

SOLID MINERAL EXPORTS, TRADE OPENNESS AND ECONOMIC GROWTH IN NIGERIA (1981– 2022)

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ABSTRACT

Purpose: Nigeria is blessed with enormous solid minerals deposit distributed extensively across the various parts of the country such as Columbite, Tin, Copper, Gold, Iron ore and Coal It is on this basis that the study aimed to examine the effect of solid minerals' exports on economic growth in Nigeria.

Method: The study used multiple regression models, employing time series data from the period 1981-2022. The center variables are Real gross domestic product as the dependent variable while solid minerals exports (SME), exchange rate (EXCR), interest rate (INTR) and the degree of trade openness(DTOP) are the independent variables. Autoregressive distributed lag (ARDL) technique was used to estimate the relationship between the dependent and independent variables. The hypotheses were verified with the use of T-test and Fisher F-test of significance. Pre-estimation tests such as Unit Root test, Auto-correlation test (Durbin Watson test), Cointegration test, Causality test, Correlation test were carried out to ascertain suitability of formulated models for robustness. Similarly, post-estimation tests such as Cumulative Sum of Squares of the residual (CUSUM Squares) Tests were carried out to ascertain the stability of the models for forecasting purposes.

Results: The result also confirmed a long run relationship between solid minerals exports and economic growth in Nigeria. It also revealed that exchange rate has positive and significant relationship with economic growth whereas interest rate has negative and significant relationship with economic growth. Trade openness also affects economic growth.

Recommendation: The study recommended among others that The study recommended that the government should restructure the Nigeria Mining Corporation with legal powers to operate in the same way which the Nigerian National Petroleum Corporation operates so as to boost its performance in the international market. The Federal government through the CBN should provide special support for indigenous companies in terms of creating an enabling environment and providing licenses for indigenous companies who intend to engage in the development and exploitation of solid minerals in Nigeria so as to bridge the gap in the production and supply chain of the solid minerals industry.

Keywords: Solid Minerals Export, Trade Openness Exchange rate, Interest rate, inflation rate, Economic Growth

INTRODUCTION

Nigeria is blessed with enormous solid minerals deposit distributed extensively across the various parts of the country. Prior to the oil boom of the 1970s and 1980s, solid minerals such as Columbite, Tin, Copper, Gold, Coal etc contributed immensely to Nigeria's economy (Ajie, Okoh & Ojiya, 2019). Coal for instance was a key source of power for the rail transportation system as well as the chief source of power generation in the country. In those periods, solid mineral earnings were utilized in developing key infrastructures and industries in the country including the petroleum industry (Olumide, Akongwale & Udefuna, (2013), Maduaka, (2014). Available data (Iwayemi, Adenikinju, Adeyemo, Adeniyi & Omenka, 2014) also supported the fact that Nigeria has large deposit of solid minerals which are distributed across the country from relevant bodies.

Before the discovery of crude oil in 1956, solid mineral was second to agriculture in terms of contribution to generation of foreign exchange. The contribution of the sector to GDP was also equally significant for instance, the contributions of solid minerals export to GDP in 1970 was 10%. However, the oil boom as a result of the Arab-Isreali war in 1973 led to the neglect of several sectors especially the exploration of solid mineral leading to a reduction in the contribution of solid minerals to export earnings from 5.6 percent in 1980 to 0.33 percent in 2020 (Edeme, Onoja & Damulak. 2018).

The demand for solid minerals has consistently been rising in the last twenty years because of government initiatives. The development of solid mineral sector has been linked to the growth of some economies like Latin America and Asia and also to the increase in the world's population (David, et al., 2016). Presently, the potentials of solid mineral in Nigeria has not been fully harnessed due to over-reliance on income from crude oil which changes from time to time as a result instability in the price of oil in world market otherwise known as oil price shock. Given the rise in international commodities prices and the benefits the economy can derive from the development of solid mineral sector, there is therefore the urgent need for the government to formulate policies that will promote exploitation and processing of solid mineral whose price has been found to be more stable in the world market than crude oil.

The dismal performance of the non-oil sector in the past two decades has left little or nothing to be desired. According to a Price Waterhouse and Cooper (PWC) report of 2022, the oil sector fell between 2019 and 2021 by 33.4% while the non-oil sector had a slight increase of 8% owing to non-mineral exports. This has been the long-standing trend which made Ogbonna, Uwajumogu, Chijioke & Agu (2013) note that diversification of the economy away from its heavy reliance on oil revenues and improving the economy's future growth is an important goal and policy. Thus, the expansion of solid mineral exports should be pursued, hence the drive for increased exploitation of the nation's solid mineral sector in recent time.

Since the beginning of the Nigeria's democratic regime in 1999, successive Governments have made efforts to revamp the nations mining industry through policy initiatives such as privatization of mining rights and the revamping of facilities such as the Ajaokuta steel production company. It is believed that the processing of mineral into semi-finished goods as well as the export of the minerals in their raw form would stabilize capital formation in the country and reduce the negative balance of trade. In 2021, non-oil revenue had a 15.7% increase

while previous statistics also showed a steady rise in non-oil revenue (PWC, 2022). Hence, the question is how much of this increase is due to solid mineral exports. Thus, this study evaluated how well these government efforts on solid mineral development and trade relations have contributed to boosting economic growth and reducing the nations over dependence on its oil wealth.

