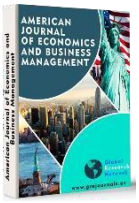

American Journal of Economics and Business Management

Vol. 7 Issue 11 | **pp.** 1212-1225 | **ISSN:** 2576-5973

Available online @ https://www.globalresearchnetwork.us/index.php/ajebm

Article

The Role of Solid Mineral Export in The Development of The Nigerian Economy: An Empirical Analysis

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Abstract: Nigeria is endowed with abundant solid mineral resources that have the potential to drive its economic diversification efforts. However, the level of exploitation of these solid mineral resources is quite minimal relative to the extent of deposits found across the country. This study therefore examined the contribution of solid mineral export to the development of the Nigerian economy. Specifically, the study investigated the impact of solid mineral export and exchange rate on economic development in Nigeria. Economic development is proxied by the misery index while exchange rate was introduced as a control variable. To conduct the study, several econometric techniques including the Augmented Dickey-Fuller (ADF) unit root test, Johansen cointegration test, error correction mechanism (ECM) and Granger causality test were used to analyze annual time series data for the period 1986 to 2022. The estimated regression result revealed that solid mineral export has insignificant negative impact on misery index while exchange rate has significant positive impact on misery index. It is therefore concluded that solid mineral export makes insignificant positive contribution to the development of the Nigerian economy. Among other things, it is recommended that the necessary infrastructural facilities needed to improve the performance of the solid mineral sector should be adequately provided.

Keywords: Solid, Mineral, Export, Development

Citation: Korgbeelo, C. The Role of Solid Mineral Export in The Development of The Nigerian Economy: An Empirical Analysis. American Journal of Economics and Business Management 2024, 7(11), 1212-1225.

Received: 10th Aug 2024
Revised: 11th Sept 2024
Accepted: 24th Oct 2024
Published: 27th Nov 2024

1. Introduction

Historically, solid mineral resources have played a significant role in the growth and development of the Nigerian economy. In fact, the presence of solid minerals was the main factor that propelled colonial interest in Nigeria and other African countries (Shasore, 2016; FGN, 2023). Recently, there has been renewed interest in the potential role of the solid mineral sector in the growth and development of the Nigerian economy. The desire for the diversification of the economy and particularly, the significance attached to breaking the dominance of petroleum in Nigeria's export basket, brought about the renewed emphasis placed on the solid mineral sector (Ojo, 1999; Okoli et al, 2023).

Nigeria is endowed with abundant solid mineral resources that have the potential to drive its economic growth and development. There are about 44 different solid mineral resources spread across the 36 states and Abuja in Nigeria. These include gold, copper, iron ore, limestone, bitumen, lignite, coal, lead, zinc, gypsum, kaoline, granite, etc. Some of these solid minerals are in high demand globally (Filani, 2014; Aniobi et al, 2021). Besides, according to the Central Bank of Nigeria (2010), the level of exploitation of these

solid minerals is very minimal compared to the extent of deposits found across the country.

Over the years, Nigeria has been heavily dependent on crude oil and natural gas export. This reliance on crude oil revenue has proven to be vulnerable, leaving the country's economy to be susceptible to global oil price fluctuations. Diversification of the revenue sources through the exploitation and export of solid minerals will be a prudent strategy to mitigate the oil price fluctuation risk. Leveraging on solid mineral resources can equally reduce the country's reliance on imports and generate substantial foreign exchange earnings which will in turn boost the country's balance of payments. In addition, solid minerals have the capacity to create jobs, foster industrialization and contribute to skill development and human capacity building in the country. Besides, the extraction and processing of solid minerals necessitate huge infrastructural investments, including transportation network, energy supply, and other socio-economic infrastructural facilities. Developing these infrastructural facilities would not only support the mining industry but also bring about broader economic benefits. For instance, improvement in infrastructure can foster inter-sectoral linkages, reduced production costs and facilitate the movement of goods and people. These would ultimately simulate economic growth in the various sectors of the economy (Eyre & Agba, 2007; Kashim, 2011; Erhun, 2015; Edeme et al, 2018; Nwogwugwu et al, 2021).

