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Economic growth and crude oil revenue in Nigeria: A control for industrial shocks

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ABSTRACT

This paper investigated how oil revenue and the activities in the oil industry affected the size of income accrue to each Nigerian (Per capita income) from 1980 to 2019. The variables were sourced from the World Bank's World Development Indicators (WDI), OPEC Statistics, Baker Hughes Rig Count and the central bank of Nigeria statistical bulletin. Using the AutoRegressive Distributional Lag (ARDL) we observed that explorative activities of crude oil in Nigeria positively impacted the size of individual income. The magnitude of the impact was massive irrespective of time; a 1% increase in exploration increases the size of individual income by 0.4786% in the long run and 0.6030% in the short run. The interaction of rigs by output (interaction of rig-count and oil-production) negatively impacted the size of individual income. This implies that the size of individual income in Nigeria is sensitive to the nature of the explorative environment of the Nigerian oil industry.

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Introduction

The volatilities in crude-oil prices are drawn from three major sources, demand shocks, supply shocks, and industrial action that affects production, (Kilian, 2006). The outcome of these shocks contributes significantly to financial and human capital development; fiscal and monetary policy outcomes and directly impacted on economic growth of the oil producing states, (Rentschler, 2013 and Baffes et al., 2015). Fluctuation in oil prices are mostly from two side of the economy, the demand and the supply side of the economy. Fluctuation due to demand are caused by the market forces and the once due to supply are mostly the decision of the oil cartel to deliberately cutdown or increase production. However, there are other factors outside the cartel decision affecting individual countries. This third factor is the safety of the explorative environment that enhances industrial productive capacity. The tension and social unrest in Nigeria (for example, pipeline vandalism of 2004-2008; 2015 and 2016) could contributes to reduce her oil revenue and production capacity. The questioned of social unrest in Nigeria have severally been seen to contribute to her failure of reaching the Organisation of Petroleum Exporting Countries (OPECs) oil production benchmark and had resulted in drastic revenue shortage even when the price of the product is increasing, (Thisday paper 5th Sept. 2021, see figure 1-4). To measure the shocks due to oil industry, studies have dwelled on the employment of rigs and innovations. These studies have shown that there is a significant relationship between rig-counts and oil prices, (Ringlund, et al., 2008; Toews and Naumov, 2015; Agerton et al., 2015 and Khalifa, Caporin, & Hammoudeh, 2017). Because technology development in the oil industry have boost oil production without adding more rigs, the assumption of increasing oil price and rigs employments is not entirely reliable. Paying attention only to rig-counts as a

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measure of industry factor can be misleading. This is the mother of the conflict in the theory of rig-counts and oil price relationship, (Bokenov, 2018).

The relationship between rig-counts oil price in Nigeria is not similar with what is obtainable in other oil-producing states as explained in the report of Anietie, *et al.*, (2020). They demonstrated a stronger relationship between rig-counts and oil productions than rig-counts and oil price. In fact, not until the aftermaths of the 2008 global financial crises the relationship between rig-counts and oil prices in Nigeria had strayed apart, dismissing the theory of direct relationship between rig-counts and oil price in Nigeria. The close movement of oil prices and rig-counts in Nigeria within the 2009 and 2020 can be traced to the discovery of the new innovations in the explorative environment, such thing as the horizontal drilling, (Bokenov, 2018). Figure 1 is a graph of the interaction term (rig-count*oil production) and crude-oil output in Nigeria, and figure 2 is the graph of rig-counts and crude-oil output in Nigeria. The graphs show a direct relationship between rig-employment and crude-oil production in Nigeria. The relationship between rig-counts and oil price are presented on figure 3. The information on figure 1, 2 and 3 shows that rigs employment mimic what happens in the Nigerian explorative environments than what happens in the oil market.