Statement of the Problem

Before Nigeria's oil boom, tin constituted the major mineral resource and important foreign exchange earner for the country. Cassiterite production in Nigeria remained at about 10,000 tonnes annually for several years from a reserve estimated at 300,000 tonnes. A production peak was attained during second world war when lots of tin, with accompanying tantalum and niobium were used by the colonial masters towards their war effort. Production declined in the 1970s to about 3,800 tonnes in 1979, less than 3,200 tonnes in 1981 and to an "all time" low of 1,700 tonnes in 1983. From 1988, the production level became even more "sorry". Only 208 and 203 tonnes of this important commodity was produced in 1994 and 1995 respectively. Production continued to decline until the emergence of President Obasanjo as President of Nigeria in 1999 when economy diversification plans for revitalizing the solid minerals industry was launched. The estimated total world reserve of tin metal as at 2017 is over 4.80 million tonnes and global production amounted to 290,000 tonnes with China being the largest producer (100,000 tonnes) and Nigeria contributing about 2,400 tonnes. Though there has been some improvement in tin export in recent time, however, current production and export rates is still below the export rates recorded in the early 1970s.

Officially recorded gold production in Nigeria started by 1913 and peaked in the period between 1933-1943 when about 1.4 tonnes of gold were produced. Gold production declined during the Second World War period and never recovered as mines were abandoned by mostly colonial companies. The Nigerian Mining Corporation started exploration for gold in Nigeria in the early 1980s but failed to be sustained due to lack of funds. The discovery of petroleum and its subsequent domination of the Nigerian economy also contributed to the lack of attention to gold exploration despite the widespread potentials. Nigeria's gold mining sector has gained attention in recent years due to the country's substantial gold deposits and the government's efforts to diversify the economy. The Nigerian government has implemented policies and regulations to promote the export of gold through legitimate channels. These measures aim to discourage smuggling and promote transparency in the gold trade. The major licensed gold exporter, Thor Explorations exported 29,000 tonnes of gold in 2023, which was highest so far. While this signify monumental improvement in the gold mining industry, the exploitation of gold is still far from what Nigeria used to produce in the 1930s (42,000 tonnes) leaving room for much improvement.

Nigeria supplies used to be over 80% of world requirements of Columbite during the 1970s but exports of this mineral virtually was at a low ebb in the early 1980s. This was due to market strategy of Brazil and Canada who were able to convert their niobium into ferro-columbium and sale at more favourable prices in the world market. While government has planned to revitalize the columbite export industry in Nigeria, current low demand for Nigeria's columbite still hampers the export of the mineral for which Nigeria was once the largest producer and exporter.

Nigeria's iron ore remains unexploited due to defunct key national infrastructure enablers such as Nigerian Iron Ore Mining Company (NIOMCO) and Ajaokuta Steel. Steel, a key output of iron ore, is still processed using scrap iron/steel and imported semi-steel products by mini steel mills. In 2020 the volume of iron production was a mere 100 metric tonnes compared to value of 18,300 metric tonnes and 20,000 metric tonnes recorded in 2015 and 2019 respectively. This has been the case in previous years as Nigeria has not been able to attain a favourable and stable iron ore production since after the instruction of the Nigeria mining industry road map and these shortages in production explains why Nigeria still imports coal and iron till date.

According to the 2015 mining roadmap, the following minerals have been designated strategic in Nigeria: Gold, Lead, Tin, Zinc, Coal, Bitumen, Columbite, Iron ore, Limestone and Barite. Government attempts to diversify and stabilize the economy through solid mineral development via the creation of the solid mineral development roadmap has been fraught with challenges of political will, finance and technical difficulties. The government has implemented initiatives resulting in some positive developments. However, challenges persist in their exploitation. Empirical and theoretical evidence on the relationship between mineral exports and economic growth in Nigeria exists, but such evidence on the relationship between solid minerals exports and economic growth in Nigeria are lacking, hence the choice of this study. This research thus tries to determine if recorded improvements in solid mineral export did contribute significantly to economic growth in the light of the present realities of the Nigerian economy.

Objectives of the Study

The broad objective of this study is to examine the contribution of solid minerals and trade openness to economic growth in Nigeria. The specific objectives are to:

- (i) examine the effect of solid minerals export on economic growth in Nigeria
- (ii) determine the effect of trade openness on solid minerals exports and economic growth in Nigeria

Research Questions

The following research questions guided the study:

- (i) What is the effect of solid minerals export on economic growth in Nigeria?
- (ii) What is the effect of degree of trade openness on solid minerals exports and economic growth in Nigeria?

Research Hypotheses

The following null hypotheses guided the study:

- H₀₁: Solid minerals exports has no significant effect on economic growth in Nigeria
- H₀₂: Degree of trade openness on solid minerals exports has no significant effect and economic growth in Nigeria.

Literature Review

Conceptual Review

Nigeria's Solid Minerals Sector

According to Ajie (2010), The Nigerian economy is ranked as the largest in Africa and the 30th in the world with a gross domestic product (GDP) of approximately \$441 billion (US dollars) in 2021. The five dominant sectors in the economy are Agriculture, Oil and gas (petroleum), Mining (solid minerals), Manufacturing and Services. It is a highly populated emerging market with a rapidly growing manufacturing and service sector. Unfortunately, the economy is still very much monolithic and dependent on the oil and gas sector which contributes about 40% of the nominal GDP, over 90% of export earnings and 75% of gross revenues. Petroleum export is also the country's major earner of foreign exchange. As revenue from crude oil declined sharply in recent years, Nigeria has struggled to find other revenue sources by trying to diversify its economy through Agriculture which currently contributes about 24% of the GDP while contribution from manufacturing has fluctuated and recently stabilized at about 21%. In 2015, Nigeria's solid minerals export and mining sector accounted for a paltry 0.3% of the GDP which increased slightly to about 0.5% in 2018. The sector has contributed only 0.02% to Nigeria's total exports. The sector's performance can be compared to contributions in other African countries in relation to their GDPs as follows: Botswana (38%), Democratic Republic of Congo (25%), South Africa (18%), Zambia (18%), Guinea (12%) and Ghana (7%). There has been some progress in Nigeria's solid mineral sector in the past few years due to the implementation of new policies but the change is still minimal.

