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INFLUENCE OF SOLID MINERAL DEVELOPMENT ON ECONOMIC GROWTH IN NIGERIA

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ABSTRACT: *Nigeria's over-dependence on crude oil revenue has exposed the economy to price shocks emanating from vicissitudes in the global oil market, which has accentuated the need for urgent economic diversification. One of such areas that holds the potential for Nigeria's economic diversification is the solid mineral subsector. The study examined the influence of solid mineral development on economic growth in Nigeria, using the Auto Regressive Distributed Lag (ARDL) Approach. Time series data which spanned 1981 to 2019 were used in the study. The study tested for stationarity among the time series while all results were tested at 5 per cent level. The result revealed that Solid Mineral Development exerted an insignificant positive influence on economic growth in the study area. Finally, the study recommended a religious implementation of the solid mineral development plan and the strengthening of regulation, among others, with a view to accelerating economic growth in Nigeria.*

Keywords: Autoregressive Distributed Lag Model, Economic Diversification, Economic Growth, Solid Mineral Development, Unit Roots, Nigeria

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INTRODUCTION

Stakeholders such as policy makers, scholars and successive governments in Nigeria, among others, have continued to express concern over the country's over-dependence on crude oil, which has exposed the economy to price shocks emanating from vicissitudes in the global oil market. Consequently, a number of them have expressed the need for urgent economic diversification. One of such areas that holds the potential for Nigeria's economic diversification is the solid mineral subsector. Currently, the subsector is being largely operated by small miners who employ crude technology.

The solid mineral subsector comprises coal mining, metal ores, quarrying and other minerals (Central Bank of Nigeria [CBN], 2020). Despite the ubiquitous presence of these resources across the federation, the contribution of solid mineral to Gross Domestic Product (GDP) in Nigeria over three decades has not been exciting. For instance, solid mineral output, according to the CBN (2020), dropped from N67.14 billion in 1981 to N29.09 billion in 1990. It further dropped to N21.31 billion in 2000. However, from 2003, the solid mineral output has been on the increase: from N23.20 billion in 2003 to N51.88 billion in 2010 and from N96.60 billion in 2018 to N106.2 billion in 2020 respectively. Nevertheless, when the output is compared in terms of percentage contribution to GDP, CBN (2020) reports that the contribution of solid mineral to GDP has been falling for most part of the period. For instance, it dropped from 0.44 per cent in 1981 to 0.15 percent in 1990 to 0.089 per cent in 2000, and rose marginally from 0.093 per cent in 2010 to 0.15 per cent in 2020.

The pedestrian performance of the solid mineral subsector has been attributed to lack of geosciences data, limited budgetary support, absence of critical infrastructure, federal-state subsidiarity/tensions, illegal mining and community challenges. Others include supervising ministry's weak institutional capacity, limited enforcement of regulations, poor ease of doing business rating and lack of funding, among others (Ministry of Solid Mineral Development, [MSMD], 2016).

In terms of growth, the Nigerian economy which rose from recession in the early 1980's to a growth rate of about 6.4 per cent in 1989, slowed down to an average of 2.6 per cent between 1990 and 1999. Between 2000 and 2014, the GDP grew at an average of 7.9 per cent after which it dwindled to 2.65 per cent and recessed to -1.62 per cent in 2015 and 2016 respectively. This had been followed by a slow recovery, with a growth rate of 0.81% in 2017, and 1.92% growth in 2018 (CBN, 2018). By the end of 2021, National Bureau of Statistics [NBS] (2022) reports that the GDP rose by 3.4 per cent, which was over and above initial forecasts.

In a bid to boost the solid mineral subsector, the Federal Government of Nigeria created the Ministry of Solid Mineral Development in 1999, which has ignited a lot of interest in the subsector. The subsector has also provided alternative sources of foreign exchange to the country in view of the fact that income generation from oil has been unreliable partly due to oil price fluctuations in the global market, the crisis in Niger Delta region of Nigeria (CBN, 2014), and other Resource-Curse factors such as inefficient spending and borrowing, limited capture of benefits and weaker institutional development (Natural Resource Governance Institute [NGRI], 2015).

The question that arises is: How has solid mineral development influenced economic growth in Nigeria? Solid mineral development entails a full range of activities, ranging from exploration through extraction or production of naturally occurring substances or formations

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whose particles are closely packed together and have relatively stable shape and volume. On the other hand, economic Growth is a consistent increase in the value of goods and services produced in an economy over a long period of time (Jhingan, 2014).