Figure 1: Interaction Term and Oil Production

Figure 3: Rig-Counts and Oil Price

Figure 2: Rig-Count and Production

Figure 4: Rig-Count and Oil Revenue

The forces that determined rigs employment in Nigeria is beyond price and innovation but includes the tension and restiveness in the explorative environments, (Anietie, *et al.*, 2020). Thus, we argue here that the reduction of oil rigs promoted by social unrest can contribute to the shortage of production output and diminish the effects of price increase and new innovations in drillings on output as well as revenue. This paper believed that sustained increase in output/revenue of the Nigeria crude-oil industry could lies in a singular or multiplicity of industry factors affecting oil production, rather than oil price alone. Thus, the paper introduces in its model an interaction term between oil rig-count and oil production for the justification of industry factor affecting oil domestic production.

The use of interaction terms in an econometric model to address control for external factors in a model has severally been discussed in the works of Chinn & Ito, (2007) on current account balance and financial development and Zahonogo, (2017) on economic growth and trade policy.

The objective of this paper is to investigate the effect of crude-oil revenue on economic growth in Nigeria by controlling for crude-oil industrial factor shocks.

The paper is divided into five sections such that section one is the introduction, sections two and three are issues in literature and methodological issues. Whereas section four and five discusses the finding and concluded the paper with recommendation drawn from the discussions.

Literature Review

The drilling of crude-oil and industrial performance are analysed in three distinguished drilling trajectories driven by technology; these are: vertical, horizontal and directional (rig less drilling). While the first two are traditional methods of crude oil production, the third is more of a hybrid of horizontal and vertical technologies. Drilling activities are driven by rigs employment. Active rigs are essential for crude oil production, oil revenue generation and in turn ensure macroeconomic performance of the host economies, (Hamilton, 2003; Kaiser, 2010 and Ewing and Thompson, 2016). The relationship between drilling activities of the oil industry, oil

price fluctuation and oil production have been demonstrated empirically by scholars; in investigating the essentialness of rigs to drilling as well as industrial cost and revenue, Apergis, Ewing, & Payne, (2021) used the nonlinear AutoRegressive Distributed Lag (ARDL) framework on the United State oil industry and concluded that long-run symmetry relationship is present between drilling activities and oil prices irrespective of drilling rig trajectory. They also show that asymmetry long-run relationship exists between oil production and drilling rigs trajectory but consistent with the nature of the trajectory. They equally demonstrated an asymmetry short-run effects of both oil prices and oil production that are consistent with companies taking advantage of the upturns to improved oil recovery during downturns. In a structural Vector Autoregressive Regression (VAR) framework Anietie et al, (2020) revealed that the response of macroeconomic variables to shocks from oil price was insignificant but significant to investment in exploration and drilling in Nigeria. They also argued that the domestic activities in the oil industry have serious implications on how macroeconomic variables responded to oil related indexes. In controlling for the exogeneity of economic and financial environment in a VAR model, Bokenov, (2018) analysis the relationship between rigs-counts, tight-oil-production and oil prices in the United States. His study demonstrated that oil price shocks emanated from oil industrial activities (rig-counts and tight-oil-output). Khalifa, Caporin, & Hammoudeh, (2017), show that rig-count play a massive role in oil price fluctuation. Their conclusion was reached with monthly data of 1990 to June 2015 in a Quantile Regression Analysis.

In the Nigerian economy various scholars has shown the respond of economic growth to oil price fluctuation. for instance, Kanu and Nwadiubu (2020), investigated global oil price shocks effect on the pace of economic growth in Nigeria with the Ordinary Least Square (OLS), VAR, AutoRegressive Conditional Heteroscedasticity (ARCH) and Generalised ARCH (GARCH) models from 1990-2019. They show that oil price changes have a significant effect on economic growth in Nigeria. Gylych, Jibrin, Celik and Isik (2020) investigated the impact of oil price fluctuations on the Nigerian economy with the Granger Causality Model, using information from first month of 1995 to last month of 2018. They demonstrated with Impulse Respond Function and Forecast Error Variance Decomposition that a one-way causality exists between oil price and macroeconomic variables in Nigeria. Alenoghena (2020) examined the effect of oil price shocks on the macroeconomic performance of the Nigerian economy with a SVAR model from 1980-2018. His results revealed that oil price shocks have significant and negative impact on economic growth and industrial output in Nigeria. Musa (2015) analysed the impact of oil price shocks on economic growth with the SVAR model on data of 1970Q1-2011Q4. He shows that oil price shocks have a long-run impact on economic growth in Nigeria. Alley, Asekomeh, Mobolaji, and Adeniran (2014) investigated the impact of oil price shocks on economic performance with Generalised method of Moment (GMM) model from 1970-2012 and shows that oil price shocks has an insignificant impact on economic growth in Nigeria.

