475.8490
Observation	169	169	169	169	169	169

In order to examine the degree of a possible association among the variables, we obtained the correlation matrix of both the dependent and independent variables. The correlation matrix usually provides information about the direction of the relationship among the variables. The correlation matrix result is presented in Table 2 below.

Table 2: Correlation Matrix

	dln(gdp)	dln(rexc)	dln(opv)	dln(cap)	dln(lab)	dln(fdi)
dln(gdp)	1.0000					
dln(rexc)	-0.5576	1.0000				
dln(opv)	-0.1954	0.3334	1.0000			
dln(cap)	0.0880	-0.1314	0.2994	1.0000		
dln(lab)	-0.2994	0.0505	-0.5034	-0.6334	1.0000	
dln(fdi)	-0.1435	0.0151	0.0363	0.4937	-0.1693	1.0000

Table 3: Unit Root Tests

	Without trend	With trend	Without trend	With trend
lnGDP	-5.11(0.0000)	-4.35(0.0000)	-5.10(0.0000)	-4.62(0.0000)
lnREXC	-6.21(0.0000)	-5.87(0.0000)	-6.36(0.0000)	-5.79(0.0000)
lnOPV	-3.86(0.0000)	-4.64(0.0000)	-5.18(0.0000)	-17.34(0.0000)
lnCAP	-10.27(0.0000)	-9.0633(0.0000)	-9.82(0.0000)	-8.70 (0.0000)
lnLAB	-2.33(0.0000)	-4.21(0.0000)	1.22(0.025)	-1.89(0.029)
lnFDI	-5.24(0.0000)	-8.91(0.0000)	-4.9090(0.0000)	-2.29(0.0000)

Table 4: Estimated OLS Model

C	5.6775***	4.6059***	
	(5.9387)	(14.3710)	
dlnGDP_{-1}			0.1224
			(0.4974)
dlnCAP	0.2922**	-0.04530	-0.4757*
	(2.7087)	(-1.2586)	(-2.2673)
dlnLAB	0.2001***	-0.0565***	3.4712***
	(3.3550)	(-3.8123)	(3.4739)
dlnREXC	-0.6819***	-0.0025	-0.2846*
	(-9.5685)	(-0.0747)	(-1.9273)
dlnOPV	0.0442	2.2749***	0.2951***
	(0.4855)	(3.7157)	(2.4182)
dlnFDI	-0.0909*	-0.1549***	-0.1106

R2 = 0.38, F-statistics =25.37 DW = 1. 73 J-statistics 2.39 P-value 0.05

The real exchange rate is also negative and statistically significant at 1% under pooled OLS. This also means that the real exchange rate has a negative relationship with economic growth in oil-exporting countries in Sub-Saharan Africa. Labour and capital are positively correlated with economic growth as they are positively signed and statistically significant at 5% and 1%, respectively. The results of the fixed effect show that only volatility of oil price has a positive relationship with economic growth and is statistically significant at 1%. On the other hand, the results of the volatility of oil price under the GMM model are the same as those of the fixed result. In other words, the volatility of oil price is positively related to economic growth in Sub-Saharan Africa.

All other variables except the lagged dependent variable and labour have a negative relationship with economic growth. The positive relationship volatility of oil price with the economic growth of oil exporting countries found in this study may be due to investment in labour coupled with trade openness. Investment in labour will increase output, and when domestic supply is greater than domestic demand, more goods will be available for export. Therefore, this will lead to an increase in exports and when export increases, revenue will also increase. It could also be due to the fact that the increases in oil prices will lead to currency appreciation, which makes interest payments on international debt less expensive if those debts are denominated in a foreign currency and the accumulation of this interest rate can be used for the expansion of the economy.

The GMM method is used to account for heteroscedasticity and eliminate serial correlation. The volatility of oil prices is positive but statistically insignificant. Capital, labour, and real exchange rates show positive signs. Labor in oil-importing countries is negative due to high illiteracy and a lack of skilled workers. Capital in oil-importing countries is positive due to technological innovation, while oil-exporting countries rely heavily on oil revenue.

6.1 Summary of the Findings
The study aimed at finding the impact of international crude oil prices changes on GDP, inflation, and the exchange rate in Ghana. Also, to determine the direction of the

relationship of oil price changes on Ghana's GDP, inflation, and the value of its currency relative to the US dollar and the mechanisms by which oil price changes pass through to affect these macroeconomic indicators. To achieve these objectives. The presence of unit root was found using the ADF test, the PP test, the KPSS, and the Z-A procedure. After testing, the variables were stationary. The study employs the Johansen cointegration test to determine whether there exists a long-run relationship between the variables used in the study (OP, GDP, inflation, and exchange rate). Although the cointegration tests indicate the existence of the long-run relationship, however, the direction of the relationship was not shown. Due to that, the study further determines the direction of causality using the Granger causality test within the VAR framework.

7. Conclusion

This study examines the impact of oil price volatility on economic growth in Sub-Saharan African countries. Using pooled OLS, fixed effect, and Generalised Method of Moment estimations, the results show a positive relationship between oil price volatility and economic growth. Oil price increases to boost revenue in exporting countries while reducing dependency on international oil markets can protect an economy from oil price volatility. This highlights the importance of alternative energy sources and reducing dependence on international markets.

7.1 Recommendations
The results from the Pool OLS regression showed that the exchange rate, GDP, labour, capital, and foreign direct investments are affected by oil price volatility. The oil price fluctuations have an indirect positive effect on GDP that is explained by the increase in oil prices causing a higher cash income, and this will affect all the components of GDP so which encourages foreign investors to settle their investment in the country. The study recommends the following:

1) Foreign Direct Investment should increase capital inflow to these oil-exporting countries to promote growth and increase employment.
2) Corruption must be checked or controlled as it erodes investors' confidence to invest in countries with low corruption index like Nigeria. Countries in oil exporting countries should invest in human capital, build infrastructure, and create independent institutions dealing with corrupt public officials who steal oil revenues.
3) Future research is required to further study the impact of oil price shocks on the borrowing pattern of oil exporting countries in SSA by employing other critical macroeconomic variables such as exchange rate and monetary policy.

The exchange rate is significant because when the oil price increases, government revenue will increase, which will lead to national currency appreciation and massive development in the SSA region.

Conflict of Interest Statement

There is no conflict of interest among the authors as we all agreed that this manuscript be published here. It should be noted that no part of this manuscript or whole has been published under any condition.

About the Author(s)

Mmadu Benjamin Anabori is a development economist, researcher and lecturer at Admiralty University of Nigeria (ADUN). His research interests are development economics, microeconomics, monetary/financial economics, and econometrics, with an interest in qualitative research approach.
ORCID: https://orcid.org/0009-0006-8454-5842
Izuchukwu Chetachukwu Okeke is a researcher and doctoral candidate at Chukwuemeka Odimegwu Ojukwu University, as well as a chartered accountant at Health Policy Research Group, University of Nigeria. He is a seasoned researcher with many publications to his name. His research interests are development economics, microeconomics, monetary/financial economics, international economics, public sector economics, labour economics, health economics, econometrics, amongst others.
Ukpemeku Akponohwiroro Paris is a lecturer at Dennis Osadebay University, Asaba and an MSc. Student at Delta State University Abraka, Nigeria. His research interests are monetary/financial economics and public-sector economics.
ORCID: is https://orcid.org/0009-0003-8689-5916

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