A consensus is yet to be established on the influence of solid mineral development on economic growth in Nigeria despite the increased clamour for economic diversification. The study provides a further insight into the solid mineral development - economic growth nexus especially from the developing country context. Findings would assist bureaucrats and governments in crafting solid mineral development policies aimed at driving economic diversification and growth in the country. Hence, the study investigated the influence of solid mineral development on economic growth in Nigeria. The specific objectives of this study were to: examine the long run relationship between solid mineral development and economic growth in Nigeria; determine the influence of solid mineral development on economic growth in the study area; and establish the direction of causality between solid mineral development and economic growth in the study area. A study of this nature is important especially in an economy whose growth has been largely dependent on a single natural resource (crude oil). The scope of the study was limited to the relationship between solid mineral development and economic growth in Nigeria between 1981- 2019. The base year of 1981 was chosen to capture the eras of boom and bust as well as the period when appreciable efforts were made towards economic reforms in Nigeria.

EMPIRICAL REVIEW

A number of researchers have studied the relationship between solid mineral development and economic growth.

For instance, Akongwale, Ayodele and Udefuna (2013) analysed the role of solid mineral on economic diversification in Nigeria, employing both qualitative and quantitative analyses. The study showed that the solid mineral subsector has the potential to contribute immensely to the economy of Nigeria. Specifically, it revealed that the development of the solid mineral subsector could help to combat poverty in the country via job creation; especially, given its forward linkage with other sectors of the economy.

Adeniyi, Adeleke and Olabode (2013) examined solid mineral and economic growth in Nigeria by employing qualitative analysis. The study revealed that the solid mineral subsector remains crucial to economic development, wealth creation and poverty alleviation in any nation that is blessed with such mineral deposits and concluded that Nigeria government should adopt best practices and mechanisms that have been used by different countries to formalise and regulate mining explorations in order to attain sustainable development in the mining subsector in the country.

Danmola and Wakili (2013) analysed the potential of solid mineral resource as a viable alternative to petroleum, which is a volatile and unreliable source of foreign exchange earnings for the country. The study suggested that in partnership with federal, state or local communities the solid mineral subsector can be fully developed with a view to generating substantial foreign exchange for the country. For a developing country such as Nigeria, solid mineral development is expected to be a veritable source of raw materials for domestic industries and a foreign exchange earner in addition to generating employment. Maduaka (2014) also investigated the

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contribution of solid mineral to economic growth in Nigeria from 1970 to 2012. Adopting the Vector Auto Regression (VAR), the finding from the study suggested that solid mineral exerts a positive effect on economic growth in Nigeria.

Furthermore, Udoka and Duke (2017) also empirically examined the influence of three sectors (solid mineral, tourism and agriculture) on Nigeria's economic growth from 1981 to 2014. Employing Ordinary Least Squares (OLS), the study found that solid mineral has a positive and significant influence on economic growth in Nigeria.

In a related study, Edeme, Onoja and Damulak (2018), using a time series data spanning from 1960 to 2015, established that solid mineral has a positive and significant impact on economic growth in Nigeria. Similarly, Ajie, Okoh and Ojiya (2019), using Johansen cointegration test and Ordinary Least Squares (OLS) technique, established that a unit increase in solid mineral development such as quarrying, bauxite, metal ores, iron ore, coal will contribute 0.26 unit to Nigeria's GDP. In the above study, economic growth was proxied by GDP, while solid mineral development was represented by the latter's contribution to GDP.

According to Ajie, Okoh and Ojiya, (2019), while a lot of opportunities exist in mineral development for both the domestic and export markets, minerals mined in the country are still largely exported with little or no value addition. Hence, there are lot of opportunities that exist in mineral development for both the domestic and export markets.

Also, Nwogwugwu *et al.* (2021) investigated the nexus between solid mineral development and economic growth in Nigeria. They employed the canonical cointegration regression (CCR) and empirically found that solid mineral production exerts a significant positive effect on economic growth in Nigeria.

In a related study, Zayone, Henneberry and Radmehr (2020) examined the effect of agricultural, manufacturing, and mineral exports on Angola's economic growth, employing data from 1980 to 2017. An Autoregressive Distributed Lag (ARDL) model was adopted to estimate the effect of sectoral exports on economic growth in the country. Analysis of the findings showed that while exports from all three sectors (manufacturing, mineral, and non-mineral) have driven Angola's economic growth in the long-run; only non-manufacturing exports (agricultural and mineral) have driven GDP growth in the short-run. Furthermore, the study found that mineral exports drove non-export GDP in the long-run whereas agricultural exports drove it in the short-run.