Studies in other major oil exporting countries have shown that economic growth responded to oil price, for instance, Mukhtarov, Humbatova, Mammadli & Hajiyeu, (2021), investigates the influence of oil price shocks on GDP per capita, exchange rate, and total trade turnover in Azerbaijan with SVAR model from 1992-2019 and observed that oil price shocks had a positive impact on GDP per capita and total trade turnover. Charfeddine, Klein, and Walther (2018) examined whether the time difference affects the impact of oil price changes on US GDP growth in an OLS model from 1973Q1-1990Q4. They show that decrease in Oil price affect the GDP growth. In Africa Awunyo-Vitor, Samahyia & Bonney (2018) examined the causal linkage between oil price change and economic growth in Ghana with a causality approach from 1970 -2012, they demonstrated that the effect of oil price change on economic growth is statistically insignificant in the long run. Gachara (2015) investigation is on the channels through which oil price shocks affect economic activity in Kenya, using a SVAR model and granger causality tests with data of 1991–2014. He shows that Crude oil price shocks have a significant impact on Kenya’s macroeconomic performance. In a panel framework, Ogede, George & Adekunle (2020), examined the impact of oil price volatility in African oil exporting countries from 1995- 2017 and show that Oil price volatility had a negative and significant effect on macroeconomic variables in African oil-exporting countries. Fititi, Guesmi, Teulon & Chouachi (2016) examined the degree of interdependence between oil prices and economic growth for four major OPEC countries in a co-spectral analysis with data of September 2000 to October 2010. Their results show that oil price shocks have both medium-term and short-term effects on economic growth of OPEC nations. there is no doubt that crude-oil activities have implication on the pattern of economic growth in Nigeria and the world.

Research & Methodology

Model Specifications

Following the technique of Apergis, Ewing, & Payne, (2021), the model for this paper is casted as follow:

$$Y_t = \alpha_t + X_t' \beta + Z_t' \beta + \mu_t$$

Y_t is the annual per capita income, X_t' is the proxies of crude-oil revenue, Z_t' is the vector of the controlled variables condition on macroeconomic and social behaviours of the host country, α_t is the intercept and μ_t is the unforeseen factors that affected the models or the stochastics error term. To provide for the long-run and short-run relationship between crude-oil shocks and economic growth in our model, the paper adopted the ARDL approach. We specifically chose the technique because our series are integrated in a mixed order of I(0) and I(1), (Pesaran, et al 1999). The econometric requirements for performing short-run and long-run estimated are equally condition on the cointegrating relationship among the variables. Given the integrating order of the series we opted for the bond-test cointegration technique.

Thus, we have;

$$\Delta Y_t = \varphi EC_t + \sum_{j=0}^{k-1} \Delta X_{t-j} B_{i,j} + \sum_{j=0}^{p-1} \pi_{i,j} \Delta Y_{t-j} + \epsilon_t$$

Where

$$EC_t = Y_{t-1} - X_t' \theta$$

φ and θ are the adjustment and the long-run coefficients respectively and are derived with the Log-Likelihood methods (Pesaran et al, 1999).