Nigeria started exploiting her solid mineral resources in 1902 and in its prime, the solid mineral sector was one of the producers of tin and coal, and also a producer of a considerable 1.4 tons of gold annually (Shasore, 2016). However, due to poor policy implementation and lack of proper attention, the solid mineral sector witnessed steady decline and today, the contribution of the sector to the country's gross domestic product (GDP) is very low and lags behind the figures for major African counterparts like Guinea, Botswana, Democratic Republic of Congo, Ghana, Cote d'Ivoire, South Africa, etc. In fact, available statistics from the Nigeria Extractive Industries Transparency Initiative's (NEITI) solid minerals annual audit report put total revenue from the solid mineral sector in 2013 at N33.86 billion and in 2014 at N55.82 billion, accounting for just 0.11 percent of GDP. The country recorded a marginal growth in solid minerals mining with accrued revenue hitting N69.2 billion and accounting for 0.33 percent of total GDP in 2015. The solid mineral sector contributed 0.55 percent to Nigeria’s GDP in 2016 while the corresponding figures were 40 percent, 25 percent and 18 percent respectively for Botswana, DR Congo and South Africa for the same period. Currently, the solid mineral sector contributes an average of about 0.5 percent to total GDP, accounting for about 0.3 percent of total employment and about 0.02 percent of total exports. The above performance is a reversal of the up to 5 percent recorded in the 1960s -70s, when the economy was mainly sustained by agriculture and solid mineral exploitation (Olade, 2019; Abimbola, 2023).

The above discussion shows that the performance of the solid mineral sector, over the years, has not been satisfactory. Hence, several factors responsible for the poor performance of the sector have been identified. These include inadequate infrastructure, illegal artesanal mining, host community challenges, insecurity, smuggling, etc. For instance, a report by the former Minister of States Mines and Steel Development, Uchechukwu Ogah, stated that Nigeria had, within a period of 6 years, lost revenue estimated at USD 5 billion to smuggling of gold. Funding challenges and the problem of insufficient geological and geophysical data on solid minerals are the other challenges facing optimal exploitation of solid minerals in the country (Shasore, 2016; Micah & Taiwo, 2020; Okonji, 2022; Abimbola, 2023). It has therefore been asserted that if the challenges facing the development of solid mineral industry are adequately mitigated, the sector would contribute significantly to the development of the Nigerian economy. This study therefore examined the impact of solid mineral export on the development of the Nigerian economy.

Review of Related Literature and Conceptual Clarifications

Solid Mineral Export

Solid minerals are naturally occurring substances derived from the earth which are of great value to man. The include metallic ores, fuel minerals (such as coal, uranium, signet, tar, sand, etc.), industrial minerals and rocks (such as limestone, marble etc.), and gemstones and ornamental stones. For the purpose of this study therefore, solid minerals refer to any naturally occurring substances found in the earth that is useful to man other than petroleum and natural gas.

Solid mineral export refers to the quantity of solid minerals produced in Nigeria and sold to buyers in other countries. For this study, solid mineral export refers to the monetary value of the quantity of solid minerals produced in Nigeria and sold to other countries.

Economic Development

Akpankpan (1999) define economic development as "the process of improvement in the various aspect of the economy and the society it supports". In similar vein, Todaro and Smith (2011) define economic development as "the process of improving the quality of all human lives and capabilities by raising people's levels of living, self-esteem, and freedom." As a multidimensional concept, economic development can be measured in terms of several indices of development. However, for the purpose of this study, economic development is proxied by the misery index.

The misery index is a composite economic indicator that determines how the average citizen is fairing economically. The pioneer misery index was developed by Arthur Okun of Yale University, USA in the 1970s. Okun's misery index which measured America's economic health was calculated by simply adding up the nation's inflation and unemployment rates. The original misery index, as created by Okun, has undergone some modifications over the years. The first modification took place in 1999, when Robert Barrow created his own misery index. Barrow's misery index which added interest rate and economic growth to the sum of inflation and unemployment rate was used to evaluate Post-World War II presidents of the United States. Later on, Hanke of John Hopkins University improved on Barrow's misery index and started using it on countries outside America. Hanke's misery index is the sum of unemployment, inflation and bank lending rates minus growth rate of per capita real GDP (Kenton, 2018).

Theoretical Literature Review

The Factor Endowment Theory

The factor endowment theory, also called the factor proportion theory, was developed to overcome the weaknesses inherent in the classical trade theories by recognizing that production involves more factors of production than just labour, and that the various countries of the world are endowed with different proportions of these factor inputs. The theory accepts the differences in comparative costs, but points out that it is the international differences in relative factor endowment that explain differences in comparative costs and therefore constitute the basis for international trade (Robinson, 2003). The theory was first developed by two Swedish economists, Eli Heckscher (1919) and Bertil Ohlin (1933), and later modified by Paul Samuelson in 1948. For this reason,it is commonly referred to as Heckscher-Ohlin-Samuelson theory, or simply, the H-O-S theory (Akpakpan, 1999).