Overall, the current study extends the frontier of knowledge by investigating the influence of solid mineral development on economic growth in Nigeria, which is from a developing country perspective, using a more recent set of data.

Methodology

Theoretical Framework

In examining the influence of solid mineral development on economic growth, this study adopted the endogenous growth theory, which is rooted in the AK growth model. The model is hinged on the assumption that economic prosperity is mainly driven by internal or endogenous factors as opposed to external or exogenous factors.

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Starting with the simple AK model which is of the following form:

$Y = f(AK)$ … (1)

Where Y is the national output, K is the composite measure of capital stock, while A is a constant on the assumption of constant return to scale (CRS). The CRS replaces the assumption of diminishing returns to scale in the neoclassical growth theory to ensure that investment matters for long run growth and that growth is endogenous (Hussien & Thirwall, 2000). But capital stock can be subdivided into physical capital and human capital, hence the model becomes:

$Y = A\ f(K, L)$ … (2)

Where L stands for labour force

This implies that:

$Y = AK + AL$ … (3)

If y = Y/A, then k=K/A, and ⌊ =L/A, then equation (3) can be re-written as follows:

$y_t = \beta_0 + \beta_1 k_t + \beta_2 ⌊_t$

Where; y represents output, k stands for physical capital, and ⌊ is human capital.

It is reasonable to expect that the output in any economy will be influenced in one way or another by the productive use of resources such as solid mineral development, (smid). Hence, there is need to introduce solid mineral development into the equation as follows:

$y_t = \beta_0 + \beta_1 k_t + \beta_2 ⌊_t + \beta_3 smid_t$ … (4)

In order to capture other relevant macroeconomic variables such as exchange rate ($\varkappa_1$) and inflation ($\varkappa_2$), we introduced them into the equation as follows:

$y_t = \beta_0 + \beta_1 k_t + \beta_2 ⌊_t + \beta_3 smid_t + \beta_4 \varkappa_{1t} + \beta_5 \varkappa_{2t}$ … (5)

Model Specification

The main objective of the study was to investigate the influence of solid mineral development on economic growth in Nigeria. Anchored on the endogenous growth theory, the model to achieve this objective takes the following form:

$RGDPGR = f(SMID, GFC, EXR, POPGR, INF)$ … (6)

The above model is explicitly stated as follows:

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$RGDPGR_t = \beta_0 + \beta_1 SMID_t + \beta_2 GFC_t + \beta_3 lnEXR_t + \beta_4 POPGR_t + \beta_5 INF_t + \mu_t$ ... (7)

Where:

RGDPGR = Real Gross Domestic Product Growth Rate as a proxy for economic growth

SMID = Solid Mineral Development proxied by the subsector's contribution to GDP

GFC = Gross Fixed Capital Formation as a proxy for capital

EXR = Exchange Rate

POPGR= Population growth rate as a proxy for labour

INF = Inflation Rate proxied by the consumer price index

β_0 = Intercept parameter or average effect on dependent variable if all the variables are excluded from the model, especially when all the explanatory variables are set at zero values.

$\beta_1 - \beta_5$ = The parameters or partial regression coefficients of the model, measuring the change in the mean value of the RGDPGR per unit change in individual explanatory variable, while holding other variables constant.

μ_t = the stochastic disturbance term that captures the effect of other variables not included in the model on economic growth.

Analytical Techniques

Unit Root Test

To empirically examine the influence of solid mineral development on economic growth in Nigeria, the series were subjected to the unit root test, using the Augmented Dickey-Fuller (ADF) statistic at 5 percent level. The unit root test was carried out to confirm if the series were stationary at level [I(0)] or at first difference [I(1)]. However, the series must not be I(2) to be amenable to the Autoregressive Distributed Lag (ARDL) model. The ADF Test was based on the null hypothesis of non-stationarity. The unit root test is very important in ensuring that a unit root does not exist in the series because the existence of unit root can lead to a spurious regression.

Autoregressive Distributed Lag (ARDL) Model

The ARDL model was originally postulated by Pesaran and Shin (1999) and further extended by Pesaran, Shin and Smith (2001). The optimal lag length (lag 1) was selected on the basis of Akaike information criterion (AIC), using Eviews 9. The ARDL technique rather than the Johansen framework was employed in the study due to its applicability because it does not require all variables to be I(1). Also, it is applicable in cases where there is a mix of I(0) and I(1) variables in the series under study. The robustness of the ARDL method of cointegration is demonstrated in its ease of applicability with respect to the order of integration of the variables (that is when they are I(0) and I(1) but not I(2)); endogeneity assumptions in respect of all variables as well as its ability to simultaneously estimate the short-run and long-run