Data

We measure Economic growth as the ratio of nominal GDP to total population (per capita income (EGR)). Crude-oil shocks is measured as the total revenue derived from crude-oil sales. crude-oil revenue provides justification for price and production effects; therefore, revenue accommodates external forces that led to price shocks and internal forces that led to shortages of outputs. Further control was used for initiating nonlinearity of oil shocks economic growth in Nigeria. In this regard we used the interaction of rig-counts and crude-oil production (NGC) output which performs better than the interaction between rig-counts and oil-prices in Nigeria. other variables included in the models are Globalization which is proxied as Trade Openness and measured as ratio of total trade to nominal GDP (OPN) and are further divided into the ratio of exports to nominal GDP and the ratio of imports to nominal GDP (EPN and IPN).

The efficiency of the financial system proxied as the Ratio of Broad money supply to nominal GDP. This financial indicator is considered because Its measurement captured financial intermediation from at least three financial institutions: Other Financial Institution, Deposit Money Banks and Central Bank (FSE), domestic price level (INF), debt profile of the economies (DBT) and Fiscal openness measured as the ratio of state expenditure to nominal GDP (FSE). We equally introduced in the model's ratio of the domestic currency to the US Dollar (EXR), and labour burden measures as the ratio of dependency to labour force (DPR). The study covers 40 years (1980-2019) and data are sourced from the World Bank's World Development Indicators (WDI), OPEC Statistics, Baker Hughes Rig Count and the central bank of Nigeria statistical bulletin.

Analysis and Findings

Table 1: Descriptive Analysis

	EGR	OPR	INF	EXR	IPN	FSE	GOVT	ENP	RGC
Mean	957.96	79858.10	18.92	97.43	21.87	16.45	8.45	34.00	94.28
Median	434.74	47374.68	12.39	97.02	20.86	13.47	8.10	34.27	91.00
Max.	3087.65	225424.30	72.84	306.92	36.56	28.63	17.86	64.99	200.00
Min.	144.13	20271.81	5.39	0.55	10.78	9.06	4.10	9.32	15.00
Std. Dev.	916.28	62402.60	16.91	89.85	8.10	6.03	2.69	13.50	53.96
Skew.	1.04	1.06	1.82	0.79	0.31	0.63	1.37	0.11	0.52
Kurtosis	2.57	2.78	5.15	3.02	1.84	1.81	5.64	2.59	2.26
JB-Stat.	7.50	7.53	29.89	4.14	2.89	4.98	24.17	0.36	2.73
P-Values	0.02	0.02	0.00	0.13	0.24	0.08	0.00	0.83	0.26

Source: Author's Computation.

The descriptive properties of the data are reported on table 1. Per capita income in Nigeria average 957.96 dollar, that is on average each person among the over 200 million persons in Nigeria get a share of 957.96 dollar from 1980 to 2019. The maximum and minimum share of income each Nigeria had gotten from the national treasury are 3087.65 and 144.23 United States Dollar. Within this period crude-oil income average 79,858.10 million US Dollar with a minimum and maximum values of 20,271.81 and 205,424.81 million US Dollar.

Looking at policy measures financial development index (financial deepening), government spending or fiscal openness, import openness and export openness averages 16.45, 8.45, 21.87 and 34.00 respectively. with an average of 18.92 the results indicates that inflation had remained high and unstable within the range of 5.39 and 72.84; also, the cost of purchasing a unit of the US Dollar using the domestic currency (naira) had remained on the increase with an average exchange rate of 97.43 Naira to a US Dollar within the period.