Based on certain assumptions and the differences in factor proportion (i.e., factor supplies), relative factor prices will differ, and for this reason, factor combination and commodity price ratios will differ. The theory goes on to show, like Ricardo's comparative advantage theory, that the two set of countries engaged in international trade will benefit from specialization through increased output, and that trade will help to spread these benefits. Trade will do this job well if it is "free", i.e., if it is not restricted by any form of barrier (Ahuja, 2013).

In summary, the factor endowment theory leads to the following predictions:

a) That countries should export commodity in the production of which a great deal of its relatively abundant and cheap factor is used and import the commodity in the production of which a great deal of its relatively scarce and expensive factor is used. The efficiency of the free market will therefore maximize world output.
b) The theory also predicts that international trade practised in the light of the theory, will lead to elimination of or reduction in the differences in factor prices between nations. This is the phenomenon of the factor price equalization (Robinson, 2003).

Export-Led Growth Hypothesis

The export-led growth hypothesis postulates that expansion of export is one of the major drivers of economic growth. It contends that the overall economic growth of a country can be achieved not only by increasing the inputs of labour and capital in the economy's production function, but also by increasing the economy's export base. According to the proponent of the theory, exports serve as the engine of growth (Dunn & Mutti, 2004).

The export-led growth hypothesis emanated from the classical and neoclassical economic theories. According to the export-led growth hypothesis, export is the main determinant of economic growth. The theory argues that an increase in export will lead to an expansion in the employment generation capacity of the export-based industry. This will lead to higher productivity which will in turn lead to an improvement in the growth performance of the economy. The implication of the theory is that if policy makers in the less developed countries want to improve the growth trajectory of their economy, they should pay attention to exports. In fact, as opined by Jimenez and Razini (2013), export is associated with positive spillover effects on other sectors of the economy. This enhances the ability of these other sectors to produce the level of output they could not produce before the export expansion. In addition, with export growth, there will be improvement in the balance of payments, increase in foreign income inflow, and increase in employment levels across the sectors. Thus, the export-led growth hypothesis postulate that expansion of export activities not only create job opportunities but also provides benefits for the industrial sector to stimulate the growth of the economy (Medina-Smith, 2001).

Initially, developing countries adopted the imports substitution strategy between 1950 and 1970. However, although few success stories were recorded from the import substitution strategy, by the late 1970s, empirical evidence started proving that export-led strategy was more robust in the stimulating growth than the inward-looking approach of the import substitution strategy (Balassa, 1980; Feder, 1983; Krueger, 1985; Dunn & Mutti, 2004). Thus, the export-led hypothesis started gaining prominence between 1970 and 1980 when it was shown to be successful in the four Asian tigers (i.e., Hong Kong, Singapore, South Korea and Taiwan) (Balassa, 1978; Tyler, 1981; Balassa, 1985; World Bank, 1993; Medina-Smith, 2001).

Empirical Literature Review

Ohwofosa and Ekaruwe (2023) investigated the impact of earnings from solid mineral exports, manufacturing exports, agricultural exports and crude oil exports on economic growth in Nigeria. The findings showed that solid mineral exports and crude oil exports have significant negative impact on GDP; agricultural exports have significant positive impact on GDP; while manufacturing exports has insignificant positive impact on GDP. Okoli et al (2023) found that solid mineral export, agricultural export, manufacturing export and gross fixed capital formation have significant positive impact on real GDP in Nigeria. Godday and Sunday (2022) established from their study that solid mineral export has significant negative impact on real GDP while services export has insignificant negative impact on real GDP in Nigeria. Aboyemi and Olufemi (2022) analyzed the impact of solid mineral development on economic growth in Nigeria. The findings showed that solid mineral output has insignificant positive impact on real GDP

growth rate. Nwogwugwu et al (2021) examined the impact of solid mineral development on economic growth in Nigeria and found that solid mineral exports and solid mineral output have significant positive impact on real GDP growth rate; oil revenue has insignificant positive impact on real GDP growth rate while solid mineral depletion has significant negative impact on real GDP growth rate. Yelwa et al (2020) found that manufacturing, solid mineral and agricultural export have significant positive impact on GDP growth rate in Nigeria.