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coefficients of the model The starting point for the ARDL model is a structure of the following form:

$$\Delta RGDPGR_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta RGDPGR_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta SMID_{t-i} + \sum_{i=1}^{n} \beta_3 \Delta GFC_{t-i} + \sum_{i=1}^{n} \beta_4 \Delta \ln EXR_{t-i} + \sum_{i=1}^{n} \beta_5 \Delta POPGR_{t-i} + \sum_{i=1}^{n} \beta_6 \Delta INF_{t-i} + \beta_7 RGDPGR_{t-1} + \beta_8 SMID_{t-1} + \beta_9 GFC_{t-1} + \beta_{10} \ln EXR_{t-1} + \beta_{11} POPGR_{t-1} + \beta_{12} INF_{t-1} + \varepsilon_t \quad \ldots(8)$$

Where:

Δ denotes the first difference operator;

β_0 is the drift component

ε_t is the white noise residuals.

The left-hand side of the equation represented by RGGDPGR (i.e. the growth rate of real GDP) was used as proxy for economic growth. The first six expressions with the summation sign ($\beta_1 – \beta_6$) on the right-hand side denote the short run dynamics of the model while the last six expressions (($\beta_7 – \beta_{12}$) represent the long run relationship.

The presence of long-run relationship among the variables was conducted using Bounds Test under Pesaran *et al.* (2001) procedure. Based on the F-test, the Bounds Test is based on a null hypothesis of no cointegration among the variables vis-à-vis the alternative hypothesis which states that cointegration (long run relationship) exists among the variables denoted as follows:

H_o: $\beta_7 = \beta_8 = \beta_9 = \beta_{10} = \beta_{11} = \beta_{12} = 0$

This implies no long run relationship (i.e. no cointegration) exists among the variables.

H_1: $\beta_7 \neq \beta_8 \neq \beta_9 \neq \beta_{10} \neq \beta_{11} \neq \beta_{12} \neq 0$

That is, there is cointegration (long run relationship) among the variables**.**

Restricted Error Correction Model

If cointegration is proven to exist, then the third step requires the construction of error correction model to check the dynamic relationship. The *a priori* expectation is that the error correction term (ECT) coefficient must be negative and significant. The purpose of the error correction term is to indicate the speed of adjustment of a departure from long-run equilibrium. However, the greater the coefficient of the parameter, the higher the speed of adjustment. The Error Correction model relating to the variables in equation (8) is as follows:

$$\Delta RGDPGR_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta RGDPGR_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta SMID_{t-i} + \sum_{i=1}^{n} \beta_3 \Delta GFC_{t-i} + \sum_{i=1}^{n} \beta_4 \Delta \ln EXR_{t-i} + \sum_{i=1}^{n} \beta_5 \Delta POPGR_{t-i} + \sum_{i=1}^{n} \beta_6 \Delta INF_{t-i} + \Omega ECT(-1) \quad \ldots. (9)$$

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Where Ω represents the speed of adjustment parameter while the ECT is the vector of residuals obtained from estimated cointegration model in equation (8).

Granger Causality Test

The Granger causality test was also used to examine directional flow of causality between variables which, in its general form, is represented as follows:

$$Z_t = \alpha + \varphi_i z_{t-i} + \varpi_n x_{t-n} + \varepsilon_{it} \quad \ldots (10)$$

Where:

Z_t = Variable whose causality is being investigated.

α = Intercept of the AR(p) process.

φ_i = Parameters of lagged values of z to be estimated.

ϖ_n = Parameters of the x to be estimated

n = Longest lag length for which the lagged values of x has been proved statistically significant.

Data Sources and Measurement of Variables

The study employed secondary data spanning from 1981 to 2019 as detailed in Table 1.

Table 1: Data Sources and Measurement of Variables

Variables	Indicator	Variable Description	Measurement	Source
RGDPGR	Real gross domestic product growth rate	RGDP growth rate as proxy for Economic Growth	Growth rate of Real Gross Domestic Product in percentage	Central Bank of Nigeria, Statistical Bulletin, 2019
SMID	Solid mineral development	Contribution of solid mineral development to GDP	Percentage contribution of solid mineral development to GDP	Central Bank of Nigeria Statistical Bulletin, 2019
GFC	Gross fixed capital formation	Capital formation as proxy for investment in the subsector	Measured as a percentage of GDP	Central Bank of Nigeria Statistical Bulletin, 2019
EXR	Exchange Rate	Proxied by the rate of Naira to the United States of America's Dollar	Natural log of Exchange Rate	Central Bank of Nigeria Statistical Bulletin, 2019

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POPGR	Population growth rate	Population growth rate as proxy for human capital embodied in Labour Force	Growth rate of Population in percentage	World Development Indicators, 2019
INF	Inflation Rate	Inflation Rate as proxied by Consumer Price Index	Year-on-year Inflation Rate measured in percentage	Central Bank of Nigeria Statistical Bulletin, 2019

RESULTS AND DISCUSSION

Result of the Unit Root Test

The result of unit root test conducted on the variables is presented in Table 2.