Between 2010 and 2015, Central Bank of Nigeria (CBN) reports indicates that the contribution of the sector to the GDP doubled from \$143 million to \$290 million and to about \$2 billion in 2018. The increase in revenues can be attributed not only to higher mineral production as such but mostly to more efficient revenue collection mechanisms and the increased foreign investment through the purchase of mineral titles. The relatively low production output of Nigeria's solid minerals constitutes a major challenge to the national economy particularly because this key sector offers such a great potential in the diversification of the Nigerian economy. The current situation was not always the case as prior to the 1960s, mining was the primary mainstay of the economy, contributing up to 50% of the GDP. But this high level of contribution declined precipitously starting in the 1960s after the discovery of oil and gas which diverted the interest of both government and investors from mining of solid minerals. Moreover, the civil war of the late 1960s and the attendant political instability and territorial insecurity led to the mass exodus of foreign mining companies and their experts as well as the migration of some indigenous miners which led to the eventual abandonment of mining operations. By the 1970s, the contribution of solid minerals to the economy had fallen to less than 5%, with further decline in 1990s to less than 1%, and eventually to 0.5% by 2007. Currently, it is believed that the country's minerals and mining sector is underachieving and efforts are ongoing to revamp and energize the sector in the quest to diversify Nigeria's economy. The expected change will be transitional rather than transformational.

Economic Growth

Economic growth has had as many definitions as there are people who have written about it. Economic expansion, on the other hand, is accompanied by a rise in a country's production over a period of time, usually a year. To put it another way, job expansion is the rise in the number of goods and services supplied over a period of time by an economy. Thus, economic growth is the rise in the total amount of goods and services produced in a given economy. Gross Domestic Product (GDP) is an economic metric defined by Olasupo (2021) as the amount of goods and services generated in an economy over a specific time period. Anyanwu (1990) stated that GDP is a representation of the production process, not sales, and that it is a representation of the economy's output. As a result, GDP is the market value of all final goods and services produced within a country during a certain time period and it shows the growth of the economy (economic growth). When a GDP is calculated using current market prices, it is referred to as nominal GDP. However, when a specific base year is utilized, it is referred to as real GDP.

Current and possible production levels differ according to Economists. Potential financial growth entails the most efficient use of resources and it is controlled by the production factors under a nation's economic command. Overall growth, on the other hand, illustrates resource consumption in practice and demonstrates the outcome. This is governed by how well a country's available production variables are developed and blended (Simuț & Meșter,2014).

Direct variables such as people resources (growing the active population and investing in human capital), natural resources (land and subterranean resources), the increase in capital employed, or technical breakthroughs all impact business growth. Indirect factors such as institutions (banking institutions, private administration quality, etc), the size of consumer spending, finance and financial rates, the efficiency of the financial system, government budget and fiscal policies, labor and capital movement of people and government transparency all affect financial growth.

It is traditionally calculated as the percentage rise in a country's Gross Domestic Product (GDP) during a one-year period. Economic expansion can be calculated in absolute dollars (which includes inflation) or in absolute dollars (which excludes inflation distortions). Economic growth is estimated in this study using Real GDP Per Capita (Simuț & Meșter,2014).

Theoretical Review

Resource Curse Theory

The natural resource curse is a phenomenon where natural resource endowed countries experience worse economic and political outcomes than countries with no natural resource endowment (Siegle 2005). The resource curse is a complicated phenomenon that results from a variety of reasons including the Dutch disease, rent seeking, crowding out of human capital and crowding out of social capital (Auty, 2001). Resource-curse theory suggests that as dependence on natural resource exports increases, economic growth (commonly measured in terms of GDP) declines (Sachs and Warner 1995). The theory argues that rather than fueling growth and development, natural-resource wealth can become the cause of economic stagnation. This is mainly because countries invest heavily in the resource sector while ignoring other vital sectors that are crucial to improving a given economy.

Export-Led Growth Hypothesis

For the reasons stated above, the export-led growth hypothesis is a theory that supports sustainable growth in emerging countries spurred by non-renewable natural resource output: The first argument according to Lucas (1988) and Grossman & Helpman (1991) is that natural resources are finite (a short-term reality) but the export-led development theory is a long-term event. Secondly, past empirical research have shown that non-oil export revenues have an unfavorable relationship with long-term economic growth (Duru & Ehidihamen, 2018). Increased profits from non-oil natural resource exports according to the Dutch disease idea, promotes currency appreciation which reduces the competitiveness of the non-resource tradable sector of the economy while increasing demand for imports” (Iyoboyi, 2019). Exports, according to international trade theory, contribute to economic growth (performance) through a variety of avenues. International trade according to Adam Smith (1776) can boost domestic production by increasing domestic market size and allowing for economies of scale. David Ricardo also documented the importance of foreign commerce in generating economic progress. He went on to say that countries should concentrate on products in which they have a comparative advantage over other countries through trade. This, in turn, may lead to more effective resource exploitation by increasing capital formation which is required to improve total factor productivity (TFP).