Similarly, Kenechukwu and Akujinma (2022) established from their study that agricultural export, solid mineral export and textile export have significant positive impact on GDP while animal export and vegetable oil export have significant negative impact on GDP in Nigeria. Ajie et al (2019) found that solid mineral output and gross fixed capital formation have significant positive impact on GDP while exchange rate has insignificant positive impact on GDP. Edeme et al (2018) found that solid mineral as a ratio of GDP has significant positive impact on GDP per capita. Chukwumaeze et al (2018) found significant positive impact of agricultural, solid mineral and tourism exports on GDP in Nigeria. Similarly, Olawale (2018) established significant positive impact of solid mineral and agricultural exports on GDP growth rate in Nigeria. On their part, David et al (2016) showed that crude oil and natural gas output has insignificant negative impact on GDP per capita; solid mineral output and agricultural output have significant positive impact on GDP per capita while manufacturing sector output has significant negative impact on GDP per capita.

From the empirical literature reviewed, it is observed that almost all the studies conducted in Nigeria concentrated on the impact of solid mineral export on economic growth measured in terms of GDP and real GDP or real GDP per capita. Hence, none of the studies investigated the impact of solid mineral export on economic development measured in terms of misery index. The empirical literature reviewed also revealed that there is no consensus in the findings of previous studies on the impact of solid mineral export on economic growth in Nigeria. Thus, while some studies (for e.g; Yelwa et al, 2020; Kenechukwu & Akujinma, 2022; Abayomi & Olufemi, 2022; Okoli et al, 2023; etc.) established positive impact of solid mineral export on economic growth, others (for e.g; Chukwuma, 2018; Godday & Sunday, 2022; Ohwofosa & Ekaruwe, 2023, etc.) found negative impact of solid mineral export on economic growth in Nigeria. To fill these gaps, this study investigated the impact of solid mineral export on economic development proxied by standard of living which is measured in terms of the misery index.

2. Materials and Methods

Model Specification

This study is modelled based on the export-led growth hypothesis and the analytical model used by Ajie et al. (2019) which is expressed as follows:

GDP = f (SMIN, GFCF, EXR) ……1

where GDP = Gross Domestic Product

SMIN = Solid Mineral Export

GFCF = Gross Fixed Capital Formation

EXR = Exchange Rate

f = Functionality Symbol

The adopted model was slightly modified to enable us include the variables of the present study. Hence, the functional form of the model on which the ordinary least squares (OLS) regression equation is built is specified as follows:

MIDX = f (SMEX, EXR) ……2

where MIDX = Misery Index (a proxy for economic development)

SMEX = Solid Mineral Export

EXR = Exchange Rate

f = Functionality Notation

MIDX is the dependent variable while SMEX and EXR are the explanatory variables. EXR was introduced as a control variable.

The OLS multiple regression equation based on the functional form above is expressed as follows:

MIDX = $\beta_0 + \beta_1 SMEX + \beta_2 EXR + \cup$……3

where β_0 is the regression intercept, β_1 and β_2 are the parameter estimates and ∪ is the error term. All other variables are as earlier defined. Equation 3 can be transformed into logarithmic form as follows:

MIDX = $\beta_0 + \beta_1 LOGSMEX + \beta_2 LOGEXR + \cup$……..4

where LOG is the natural logarithm of the variables. All other variables are as earlier interpreted.

Apriori Theoretical Expectations

Based on the apriori reasoning, the following signs of the parameter estimates are expressed.

$\beta_1 < 0$ $\beta_2 > 0$,

The implication of the above signs of the parameter estimates is that solid mineral export is expected to have negative impact on misery index while exchange rate is expected to have positive impact on misery index.

Description of Variables

Dependent Variable

The dependent variable for this study is economic development proxied by misery index. The misery index is the sum of unemployment, inflation and bank lending rate minus the growth rate of real GDP per capita.

Explanatory Variables

a) **Solid Mineral Export**
   This refers to the monetary value of the total quantity of solid minerals produced in Nigeria and sold to other countries in a year. It is measured in billions of naira.

b) **Exchange Rate**
   This refers to the average amount of naira that is exchanged for one United States of America's dollar in a year.

Nature and Sources of Data

This study made use of annual time-series data for the period 1986-2022. They are secondary data obtained from the Central Bank of Nigeria (CBN) annual statistical bulletin for 2022, the CBN annual reports and statements of accounts (various years) and the World Bank development indicators (various years).