Table 2: Result of the Unit Root Test

Variable	ADF Test Statistic Level	MacKinnon Critical Value at Level at 5% level	ADF Test Statistic at First Difference	MacKinnon Critical Value at First Difference at 5% level	Decision
RGDPGR	-3.438731*	-2.945842	N/A	N/A	I(0)
SMID	-5.218905*	-2.945842	N/A	N/A	I(0)
GFC	-0.624952	-2.945842	-6.800072*	-2.948404	I(1)
LNEXR	-2.119490	-2.945842	-5.200041*	-2.948404	I(1)
POPGR	-4.840464*	-2.945842	N/A	N/A	I(0)
INF	-2.831565	-2.945842	-5.252626*	-2.948404	I(1)

**Significant at 5% level.*
Source: Authors' Computation, 2021

The result in Table 2 shows that variables RGDPGR, SMID and POPGR are stationary at level since ADF statistics (absolute values) are greater than the critical values at 5 percent level, while GFC, LNEXR and INF are stationary at first difference because the absolute values of the ADF statistics are greater than the critical values at 5 percent level at first difference. Thus, we conclude that the variables RGDPGR, SMID and POPGR are I(0) while others (GFC, LNEXR and INF) are I(1).

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Examination of the Long Run Relationship between Solid Mineral Development and Economic Growth in Nigeria

The study employed the ARDL (Bounds Test) Approach to assess the long run relationship between solid mineral development and economic growth in Nigeria.

Table 3: Result of the Bounds Test

Panel A		
Test Statistic	Value	K
F-statistic	9.753520	5
Panel B	Pesaran *et al.* (2001) critical values	
Critical Value Bounds	I (0)	I (1)
(at 5% Significance Level)	2.39	3.38

Source: Authors' Computation, 2021

From Table 3, it can be inferred that there is cointegration (long run relationship) between the variables as the value of the F-statistic is greater than the upper bound of the Pesaran critical value at 5 percent level. Therefore, we reject the null hypothesis and conclude that there is long run relationship between the independent variables and the dependent variable.

Determination of the Influence of Solid Mineral Development on Economic Growth in Nigeria

The short run and long run ARDL results of the model are presented in Table 4: With an adjusted R^2 of about 0.463, it indicates that the independent variables explain about 46.3 per cent of the variation in the dependent variable while an F-statistic of about 4.10 (Prob. F-stat: 0.001) implies that the overall model is significant at 5 percent level.

As can be observed from the diagnostic tests, the model passed all diagnostic tests against serial correlation (Breusch-Godfrey test) and heteroscedasticity (Breusch-Pagan-Godfrey test). Figure 1 shows the plot of cumulative sum of squares of recursive residuals, which indicates the absence of any instability in the coefficients and a confirmation of normality of errors. This is because the plot of the CUSUM statistic fell within the critical bounds of the 5 percent significance level of parameter stability.

Table 4: Result of ARDL Estimation

Variable	**Coefficient**	**t-Statistic**	**Prob.**
D(RGDPGR(-1))	-0.073504	-0.497511	0.6234
D(SMID(-1))	0.509877	1.806179	0.0834
D(GFC(-1))	-0.002359	-1.179805	0.2496
D(LNEXR(-1))	0.144266	2.667352	0.0135*
D(POPGR(-1))	108.4335	2.311536	0.0297*

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D(INF(-1))	0.001154	2.630689	0.0146*
RGDPGR(-1)	0.191314	1.184836	0.2468
SMID(-1)	0.057452	0.234859	0.8162
GFC(-1)	-0.002970	-1.409878	0.1704
LNEXR(-1)	0.079251	1.850397	0.0757
POPGR (-1)	73.83486	2.467202	0.0205*
INF(-1)	0.000829	1.847477	0.0761
C	0.000857	0.117333	0.9076
R-squared	0.612264	F-statistic	4.105594
Adjusted R-squared	0.463135	Prob (F-stat)	0.001805
Durbin-Watson Stat:	1.998505		
Diagnostic Tests			
Breusch-Godfrey Serial Correlation LM:	3.977985	Prob (F-statistic)	0.0571
Breusch-Pagan-Godfrey Heteroscedasticity	Obs*R-squared : 21.47	Prob (F-statistic)	0.1930

** indicates 5% level of significance*

Source: Authors' Computation, 2021.