Table 2: Unit Root Results

Test/ VAR.	ADF Levels	1 st Diff.	PP Levels	1 st Diff.	I(d)	KPSS Levels	1 st Diff.	ERS Levels	1 st Diff.	I(d)
<i>egr_t</i>	-0.2526	-4.8606	-0.2526	-4.8113	I(1)	0.5524	0.4473	20.4547	1.2974	I(1)
<i>opr_t</i>	-1.1658	-5.7871	-1.0846	-6.0342	I(1)	0.5862	0.1423	8.0183	2.6074	I(1)
<i>nfa_t</i>	-1.5397	-3.8101	-1.2374	-3.0013	I(1)	0.6476	0.5000	4.8133	17.5473	I(1)
<i>inf_t</i>	-3.0033	-5.8348	-2.9704	-11.882	I(0)	0.2776	0.5000	2.1485	1.5169	I(0)
<i>exr_t</i>	-2.8420	-3.5590	-2.3427	-3.6028	I(1)	0.6865	0.4250	443.75	1.6771	I(1)
<i>dpr_t</i>	1.6889	-6.8277	-1.1352	-2.6180	I(1)	0.4618	0.1934	132.62	9.0823	I(1)
<i>inp_t</i>	-2.2498	-6.7872	-2.1907	-12.020	I(1)	0.7309	0.1575	3.8193	2.0136	I(1)
<i>fse_t</i>	-2.3720	-9.0913	-2.5883	-14.652	I(1)	0.5163	0.3222	10.319	34.437	I(1)
<i>gvt_t</i>	-1.8399	-10.527	-3.42**	-10.855	I(1)	0.5668	0.2829	8.4294	1.3440	I(1)
<i>enp_t</i>	-2.4590	-6.6437	-2.4590	-9.3726	I(1)	0.6181	0.2100	3.4185	1.0009	I(1)
<i>rgc_t</i>	-1.8178	-5.7583	-1.7967	-5.7600	I(1)	0.8165	0.1204	18.961	1.3438	I(1)
<i>ncp_t</i>	-3.4674	-4.5383	-2.970	-3.9588	I(0)	0.8521	0.1108	10.192	0.7348	I(1)
C-Value	-2.9390	-2.9411	-2.9390	-2.9411		0.4630	0.4630	2.9700	2.9700	

Source: Author Computations Note that ** ≤ 0.05 level of significance. The null hypothesis is rejected if the probability values of the estimated coefficients is less than or equal to 0.05 level of significance. Note that VAR=Variables; C-Value=Critical Values.

Checking for the unit roots properties of the times series employed in an econometric model is now a standard procedure for research in economics, at least for two reasons, (1) to ensure the stability properties of the series through the test of stationarity and (2) to select the appropriate models for cointegration and techniques for estimation. Because of the issues of time and space several unit root test methods had been developed. This study relied on at least four types of unit root test methods. The Augmented Dickey-Fuller (ADF) test, the Philip-Perron (PP) test, the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test and Elliott-Lothenberg-Stock (ERS) test. The standard unit root test developed by Dickey and Fuller (1979) uses the assumption that the time series exhibits only the first order Autocorrelation AR(1). However, they further observed that there are series that could exhibited more than AR(1). By introducing the lag of the series into the standard DF equation they Augmented for more AR(P) process for stationarity test. Like the ADF test, the PP test objective is to control for AR(P) in the unit root equation. The noticeable differences between the ADF and PP tests are the non-augmentation of lag and nonparametric approach of the PP test to stationarity. However, the ADF and PP tests did not provide for the detrending of the time series, KPSS and ERS approach Provided for detrending of the series and uses the residual equation for unit root test. The ERS unit root test is a feasible point test that optimized the serial correlation of the error term. The process involves the detrending of the time series. The KPSS assumed that the time series is trended. The noticeable difference between each test (KPSS and ERS) is the use of original data by KPSS and quasi-differenced data by ERS. The null hypothesis for KPSS and ERS is inverse to ADF and PP. in the ADF and PP the series are not stationary under the null while the series are stationary for KPSS and ERS tests under the null.

The PP and ERS test are used to validates the results of ADF and KPSS respectively. The unit roots results obtained for this study is summarized on table 2, we observed a mixed order of integration among the variables irrespective of the test method. Inflation rates and the interaction term are stationary series of order zero (I(0)). The result is validated by the PP test. However, inflation rate was stationary with KPSS and validated with ERS, but the methods could not ascertain the stationarity of the interaction term. There are implication that the impact of internal or external shocks on economic growth model could be permanent since most of the series are I(1). Thus, there is need to check for possible long run or cointegration relationship among the variables in the model.