Techniques of Data Estimation

Since the study made use of time-series data, it was necessary to account for the time-series properties of the variables. To this end, the actual estimation procedure was proceeded by stationary test. The essence of the stationarity test is to check whether the time-series are stationary or not, and to determine their various order of integration. The stationarity test was conducted using the Augmented Dickey-Fuller (ADF) unit root test. Based on the result of the unit root test, the Johansen cointegration test was used to test for the presence or otherwise of long-run (equilibrium) relationships among the variables of the study. The error correction mechanism (ECM) was used to determine the short-run (dynamic) behavior of the variables. Particularly, the ECM was used to determine the speed of adjustment of short-run disequilibrium to long-run (equilibrium) trend. The Granger causality test was used to determine whether one time-series is useful in forecasting another. Hence, the Granger causality test was used to test the nature and direction of casual relationship between the dependent variable and each of the explanatory variables.

3. Results

Descriptive Statistics

The result of the descriptive statistics is summarized in table 1.

Table 1. Descriptive Statistics Result

Variable	MIDX	**SMEX**	**EXR**
Mean	46.97324	22.75956	134.1046
Median	43.52000	1.203400	125.8300
Maximum	95.74000	276.9200	426.0000
Minimum	22.14000	0.010500	3.320000
Std. Dev.	17.59661	59.93021	120.2551
Skewness	1.125205	3.250288	0.841689
Kurtosis	3..582561	12.71487	2.835514
Jarque-Bera	8.330736	210.6474	4.410429
Probability	0.015524	0.000000	0.110227
Sum	1738.010	842.1039	4961.870
Sum sq. Dev.	11147.07	129298.7	520606.5
Observations	**37**	**37**	**37**

Source: E-view Output

The descriptive statistics result in table 1 shows that the mean values of the variables are 46.97324, ₦22.75956 billion and ₦134.1046 per dollar for MIDX, SMEX, and EXR respectively. The minimum values of the variables are 22.14000, ₦0.010500 billion and ₦3.320000 per dollar for MIDX, SMEX, and EXR respectively while the maximum values are 95.74000, ₦276.9200 billion and ₦426.0000 per dollar for MIDX, SMEX, and EXR respectively. The standard deviation statistic shows that EXR with a standard deviation value of 120.2551 is the most unstable variable while MIDX with a standard deviation value of 17.59661 is the most stable variable. All the variables are positively skewed. From the Kurtosis statistic, EXR is platykurtic since its value is less than 3. Hence, it has thinner tails relative to normal distribution. On the other hand, MIDX and SMEX are leptokurtic since their values are greater than 3. Hence, they are heavier or wider tails relative to normal distribution.

Stationarity Test

The stationarity test was conducted using the Augmented Dickey-Fuller (ADF) unit root test. The result is presented in table 2.

Table 2. ADF Unit Root Test Result

Variable	**ADF Test Statistics (At Levels)**	**Critical Values**		**Prob.**	**ADF Test Statistic (At 1st Diff)**	**Critical Values**		**Prob.**	**Order of Integration**
		1%	**5%**			**1%**	**5%**		
MIDX	-2.352908	-3.639407	-2.951125	0.1622	-7.112462	-3.639407*	-2.951125	0.0000	*I* (I)
SMEX	0.544432	-3.639407	-2.951125	0.9858	-11.41990	-3.639407*	-2.951125	0.0000	*I* (I)
EXR	2.215098	-3.626784	-2.945842	0.9999	-5.133417	-3.632900*	-2.948404	0.0002	*I* (I)

Source. Eview Output

Note: * denotes rejection of the null hypothesis of unit root at the 1 percent level of significance.

From the ADF unit root test result in table 2, none of the variable is stationary at levels. However, all the variables become stationary at first difference at the 1 percent critical level. Hence, all the variables are integrated of order one (i.e., I (1)).

Cointegration Test

The result of the Johansen cointegration test is reported in table 3. The standard test statistics used in evaluating the result are the Trace and Max-Eigen test statistics.

Table 3 Johansen Cointegration Test Result
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	**Eigenvalue**	**Trace statistic**	**0.05 Critical value**	**Prob.****
None*	0.512541	38.37763	29.79707	0.0040
At most 1	0.307142	13.22838	15.49471	0.1067
At most 2	0.010962	0.385798	3.841466	0.5345
Hypothesized No. of CE(s)	Eigen Value	Max-Eigen statistic	0.05 Critical value	Prob.**
None *	0.51541	25.14925	21.13162	0.0129
At most 1	0.307142	12.84258	14.26460	0.0828
At most 2	0.010962	0.385798	3.841466	0.5345

Source: Computed form E-review

Trace test indicates 1 cointegrating equation at the 0.05 level
Max-eigenvalue test indicates 1 cointegrating equation at the 0.05 level
* denotes rejection of the hypothesis at 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

From the Johansen cointegration test result in table 3, both the trace and Max-eigen value tests indicated 1 cointegrating equation each. This implies the presence of long-run (equilibrium) relationships among variables of the study.