Empirical Review

Adekanle (2022) examined the impact of selected solid mineral exports on economic growth in Nigeria from 2000-2021. The selected solid minerals were lead, Tin, Iron ore, and Zinc. Economic growth being the dependent variable was proxied by Real Gross Domestic Product while Lead exports, Tin Exports, Iron ore exports and Zinc export were distinctly used in four econometric models to capture solid mineral resources for the period under review. From the findings, Lead, Tin and iron ore exports has not risen to levels that would positively stimulate economic growth thus indicating that the development in the sub areas of the solid mineral industry is weak. However, Zinc exports were observed to stimulate positive economic growth within the period under review. On the other hand, economic growth did not granger cause any of the solid minerals selected and vice versa. This indicates instability in production rates within the period under review revealing lack of cohesive government efforts in these periods. In summary, the solid mineral industry in Nigeria is still operating below expected levels in comparison to resource deposits. Hence, the government is lacking the will to make structural changes that will truly diversify the economy and ensure stability and growth in the long run.

Abayomi & Olufemi (2022) examined the influence of solid mineral development on economic growth in Nigeria, using the Auto Regressive Distributed Lag (ARDL) approach with a time series data spanning between 1981 to 2019. The study tested for stationarity among the time series while all results were tested at 5 per cent level and revealed that Solid Mineral Development exerted an insignificant positive influence on economic growth in the study area.

Agunuwa & Johnson-Itabita (2022) assessed the effect of government expenditure on solid mineral resources and the level of economic growth in Nigeria and covered the period between 1990 and 2020. The co-integration and its implied error correction model (ECM) were used to analyze the data. The result of the Parsimonious ECM indicated that government expenditure on gold (GG) and government expenditure on coal (GC) have significant and positive impact on the

real gross domestic product (RGDP). Government expenditure on limestone (GL) has an insignificant and positive impact on the RGDP. The result of the ECM indicates a satisfactory speed of adjustment and indicated no bidirectional causality between GG, GC, and RGDP however, a unilateral causality running from GG and GC to RGDP exists. No causality exists between GL and RGDP. The study revealed that government expenditure in limestone extraction has not been satisfactory due to insufficient fund allocation or to poor fund management. The paper concluded that government expenditure on coal has potentials to improve the level of economic progress.

Nwinyodee and Kerebana (2022) focused on the impact of trade openness on the growth of solid mineral sub-sector in Nigeria from 1981 to 2020. The study employed Auto Regressive Distributed Lag (ARDL) as the modeling technique. Solid mineral subsector (SLM) was used as the dependent variable while Trade openness (TPN), Foreign direct investment (FDI), Foreign portfolio investment (PFI), Remittances (RMT) constituted the independent variables. Exchange rate (EXR) was used as check variable. The study found that TPN, FPI, RMT and EXR negatively influenced the solid mineral sub-sector. FDI maintained a positive relationship with SLM.

Azubuike, Nakanwagi and Pinto (2022) explored the development of a Mining Resource Corridor (MRC) to reduce poverty and assist the country's sustained growth and development. The paper posited that to achieve this requires the drawing up of an articulated delivery mechanism through a strategic framework implementation plan to attain a strategic diversification away from hydrocarbons to mineral resources. This paper took an applied research approach to examine the critical considerations and actions that Nigeria should take in developing an MRC to ensure a diverse and sustainable economic future. Additionally, it discussed the lessons Nigeria can learn from two corridors in Mozambique. The paper concluded that the success of a Mining Resource Corridor is a function of, among other things, a skilled and adequately strengthened institution, enabling infrastructure and the participation of communities in the decision-making process of the corridor development. It noted that the support at all levels of government and possible assistance from development partners and donor agencies such as the World Bank is needed to provide the much needed financial and technical component for developing a viable Mining Resource Corridor.

Research Gap

The key concepts reviewed were solid minerals and economic growth. The review showed that Nigeria is a mineral-rich country with various exportable minerals deposited in commercial quantities across the country. Thus, the country has the potential to diversify its exports profile to improve capital formation and significantly resolve its balance of payment issues. Theoretically, three theories were reviewed: the resource curse theory, Dutch Disease theory and the Export-led Growth theory. This study is based on these theories as they are captured in the model developed for this study. Resource curse theory suggests that poor institutional quality is to be blamed for poor economic impact from natural resources and overdependence on them that results in Dutch disease. For Export-led theory, the interactive effect between solid minerals export, exchange rate and interest rate captures it succinctly.

Regional studies took both a holistic and individualistic approach to examining the contribution of the mining sectors of different countries in sub-Saharan Africa to their economic growth.



Generally, quite a lot of the studies confirmed the resource curse theory while others did not. In many ways, foreign studies followed the patterns of previous studies reviewed. However, a few of them looked at the relationship between minerals export and economic growth in consideration of the economies of their trading partners as well as competitive countries. These studies clearly observed that the economies of trading partners and competitive countries do have some impact on the relationship between solid minerals exports and economic growth thus shedding light on the economic shocks often experienced by mineral-rich and mineral-based economies.

Of all the literature reviewed and the theories, that of resources curse theory and Export- led growth theory appealed to the researcher most and formed the basis for the study. Meanwhile, the literature review of Adekanle (2022) stands out and formed the point of departure for this study.

Methodology

The study adopted a quasi-experimental design using ARDL regression modelling Pre-diagnostic tests such as descriptive statistics, unit root test for stationarity of variables, and cointegration test for the determination of long run relationship among the variables of the study were employed to determine the suitability of the model formulated for ARDL Modelling. ARDL modelling was used to estimate the long run and short run relationship of the variables in the model. Pairwise Granger Causality Test was conducted to test for the direction of causation between pair of all included variables. Post diagnostic tools such as Breusch-Godfrey test for Autocorrelation, Breusch-Pagan-Godfrey test for Heteroskedacity and CUSUM tests for structural breaks were employed.