Table 4: Cointegration Test

Critical values	Test Statistics		
Significance Level	I(0) Bound	I(1) Bound	
10%	2.72	3.77	K
5%	3.23	3.69	
1%	4.29	5.61	F-Statistics
			25.4867

Source: Author Computations Note that ** ≤ 0.05 level of significance. The null hypothesis is rejected if the probability values of the estimated coefficients is less than or equal to 0.05 level of significance.

The choice of our cointegration technique emanated from the unit root results. the bound tests performed better than any other form of cointegration technique when the series in the model are integrated at I(0) and I(1) without cases of I(2) series, (Pesaran, et al., 1999). Table3 summarizes the outcome of the test. With F-statistics greater than the upper bound of I(1) we concluded that there is a cointegrating relationship among the series in the model. This also means that the effect of internal or external shocks is temporary on the model and there is need to estimate both the long run and short run coefficients.

Table 4: Estimated Coefficients for Static and Dynamic Models

Models	Static Model			Dynamic Model			
VAR	Coeff.	t-Stat.	P-Value	VAR.	Coeff.	t-Stat.	P-Value
opr_t	0.1299**	6.4965	0.0000	ecm_{t-1}	-0.4751**	-8.0727	0.0000
inf_t	0.4124	0.9552	0.3509	Δegr_{t-1}	0.2508**	2.2889	0.0331
exr_t	1.7646	0.8587	0.4007	Δopr_t	0.0117**	5.7910	0.0000
nfa_t	-0.7304**	-6.7973	0.0000	Δopr_{t-1}	-0.0015	-1.5739	0.1312
dpr_t	-0.0325**	-4.6531	0.0001	Δinf_t	0.1462	0.9979	0.3302
inp_t	-0.3439	-0.5815	0.5674	Δexr_t	-0.3743	-1.6080	0.1235
fse_t	0.0218**	2.3989	0.0241	Δexr_{t-1}	0.5712**	3.2596	0.0039
gvt_t	0.3309	0.5166	0.6111	Δnfa_t	-0.7878**	-6.9754	0.0000
enp_t	-0.4443**	-3.1574	0.0050	Δdpr_t	-0.8832	-0.6720	0.5093
rgc_t	0.4786**	2.3671	0.0281	Δinp_t	-0.0639	-0.5880	0.5631
ncp_t	-0.1847**	-2.8264	0.0104	Δfse_t	0.0559*	1.7528	0.0950
C	0.4165	0.4557	0.6535	Δgvt_t	4.9085	0.5258	0.6048
				Δenp_t	-0.8629**	-3.1399	0.0052
				Δrgc_t	0.6030**	2.5195	0.0204
				Δncp_t	-0.0877**	-2.9906	0.0072

Source: Author; Computations Note that ** ≤ 0.05 level of significance.

The null hypothesis is rejected if the probability values of the estimated coefficients is less than or equal to 0.05 level of significance. Note that, The ARDL model employed in this study was selected using Schwartz information criterion (SIC) with an automatic lag selection process. This is because the model that were developed using the Akaike information criteria, Hannan-Quinn information criterion (HQC) and Adjusted R^2 did not have a better fit than SIC. Also, the diagnostic assumptions of OLS were not satisfied using these other model selection criteria.

Before discussing our result, it is best to analyse the diagnostic behaviour of our model to see whether econometric problems associated with time series has been properly taken care of.

Figure 5: Jarque-Bera Residual Normality Test

Figure 5 is the chart of the normality behaviour of the model residual. The statistics are reported at the right-side of the charts. The Jarque-Bera statistic reveals that the residual from the estimated ARDL model is normally distributed with zero mean.

Table 5: Residual Serial Correlation Test

Test Method	Test Statistics	Values	P-Value
Breusch-Godfrey Correlation LM Test	Serial F-statistic	0.781317	0.4727
	Chi-Square	3.035383	0.2192

Source: Author Computations Note that ** ≤ 0.05 level of significance. The null hypothesis is rejected if the probability values of the estimated coefficients is less than or equal to 0.05 level of significance.