Long Run Regression Result

The normalized cointegrating coefficients are shown in table 4.

Table 4. Normalized Cointegrating Coefficients

MIDX	**SMEX**	**EXR**
1.000000	0.461869	-0.085205
	(0.31766)	(0.03736)

Source: E – view Output

Note: The figures in parentheses are the standard errors.

From the normalized cointegrating coefficients in table 4, the long-run coefficients were obtained by reversing the signs of the coefficients. Hence, the estimated long-run coefficients are presented in table 5.

Table 5. Estimated Long-Run Coefficients

MIDX	**SMEX**	**EXR**
1.000000	-0.461869	0.085205
	(0.31766)	(0.03736)
	(-1.453973)	(2.280648)

Source: E – view Output

Note: The figures in the first and second parentheses are the standard errors and t-statistics respectively for each variable.

The long-run regression result in table 5 indicated that solid mineral export has insignificant negative impact on misery index while exchange rate has significant positive impact on misery index.

VAR Lag Order Selection Criteria

The optimal lag length for the ECM model is presented in table 6. The optimal lag length is the one that minimizes the Akaike information criterion, Schwarz criterion and Hannan-Quinn criterion, and at which the model does not have autocorrelation.

Table 6. VAR Lag Order Selection Criteria
Endogenous variables: MIDX SMEX EXR
Exogenous variables: C
Sample: 1986- 2022
Included observations: 34

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-527.6990	NA	7.25e+09	31.21759	32.35227	31.26352
1	-442.4753	150.3947*	82103752	26.73384	27.27256	26.91756*
2	-433.0523	14.96596	81266024*	26.70896*	27.65171*	27.03046
3	-425.5959	10.52668	92233018	26.79976	28.14655	27.25905

Source: E-view Output

* indicates lag order selected by the criterion
LR: Sequential modified LR test statistic (each test at 5% level)
FPE: Final Prediction Error
AIC: Akaike Information Criterion
SC: Schwarz Information Criterion
HQ: Hannan-Quinn Information Criterion

Based on table 6, the optimal lag length for the ECM model is lag 2 based on the Akaike information criterion.

Estimated Short-Run (Error Correction Model) Result

The result of the parsimonious short-run or error correction model (ECM) is presented in table 7

Table 7. Parsimonious Short-Run (ECM) Result
Dependent Variable: D (MIDX)]
Method: Least Squares
Sample (adjusted): 1989 2022
Included observations: 34 after adjustments.

Variable	Coefficient	Std. Error	t-statistic	Prob.
C	-1.458315	2.574088	-0.566537	0.5755
D(MIDX (-1))	0.270889	0.165587	1.635929	0.1130
D(MIDX (-2))	-0.253038	0.174957	-1.446285	0.1592
D(SMEX (-2))	-0.042205	0.189303	-0.222952	0.8252
D(EXR(-2))	0.148065	0.125173	1.182888	0.2468
ECM (-1)	-0 .427066	0.201785	-2.116448	0.0433
R-squared	0.598336	Mean dependent var		-0.730882
Adjusted R-squared	0.520895	S.D. dependent var		15.51622
S.E. of regression	13.06595	Akaike info Criterion		8.136682
Sum squared resid	4780.135	Schwarz Criterion		8.406039
Log likelihood	-132.3236	Hannan-Quinn Criter.		8.228540
F-Statistics	3.707513	Durbin-Watson stat		2.168142
Prob (F-statistic)	0.010620			

Source: Computed from E-view

From the estimated short-run regression result in table 7, the error correction term (i.e., ECM (-1)) displayed a correct negative coefficient. It is also significant at the 0.05 level of significance. In terms of size, the coefficient of the error correction term is -0.427066. The implication of the behaviour of the error correction term is that any disequilibrium in the short-run is adjusted to the long-run (equilibrium) trend with a speed of adjustment of about 42 percent.

Post Estimation Tests

To verify the validity of the ECM (short run) result in table 7, the assumptions underlying the classical linear regression model are tested in the section. These tests include linearity, serial correlation, heteroscedasticity, normality and stability tests. The results and decisions for these tests are reported in table 8.