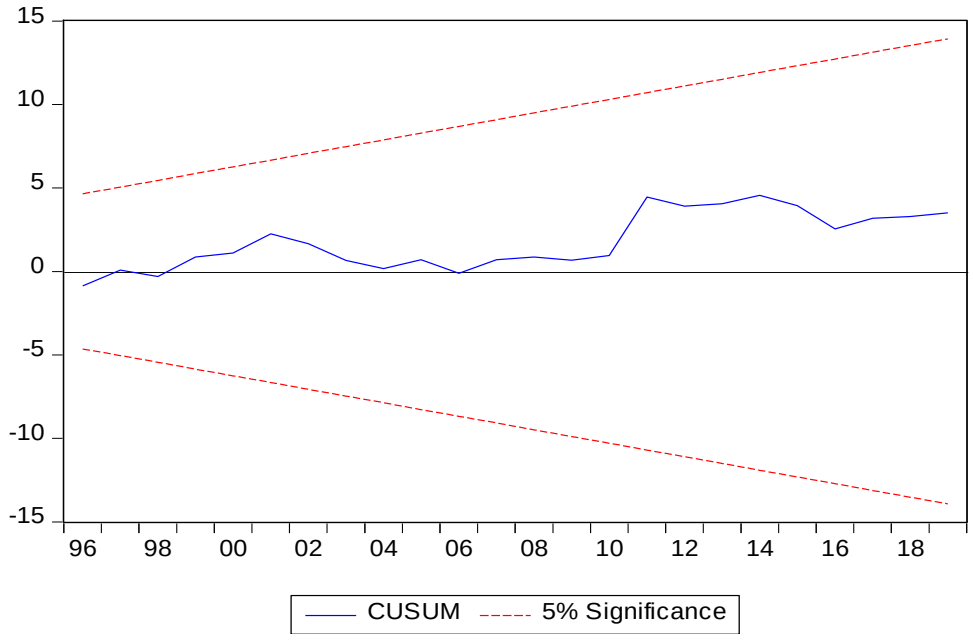

Figure 1: Plot of Cumulative Sum of Recursive Residuals of the model

Source: Authors' Computation, 2021

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Furthermore, Table 4 reveals that solid mineral development exerts a positive but insignificant influence on economic growth at 5 percent level in the short run. It is worth noting that the positive influence exerted by solid mineral development on economic growth is even weaker in the long run. The implication of these findings is that the output generated from solid mineral development is either not large enough to significantly drive economic growth in Nigeria or it is done illegally without entering government records. These findings contrast those of Udoka and Duke (2017), and Nwogwugwu *et al.* (2021) who suggested that solid mineral development exerts a significant positive effect on economic growth in Nigeria. However, the findings of this study corroborates CBN (2020) which reports that the contribution of solid mineral to GDP has been falling for most part of the period covered by the study. For instance, it dropped from 0.44 per cent of GDP in 1981 to 0.15 percent in 1990 to 0.089 per cent in 2000, and rose marginally from 0.093 per cent 2010 to 0.15 per cent in 2020. Hence, there is need for government to ensure the implementation of the solid mineral development plan while regulation of the subsector may require strengthening in order to minimize leakages.

The result in Table 4 also reveals that capital formation exerts a negative but insignificant influence on economic growth at 5 percent level in the short run as well as in the long run. The implication is that capital formation has not been effectively deployed in the country. This finding contrasts that of Ugwuegbe and Uruakpa (2013) who found that capital formation exerts a significant positive influence on economic growth in Nigeria. Hence, Government may need to review its capital formation strategies.

The result also indicates that exchange rate exerts a positive and significant effect on economic growth in the short run at 5 percent level, which pales into insignificance in the long run. This implies that the exchange rate management in Nigeria is not beneficial in the long run. This finding is in tandem with that of Akpan and Atan (2011) who reported that exchange rate does not have a direct influence on economic growth in the country. The result also reveals that labour force exerts a significant positive effect on economic growth at 5 percent level both in the short run and long run. This implies that labour force has been an asset to the country during the period. This finding is in line with that of Yakubu, Akanegbu and Jelilov (2020) who found that labour force exerts a significant positive effect on economic growth in Nigeria.