The data is made up of annual time series on Real Gross Domestic Product (RGDP), a proxy for Economic Growth which served as the dependent variable while the explanatory variables in the model are Exchange Rate (EXR), Inflation Rate (INFR), Nominal Interest Rate (INTR), Trade Openness (TOP) and Solid Minerals Exports (SME). The data ranges from 1981 to 2022, a period of forty-one (41) years.

The data for the study are essentially time series secondary data to be sourced from the World Bank Development Indicators (WDI) data base and the Central bank of Nigeria Database.

The study adopted the model used by Adekanle (2022) and some modifications were made to improve on the model in order to capture other types of solid minerals in Nigeria. The functional forms of the model are stated thus:

$$RGDP = F (SME, EXCR, DTOP, INTR,) \dots\dots\dots (1)$$

Where RGDP is the proxy for economic growth and SME is solid mineral export, EXCR is exchange rate and INTR is the interest rate.

In order to capture the stochastic term U_t , the explicit form of the models is given in econometric form below:

$$RGDP = b_0 + b_1SME + b_2EXCR + b_3DTOP + b_4INTR + U_t \dots\dots\dots (2)$$

The estimated model is further transformed into log linear form. This is aimed at reducing the problem of multi-collinearity among the variables in the model. Thus, the log-linear model is specified as shown below.

$$\ln RGDP = b_0 + b_1 \ln SME + b_2 \ln EXCR + b_3 \ln DTOP + b_4 \ln INTR + U_t \quad .. (3)$$

Where:

RGDP	=	Real Gross Domestic Product
SME	=	Solid Minerals Export
EXCR	=	Exchange Rate
DTOP	=	Degree of Trade Openness
INTR	=	Interest Rate
μt	=	Stochastic error term

Results

Descriptive Statistics

The summary statistics as shown in Table 1 depict the mean, minimum, maximum, the skewness, kurtosis and probability values of each of the variables during the period under review.

Table 1: Summary of Descriptive Statistics

DESCRIPTION	RGDP	SOLMIN	EXCR	DTOP	LINTR
Mean	2.27E+11	507.1714	115.6556	196.1848	17.32432
Maximum	5.74E+11	5.327.990	425.9792	728.3905	31.65000
Minimum	4.40E+10	3.715748	0.617708	-35.8422	8.916667
Skewness	0.519456	2.936411	1.025345	0.738684	0.357460
Kurtosis	1.758888	10.02010	3.230143	2.596649	3.601321
Probability	0.101040	0.000000	0.024089	0.128459	0.465982
Observations	42	42	42	42	42

Source: Extracted from E-views 9.0 output

Table 1 showed the descriptive statistics of the variables for the study. It presents the mean maximum and minimum values of the data set obtained from the annual reports. The real gross domestic product which is a measure of economic growth (the dependent variable) showed a mean value of 2.27 trillion naira. Meanwhile, solid minerals export during the period stood at an average of N=507 Billion, exchange rate at N115, degree of trade openness at 196 Billion while the lending interest rate to the investors remained at 17 %. Their maximum and minimum values for the various indices are as shown above.

It was further revealed that only the coefficient values for degree of trade openness and lending interest rate passed the Jarque-Bera (JB) test of normality. This implies that those variables that could not meet the specified threshold deviate from normality. Their low probability values of below 5 percent validate this. On the other hand, the skewness of the variables is dominated by positive

signals, indicating that the distribution was skewed to the right. This basically means that the data set evaluated were dominated by positive values.

On the other hand, the kurtosis revealed that most of the series in the model had a kurtosis bigger than three over the reviewed period. This suggests that the variables' distributions is peaked or leptokurtic.

Unit Root Test

Before carrying out the ARDL bounds test, we first test for the stationarity of all the variables in the model to determine the order of integration for each variable. This is a necessary step to ensure that variables are not second-order stationary (i.e., I(2)) and to avoid fallacious results. According to Ouattara (2006), the calculated F-statistics which Pesaran et al. (2001) provide are not valid in the presence of I(2) variables, since the bounds tests are based on the assumption that variables are either I(0) or I(1). For clarity and ease of understanding, the results from the ADF unit root tests are hereunder tabulated:

Table 2: ADF Unit Root Test Results Summary

Variable	Calculated ADF t-statistic	ADF critical value at 5%	Order of Integration	Remarks
RGDP	-4.897540	-2.936942	I(1)	Stationary
SME	-5.867488	-3.526609	I(1)	Stationary
EXCR	-4.211353	-2.936942	I(1)	Stationary
DTOP	-5.257476	-2.936942	I(1)	Stationary
LINTR	-4.252004	-3.526609	I(0)	Stationary

Source: Author's Computation using E-views

Augmented Dickey Fuller (ADF) test showed that economic growth, proxied by real gross domestic product (RGDP), solid minerals export (SME), exchange rate (EXC R), degree of trade openness (DTOP) and lending interest rate (LINTR) rate respectively were stationary. While the first four variables were integrated of one, only lending interest rate became stationary at the level form. Consequently, we can confidently proceed with the application of the ARDL bounds tests to our model. However, a suitable lag selection criterion has to be determined.

Lag Length Selection

Prior to the estimation of the ARDL bounds testing for cointegration, a suitable lag selection criterion was selected as presented below.