Table 8. Post Estimation Tests Results

Tests	Value	Prob.	Decision
Linearity (Ramsey Reset) Test			Accept Ho (Model correctly specified)
t-statistic	0.019722	0.9844	
F-statistic	0.000389	0.9844	
Breusch – Godfrey Serial			Accept Ho (No Serial correlation)
Correlation LM Test			
F-Statistic	0.161421	0.8518	
Breusch – Pagan-Godfrey			Accept Ho (Residuals have constant variance, i.e., model is homoscedastic)
Heteroskedasticity Test			
F-Statistic	1.854203	0.1392	
Normality (Jarque-Bera) Test			Accept Ho (Data normally distributed)
F-Statistic	0.545626	0.761235	

Source: E-view Output

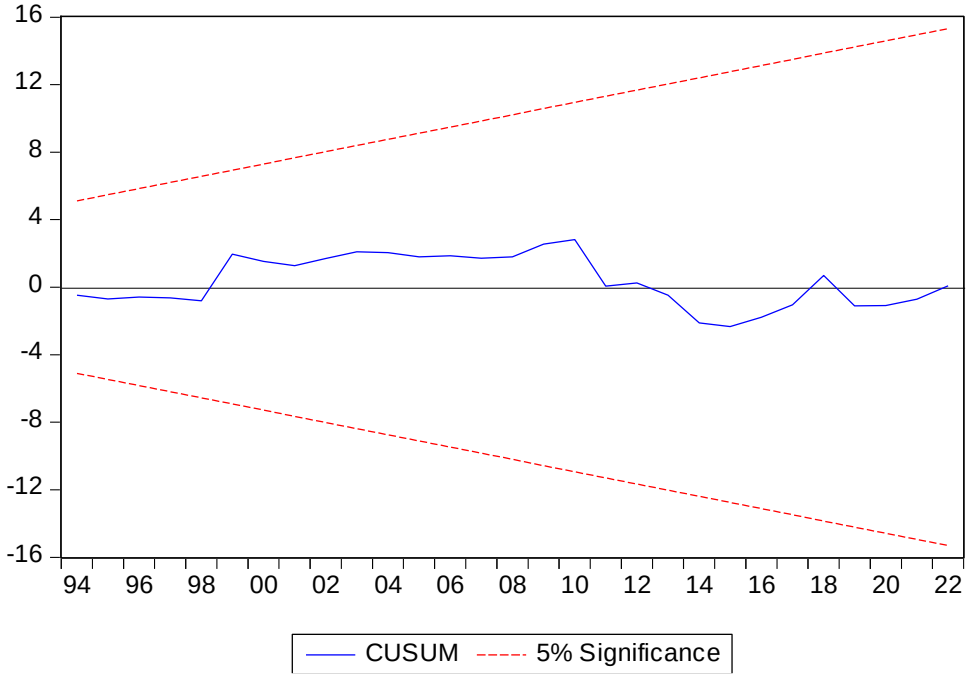

Figure 1. Cumulative Sum Test for Stability
Source: E-view Output

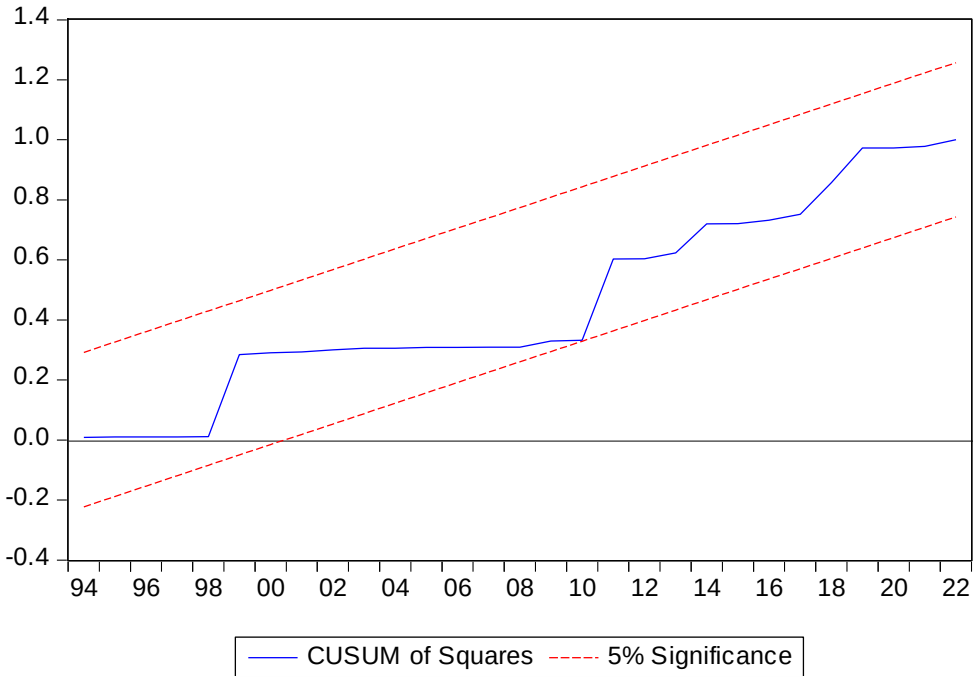

Figure 2. Cumulative Sum Squares Test for Stability
Source: E-view Output

Note that for each of the tests in table 8, the null hypothesis (Ho) was not rejected since the estimated probability value is greater than 0.05 while for the tests in figure 1 and 2, the model is considered stable since the plots of CUSUM and CUSUM Squares for the model lie within the 5 percent critical bounds.

Granger Causality Test

The result of the pairwise Granger causality test is presented in table 9.

Table 9. Granger Causality Test Result
Pairwise Granger Causality Test
Sample: 1986-2022
Lags: 2

Null Hypothesis	Obs	F-Statistic	Prob.
SMEX does not Granger Cause MIDX	35	0.06312	0.9390
MIDX does not Granger cause SMEX		0.19284	0.8256
EXR does not Granger cause MIDX	35	0.39981	0.6740
MIDX does not Granger cause EXR		1.29844	0.2879
EXR does not Granger cause SMEX	35	1.96067	0.1584
SMEX does not Granger cause EXR		0.21235	0.8099

Source: E-view Output

The Granger Causality test result in table 9 indicated that there is no causality among the variables.

4. Discussion

Estimated Long-Run Regression Result

The estimated long-run regression result revealed that solid mineral export has insignificant negative impact on misery index. This implies that an increase in solid mineral export will bring about an insignificant reduction in the misery index. In terms of size, N 1 billion increase in solid minerals export is associated with an average of 0.461869 reduction in misery index. Exchange rate has significant positive impact on misery index, implying that an increase in the naira-dollar exchange rate will lead to an increase in the

misery index. Hence, N1 increase in the exchange rate is associated with an average increase of 0.085205 in the misery index.

Estimated Short-Run Regression Result