Table 6: Residual Serial Correlation Test Q-statistic Dynamic Regressors

Test Method	Partial	Q-statistic			Q-statistic Square		
Autocorrelation	Correlation	AC	Q-Stat	P-Value	AC	Q-Stat	P-Value
. .	. .	-0.032	0.0428	0.836	-0.025	0.0257	0.873
.* .	.* .	-0.180	3.2961	0.348	0.224	2.8112	0.422
. .	.* .	0.027	3.4471	0.631	0.259	5.9237	0.314
. .	. .	0.028	3.6913	0.815	-0.110	6.5410	0.478
.* .	** .	-0.204	7.5375	0.581	-0.203	10.803	0.289
. **	. .	0.245	10.982	0.445	-0.118	12.725	0.312
. *.	. *.	0.079	12.921	0.454	0.027	19.815	0.100
.* .	.* .	-0.118	17.350	0.363	-0.198	22.734	0.115

Source: Author; Computations Note that ** ≤ 0.05 level of significance.

The null hypothesis is rejected if the probability values of the estimated coefficients is less than or equal to 0.05 level of significance.

Table 7: Results of Test for Heteroscedasticity

Test Method	Test Statistics	Values	P-Value
Heteroskedasticity Test: Breusch-Pagan-Godfrey	F-statistic	1.109970	0.4077
	Obs*R-squared	18.44739	0.3612
	Scaled explained SS	3.526314	0.9998
Heteroskedasticity Test: Glejser	F-statistic	1.234952	0.3228
	Obs*R-squared	19.46078	0.3027
	Scaled explained SS	10.01820	0.9028
Heteroskedasticity Test: Harvey	F-statistic	1.776488	0.1095
	Obs*R-squared	22.86065	0.1538
	Scaled explained SS	24.50818	0.1272

Source: Author; Computations Note that ** ≤ 0.05 level of significance.

The null hypothesis is rejected if the probability values of the estimated coefficients is less than or equal to 0.05 level of significance.

Table 8: Ramsey RESET Test for Functional Form

Test Method	Values	Degree of Freedom	P-Value
t-statistic	1.262994	19	0.2219
F-statistic	1.595153	(1, 19)	0.2219
F-test Summary			
Test	Sum of Sq.	Degree of Freedom	Mean Squares
Test SSR	9661.343	1	9661.343
Restricted SSR	124738.4	20	6236.920
Unrestricted SSR	115077.1	19	6056.688

Source: Author; Computations Note that ** ≤ 0.05 level of significance.

The null hypothesis is rejected if the probability values of the estimated coefficients is less than or equal to 0.05 level of significance.

Looking at the summary of the results on table5 to table8, we concluded that the null hypothesis for no serial correlations, homoscedasticity and functional form of our model (that is the coefficients on the powers of fitted values from the regression are jointly zero) was failed to be rejected, also, our results are robust by various test methods. Thus, the results certified at least the first econometric problems associated with time-series data.

Table 4 is the summary statistics for the static and dynamic models. The dynamic model reported the cointegrating multiplier for adjustment or the Error Correction Mechanism (*ecm*). The cointegrating multiplier measures the rate at which the model will adjust to internal and external shocks. The multiplier is subjected to two statistical conditions, the first condition is the negativity of the multiplier and the second is the relevance of the multiplier. If the two conditions are not meet the null hypothesis of cointegration is allowed (Engel & Granger, 1987; Philip & Ouliaris, 1990 and Pesaran *et al.*, 2001). The *ecm* value for this paper is -0.4751 and is significant at P-value of 0.0000, thus, the study rejected the null hypothesis of no cointegrating relationship between crude-oil revenue and economic growth in Nigeria. This implies that the responds of the model to shocks is certain but the rate of recovering within an annual is slow and below average

The short-run dynamics model in table 4 also reveals that the result of the lag of economic growth is positive and inelastic indicating that previous year's activities of the economy have the capacity to improve the output of the current period, the coefficients being inelastic implies that a 1% increase in previous year activity of economic performance could lead to a less than 1% increase in the future performance. This is in conformity with the Kaldor (1967) law of economic growth. Kaldor's law sees the real sector as the engine of growth of the economy. The law implies that the productive sector could stimulate itself to future growth path from previous year output. Our results show that it will take at least one period lag before the economic activity of previous year in Nigeria can stimulate its future output, since only the first lag was statistically significant.