Table 3: Lag Length Selection Criterion

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1908.631	NA	2.86e+36	98.13491	98.34819	98.21144
1	-1693.41	364.2206	1.68e+32	88.37998	89.65964*	88.83911
2	-1660.047	47.90539*	1.17e+32*	87.95112*	90.29717	88.79286*
3	-1638.768	25.09825	1.69e+32	88.14194	91.55438	89.36630

Source: Extracts from E-views 9.0

This study is predicated on the Akaike Information Criterion (AIC) in choosing its optimal lag. Using the AIC criteria lag length two (2) was selected and used in the study.

The ARDL Bounds Testing for Cointegration

The cointegration test as developed by Pesaran et al. (2001) is to determine the existence (or not) of a long-run relationship between the variables. The bounds test cointegration results for the models are summarized in Table 4.

Table 4: Cointegration Test using ARDL Bounds Testing Approach

Test Statistic	Value	K
E-Statistic	8.699772	4
Critical Value Bounds		
<i>Significance</i>	<i>I(0) Lower Bounds</i>	<i>I(1) Upper Bounds</i>
5%	2.86**	4.01
10%	2.45	3.52

Source: Author's extract from E-views 9.0

Notes: The critical values are taken from Pesaran and Pesaran (1997: 478) with five regressors. ** denote rejecting the null at 5% level of significance..

Judging from the ARDL Bounds estimate above, it is reported that the calculated F-statistics of the joint null hypothesis that there is no long-run relationship between the variables as the value is 8.699772, a value that is greater than the lower and higher bound of the 95 percent critical value interval (2.86 –4.01). This implies the rejection of the null hypothesis that no long-run relationship exists between the variables; hence we conclude that there is evidence of a unique long-term relationship between the series economic growth, solid minerals exports, exchange rate, trade openness and lending interest rate from 1981 – 2022.

Model Estimation

Having proven the existence of a long-term relationship between the variables in the model, the second step of the methodology consists in searching for the short- and long-term coefficient estimates of the model. On the basis of the Akaike Information Criterion (AIC), the optimal ARDL model selected by E-views 9.0 is ARDL (1, 0, 1, 2, 0). The AIC was preferred because it is more parsimonious than the other criterion. The empirical results of the ARDL are as presented in the tables 5, and they reveal the long run and short run coefficients of the estimates.

Table 5: ARDL Estimates

Dependent Variable: RGDP				
Variable	Coefficient	Std Error	t-statistic	P-value
A: Long run Estimates				
SME	0.038012	0.079274	3.254706	0.0027
DTOP	-0.090786	0.054754	-1.658053	0.1098
LINTR	0.021295	0.072444	4.293951	0.0012
EXCR	-0.065134	0.002373	-3.177609	0.0071
B: Short run Estimates				
D(SME)	0.033164	0.017327	1.913979	0.0498

D(DTOP)	0.049306	0.028469	1.731937	0.0089
D(LINTR)	0.138484	0.024993	5.540866	0.0001
D(EXCR)	-0.000127	0.000928	-0.137201	0.8931
ECM (-1)	-0.083436	0.240258	-3.451030	0.0048

Source: Author's computation from E-views 9.0

Table 5 captured the ARDL long run effect of solid minerals exports on economic growth. The explanatory power of the regressors as captured by the R-squared of 87%, which indicated that only 87% of the variations in RGDP (economic growth) was explained by the independent variables in the model. Furthermore, the Durbin Watson statistic of 1.85 indicated is closer to 2 and thus indicated that the model is not spurious. The long and short run effect of solid minerals export on economic growth revealed a positive and statistically significant effect on the Nigerian economy. This result is in tandem with our apriori expectation of a positive link between solid minerals export and economic growth.

In the same vein, the study revealed a statistically significant negative relationship between exchange rate, solid minerals exports and economic growth in Nigeria. Though the short run analysis indicated a non-statistically significant relationship, it bears examining owing to its importance in the model. The implication of the above findings is to the effect that every percentage decline in the export value of solid minerals trade was a consequence of exchange rate volatility.

Furthermore, the coefficient value of interest rate, which represented the value at which banks and other financial institutions lend to investors in the sector showed an inverse relationship to the dependent variable (economic growth) both in the long and short-term basis. For instance, in the long run, the coefficient value of LINTR (-0.021295) implied that every unit rise in lending rate to investors in the solid minerals sector resulted to over a Twenty-one Billion Naira decrease or decline in the value of solid minerals exports and hence a fall in economic growth in Nigeria.

Additionally, Table 5 revealed a negative and statistically insignificant relationship between the coefficient of trade openness, solid minerals exports and economic growth in Nigeria. This suggested that the country's geographic space needed further expansion and flexibility for enhanced trade with the outside world. The result showed how a constricted trade relation between Nigeria and her trading partners has been with consequences for retarded growth. The short run estimates however revealed a positive outcome, implying that the opportunity of a more diversified trade will further boost or increase solid minerals exports price.

Finally, the slope coefficient of the error correction term (-0.083436) represents the rate of adjustment which is also consistent with the long-run convergence hypothesis. The empirical result indicated that given system innovation, the error correction term will take approximately 8.3 % period for adjustment to equilibrium every year.

Robustness Checks

Some diagnostic tests were carried out to ensure that the models yield robust estimates. Based on the diagnostic tests, we can conclude that the modelling and results of all our models are robust and as such, we can make inference with greater certainty.

The tests are hereunder analyzed.

(a) Autocorrelation Test

The test results are shown on table 6(a) below:



Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.137453	Prob. F (2,29)	0.3345
Obs*R-squared	2.909561	Prob. Chi-Square (2)	0.2335

Source: Extracted from E views 9.0

From the test results presented above, the probabilities of both the F-statistic (1.137453) and the probability of the observed R squared (0.2335) are greater than 0.05. Therefore, H_0 is rejected, depicting the absence of serial autocorrelation.