Table 4 also indicates that inflation exerts a significant positive effect on economic growth in the short run but the effect becomes insignificant in the long run. This implies that inflation management only drives short run increase in GDP but it is ineffective in the long run. This finding is consonance with that of Ogu, Adagiri, and Abdulsalam (2020) who stated that inflation does not drive economic growth in the long run. These findings suggest that the Central Bank of Nigeria may need to review its inflation and exchange rates management policies with a view to enabling them to significantly drive economic growth in the long run in the country.

The coefficient of the ECT(-1) is -1.074 and is statistically significant at 5 percent level (Table 5). It indicates that any departure from long run equilibrium is fully corrected within one year. This implies that the speed of adjustment is very high. The significance of the Error Correction Term (ECT) provides further evidence on the long-run cointegration dynamics that exists between Real GDP Growth Rate and its regressors in the model.

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With an adjusted R^2 of about 0.810, it indicates that the independent variables explain about 81 per cent of the variation in the dependent variable while an F-statistic of about 4.10 (Prob. F-stat: 0.0004) implies that the overall model is significant at 5 percent level.

The result of the Diagnostic Tests shows that the model passed all diagnostic tests against serial correlation (Breusch-Godfrey test) and heteroscedasticity (Breusch-Pagan-Godfrey test). The plot of cumulative sum of squares of recursive residuals in Figure 2 indicates the absence of any instability in the coefficients. It is also a confirmation of normality of errors as the plot of the CUSUM statistic lies within the critical bounds of the 5 percent significance level of parameter stability.

Table 5: Result of the Restricted Error Correction Model

Dependent Variable: D(RGDPGR) Method: ARDL Proxy for Solid Minerals Development: SMID			
Variable	Coefficient	t-Statistic	Prob.
ECT (-1)	-1.073504	-9.238144	0.0000*
D(LNEXR(-1))	0.144267	2.667352	0.0135*
D(POPGR(-1))	108.4336	2.311536	0.0297*
D(INF(-1))	0.001155	2.630689	0.0146*
R-squared	0.837849	F-statistic	9.753520
Adjusted R-squared	0.810824	Prob (F-statistic)	0.000445
Durbin-Watson Stat:	2.015455		
Breusch-Godfrey Serial Correlation LM: F-Stat	0.9322	Prob (F-statistic)	1.0030
Breusch-Pagan-Godfrey Heteroscedasticity	Obs*R-squared : 16.83	Prob (F-statistic)	0.1570

Source: Authors' Computation (2021)

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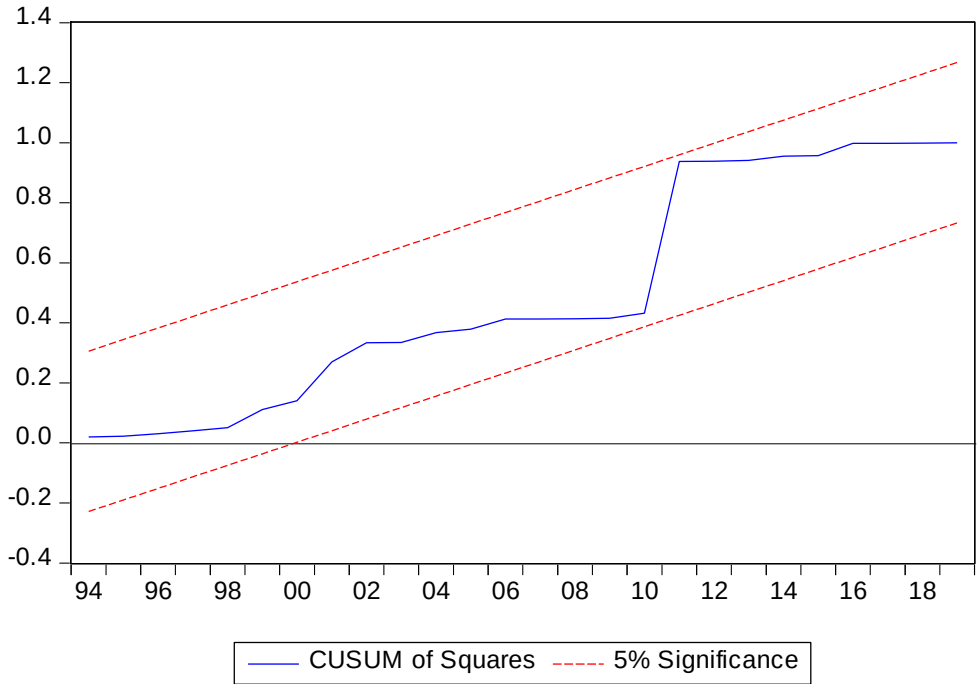

Figure 2: Plot of Cumulative Sum of Recursive Residuals of the Restricted Error Correction Model

Source: Authors' Computation, 2021

Direction of Causality between Solid Mineral Development and Economic Growth in Nigeria

Table 6 presents the result of long run Granger causality test (GCT) between the dependent and independent variables.