Let us start by analysing the crude-oil industrial factor variables (rgc). The result shows that the numbers of rig employed in the exploration of crude-oil in Nigeria positively impacted on the growth of economic output. The magnitude of the impact was impressive as 1% increase in the numbers of rig increases economic growth by 0.4786% in the long run. The impact was even more expressive and encouraging in the short run because a percentage increase in rig employment increase economic growth by 0.6030 percent. This implies that more rigs will increase oil production and in turn increase oil output and revenue then accelerate economic growth. These observations are in-line with empirical finding in literature. The results corroborated with the findings of Ewing, & Payne, (2021) that presented a positive relationship between rigs and oil-industrial output irrespective of drilling rig trajectory. It is also in-line with the finding of Anietie et al, (2020) whose argued that domestic activities in the oil industry have serious implications on how macroeconomic variables responded to oil related indexes. However, we observed that the interaction of rig-count and oil-production (ncp) negatively impacted on economic output in Nigeria. It shows that the effect of this interaction or negative externality on oil activity is more severe in the long run.

The negative impacts can be attribute to the increase attacks on oil production facilities in Nigeria which have disrupted output and in turn revenue. The, result supported the arguments of Medee & Ikue-John, (2017) and Aniteie et al, 2020, the results implies that the reduction of oil rigs promoted by social unrest contribute to the shortage of production output and underwrite the parts of output to oil revenue. We equally agree no less with other scholars and argue that domestic crude-oil activities have not contributed meaningfully to the growth of the Nigerian economy, rather it has resulted in negative activities such as land and water pollution, social unrest and negative externality. In this regard the government of Nigerian is in the business of channelling a significant amount of the revenue generated revenue from oil sales to correcting the negative external measures (Ex-Niger-Delta Militia Allowances, TNP surveillance contract payments, etc) instead of the growth of the macroeconomy.

The models reveal that a percentage increase in oil revenue increases economic growth by 0.1299% in the long-run and 0.0117% in the short run. This implies that in the short term the contribution of oil revenue to the growth of the Nigerian economy is almost zero or the change of the growth of the Nigerian economy to changes in crude-oil revenue is perfectly inelastic. This observation is in-line with the works of Musa (2015) and Kanu & Nwadiubu (2020) whose observed that oil price related indexes have a positive and significant lasting impact on the Nigeria economic growth in the long run. However, we could not see reasons with Alenoghena (2020) and Alley, et al., (2014) whose argument supported insignificant and negative impact of oil related indexes on the Nigerian macroeconomic growth. The controlled variables used in the models were correctly sign and some were statistically significant to Nigerian economic growth. The sign and significance of the variables remain consistent in the long run and short run models except the significance of dependency ratio and financial development index.

Conclusion

Nigeria as a net crude oil exporting country and a member of the OPEC bloc has setbacks that impede her from reaching her required oil production benchmark by OPEC. One of these setbacks is the hostile crude-oil explorative environment. This paper investigated the interaction between rig-counts and oil production on economic growth in Nigeria, using data from 1980-2019. Dwelling on the ARDL technique we concluded that the contribution of oil-revenue to economic growth in Nigeria is promising on the safety of the explorative environment. We arrive at this conclusion because the results supported the arguments that the reduction of oil rigs due to social unrest contributed to the shortage of production output and underwrite the parts of output to oil revenue; also, that, domestic crude-oil activities have not contributed meaningfully to the growth of the Nigerian economy, rather it has resulted in negative activities such as land and water pollution, social unrest and negative externality. Hence, the State have diverted the resources that was supposed for capital investment to fighting and appealing pipeline vandals and Oil Militia; and remedy to the negative externality.

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