(b) Breusch-Pagan-Godfrey Heteroskedasticity Test

The heteroskedasticity test was conducted under Harvey’s assumption, the result is as presented in Table 6(b).

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.411870	Prob. F (8,31)	0.2306
Obs*R-squared	10.68209	Prob. Chi-Square (8)	0.2204
Scaled explained SS	9.700486	Prob. Chi-Square (8)	0.2867

Source: Extracts from E-views 9.0

The outcome of the heteroskedasticity test showed that the probability of F-statistic is 0.2306 is insignificant thus indicating that there was no heteroskedasticity problem in the model, hence its homoscedastic. This is because their corresponding probability values are greater than 0.05.

(c) Normality Test

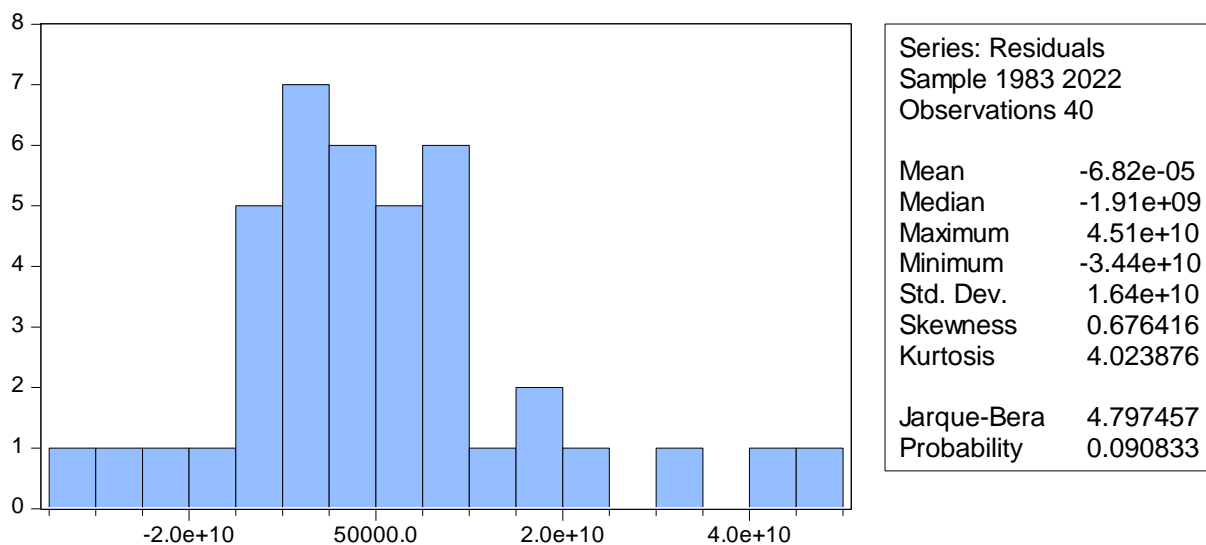


Figure 1: Normality Test

The Jarque-Bera test is used to detect normality of a model. This test first finds the skewness and kurtosis of the residuals. The test is conducted to check whether the error term follows the normal distribution. The normality test adopted is the Jarque-Bera (JB) statistics. Looking at the histogram, the study observes that the residual is normally distributed because of the insignificant probability value of 9%, which is above the threshold allowed by economic theory.

(d) Stability Test results

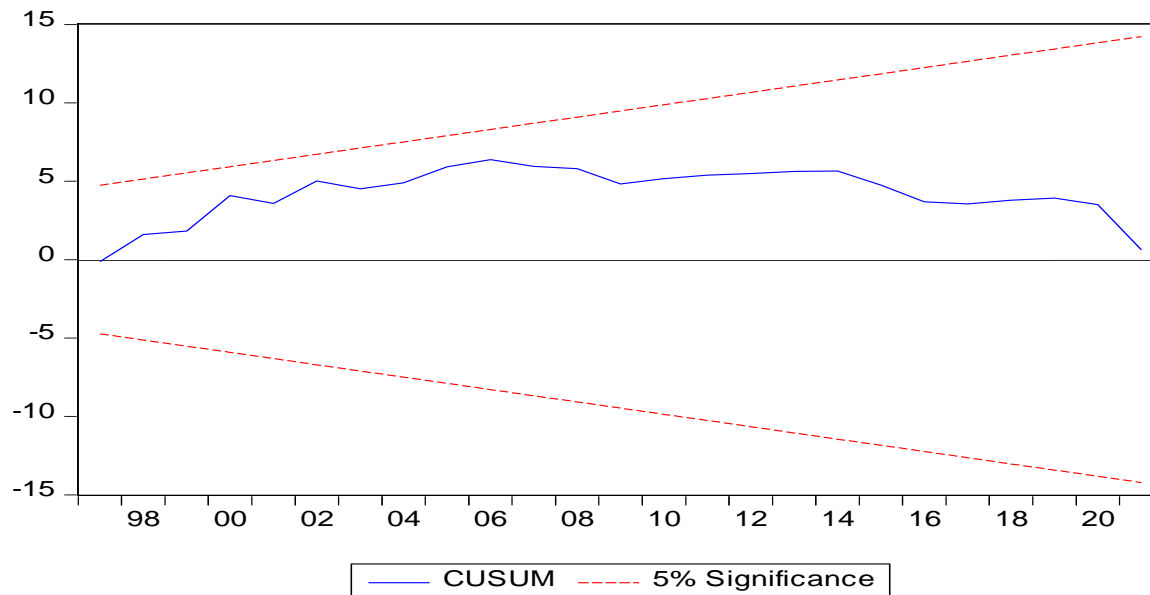


Figure 5.7: Cusum plot for the model

The cusum plot for model showed a plot between the upper and lower limits which indicated that that the model is stable and hence suitable for forecasting purposes.