Table 6: Result of Granger Causality Test

Pairwise Granger Causality Tests			
Date: 07/15/21 Time: 15:57			
Sample: 1981 2019			
Lags: 1			
Null Hypothesis:	Obs	F-Statistic	Prob.
SMID does not Granger Cause RGDPGR	37	2.26436	0.1416
RGDPGR does not Granger Cause SMID		0.45532	0.5044
GFC does not Granger Cause RGDPGR	37	1.30862	0.2606
RGDPGR does not Granger Cause GFC		0.56134	0.4589
LNEXR does not Granger Cause RGDPGR	37	1.12229	0.2969
RGDPGR does not Granger Cause LNEXR		0.24265	0.6255

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POPGR does not Granger Cause RGDPGR	37	0.15340	0.6978
RGDPGR does not Granger Cause POPGR		6.23698	0.0175*
INF does not Granger Cause RGDPGR	37	0.71291	0.4044
RGDPGR does not Granger Cause INF		1.04408	0.3141
GFC does not Granger Cause SMID	38	2.05255	0.1608
SMID does not Granger Cause GFC		0.49331	0.4871
LNEXR does not Granger Cause SMID	38	0.01527	0.9024
SMID does not Granger Cause LNEXR		0.74256	0.3947
POPGR does not Granger Cause SMID	37	2.37504	0.1325
SMID does not Granger Cause POPGR		2.08619	0.1578
INF does not Granger Cause SMID	38	2.39562	0.1307
SMID does not Granger Cause INF		0.22039	0.6417
LNEXR does not Granger Cause GFC	38	2.03154	0.1629
GFC does not Granger Cause LNEXR		0.00595	0.9389
POPGR does not Granger Cause GFC	37	4.04697	0.0522
GFC does not Granger Cause POPGR		2.07293	0.1591
INF does not Granger Cause GFC	38	0.22555	0.6378
GFC does not Granger Cause INF		0.43311	0.5148
POPGR does not Granger Cause LNEXR	37	0.02726	0.8698
LNEXR does not Granger Cause POPGR		0.74382	0.3945
INF does not Granger Cause LNEXR	38	0.88995	0.3520
LNEXR does not Granger Cause INF		0.34894	0.5585
INF does not Granger Cause POPGR	37	3.45803	0.0716
POPGR does not Granger Cause INF		0.00361	0.9524

** Significant at 5% Level*

Source: Authors' Computation, 2021

The focus was on the causal relationship between Solid Mineral Development and Economic Growth in Nigeria. The null hypotheses state that solid mineral development (SMID) does not Granger-cause economic growth (RGDPGR), and economic growth (RGDPGR) does not Granger-cause solid mineral development (SMID). The result in Table 6 indicates that these two null hypotheses should be accepted as directional causality neither runs from solid mineral development to economic growth nor from economic growth to solid mineral development at 5 percent level of significance. These imply that solid mineral development neither directly drives nor is it directly driven by economic growth in Nigeria. However, causality runs from

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economic growth (RGDPGR) to labour force (POPGR). This implies that economic growth drives labour force in Nigeria.

CONCLUSION AND RECOMMENDATIONS

The study empirically examined the influence of solid mineral development on economic growth in Nigeria, using annual time series data from 1981 to 2019. The result revealed that Solid Mineral Development exerts a weak positive effect on Economic growth in the study area. This result was buttressed by granger causality test which indicates that neither solid mineral development nor economic growth granger-causes each other. This is an indication that the solid mineral subsector is yet to be given a pride of place in the country as evidenced by its weak influence on economic growth. It also suggests the existence of a high level of illegal activities and leakages in the subsector.

Based on findings from the study, the following recommendations are hereby put forward:

i. Government should ensure a religious implementation of the solid mineral development plan in order to accelerate a sustainable solid mineral production and thereby speed up economic growth in the country.

ii. The Ministry of Solid Mineral Development should strengthen its regulation of the solid mineral subsector in order to exterminate illegal activities and minimise leakages.

iii. Government should review capital formation with a view to ensuring a productive deployment of capital in the country.

iv. The Central Bank of Nigeria should review its management of inflation and exchange rates with a view to enabling them drive economic growth in the long run.

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