Test of Hypotheses

The following hypotheses were tested at the 5% (0.05) significance level.

Hypothesis one

H₀₁: Solid minerals exports have no significant effect on economic growth in Nigeria.

The first hypothesis which posited that solid minerals exports have no significant effect on economic growth in Nigeria is rejected based on the significant value of P-value at 5% level of significance. Thus, this study concludes that solid minerals exports had significant positive effect on economic growth in Nigeria within the period under review.

Hypothesis Two

H₀₂: Degree of trade openness and solid minerals exports have no significant effect and economic growth in Nigeria.

The fourth hypothesis which posited that degree of trade openness and solid minerals exports have no significant effect on economic growth in Nigeria is decided based on the insignificant value of P-value at 5% level of significance. Thus, this study concludes that trade openness and solid minerals exports have no significant effect on economic growth in Nigeria, especially in the long run.

Discussion

This part discussed the findings of the study from the estimated long and short run results based on the study's objectives.

The long and short run effect of solid minerals export on economic growth revealed a positive and statistically significant effect on the Nigerian economy. This result is in tandem with our apriori expectation of a positive link between solid minerals export and economic growth. To be precise, it was noted that every billion naira increase in the export value of solid minerals products such as tin, columbite, iron ore, gold etc translated to an approximate three billion naira rise in gross domestic product (economic growth) of Nigeria during the referenced period. The infinitesimal contribution of this sector to economic growth in Nigeria is not unconnected to the abysmal performance of the solid minerals sector during the period under review, given the low incentives and participation due to the sector's poor performance over the years, hence investors were not keen in committing resources towards enhanced performance. Again, the unfavourable business climate in Nigeria could also be a determinant for this low output. For instance, the unending incidence of insecurity of lives and properties and the deplorable state of our power sector and road networks are enough to discourage investors from any meaningful investment in the sector, hence the low rate of return. The preceding finding aligns with the studies by Ajie, et al. (2019), Ideh, et al. (2021), Nwogwugwu, et al (2021), Agunuwa, et al. (2022), Nchimani (2022) and Ideh, et al. (2021) who variously found in their studies that solid minerals significantly contributes to economic growth in Nigeria. It is however at variance with the findings by Abayomi & Olufemi (2022) and Yelwa, et al. (2020) who concluded that solid minerals exports exerted an insignificant effect on economic growth.

Additionally, Table 5 revealed a negative and statistically insignificant relationship between the coefficient of trade openness, solid minerals exports and economic growth in Nigeria. This suggested that the country's geographic space needed further expansion and flexibility for enhanced trade with the outside world. The result showed how a constricted trade relation between Nigeria and her trading partners has been with consequences for retarded growth. The short run estimates however revealed a positive outcome implying that the opportunity of a more diversified trade will further boost or increase solid minerals exports price. These findings are in tandem with studies by Nwinyodee, et al. (2022) who found that trade openness negatively influenced the solid minerals sector in Nigeria. It is however at variance with Anyanwu, et al's (2019) where it was found that trade openness had a positive relationship with solid minerals exports.

Conclusion

This study which aimed to evaluate the effect of solid minerals export on economic growth in Nigeria concluded that that solid minerals exports (Gold, Iron ore and Tin) had significant positive effect on economic growth in Nigeria within the period under review while Columbite is negative and insignificant in the long run. The study also held that exchange rate had a positive significant effect on economic growth, just as it concluded that lending interest rate export has a positive significant effect on economic growth in Nigeria both in the short run and long run. It finally confirmed that the variables in the model do indeed have a unique long run relationship with economic growth during the period under review. The result agrees with the Resource Curse theory, Dutch Disease theory and Export-led Growth Hypothesis which underlined the study. That is, trade liberalization policy and economic diversification policy of the government can improve solid minerals exports and hence facilitate economic growth of Nigeria and other countries of the world.

The study enriched the literature in this area of study. In addition, the study provided a guide to policy makers with knowledge to formulate policies that will take the nation out of its present economic challenges occasioned by high neglect of solid minerals industry and over dependence on oil revenue. For academics, it is a springboard for future research. It will also serve as a reference material for students in economics and other related fields.

Recommendations

The empirical review and analysis carried out on the effect of solid minerals exports on economic growth in Nigeria has not met optimum expectations. Hence, the study proffers the following policy template for the Nigerian economy.

Recommendation for Policy

On the basis of the empirical findings, the following recommendations are proffered.

1. The government should restructure the Nigeria Mining Corporation with legal powers to operate in the same way the Nigerian National Petroleum Company operates so as to boost its performance in the international market.
2. The Federal Government should use tax waivers and other means to attract foreign direct investment into solid minerals development and exploitation.
3. The Nigerian government through its agencies should advocate for an export promotion policy that will stimulate trade expansion so that it can benefit from trade. This they can achieve through a flexible exchange rate favorable to export expansion and consistent with Nigeria as an emerging economy.
4. The government should provide adequate security for miners. This will enhance productivity and increase the supply of solid minerals in the international market.

Suggestions For Further Studies

For further studies, research work may be carried out to explore government's efforts in revitalizing the mining industry. Another study can take a comparative approach to examine the impact of solid minerals exports on economic growth for African countries heavily involved in solid mineral export in order to x-ray what policies they put in place in order to develop their mining sector for optimal economic growth.

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