The estimated short-run regression result showed that lagged value of misery index in period one has insignificant positive impact on misery index in the current period while lagged value of misery index in period two has insignificant negative impact on misery index in the current period. Solid mineral export lagged by 2 periods has insignificant negative impact on misery index in the current period while lagged value of exchange rate in period 2 has insignificant positive impact on misery index in the current period.

The estimated short run regression result also showed that the Error Correction term (ECM(-1)) turned up with the right negative coefficient and it is also significant at 0.05 level of significance. The coefficient of the error correction term is -0.427066. This means that any disequilibrium in the short-run is reconciled to long-run (equilibrium) trend with a speed of adjustment of about 42 percent within a year.

Furthermore, the short-run regression result showed that the coefficient of multiple determination (R-squared) is 0.598336. This means that the explanatory variables together account for about 59 percent of the total variations in the misery index. The adjusted R-squared measures the penalty (the change in the R-squared) for including irrelevant explanatory variables in the model. With an estimated adjusted R-squared of 0.520898, the meaning is that if additional explanatory variables are introduced to the model, all of them together will account for about 52 percent of the total variations in misery index. The decrease in the R-squared is caused by the loss of degree of freedom as more explanatory variables are added to the model. The estimated F-statistic is 3.707513 with a probability value of 0.010620. The implication is that the overall estimated error correction model is significant at the 0.05 level of significance. The Durbin-Watson statistic is 2.168142. Since it is greater than 2, it means that the estimated error correction model is not affected by the problem of autocorrelation.

5. Conclusion

Based on the findings of the study, we concluded that solid mineral export makes insignificant positive contribution to the development of the Nigerian economy.

Policy Recommendations

Based on the findings of the study, the following policy measures are recommended:

a) There is a need for infrastructural development in the solid mineral sector. Particularly, transportation infrastructure in terms of road and rail transport should be provided in the solid mineral sector. To this end, all identified solid mineral locations should be linked with good network of roads and rail lines. A well-established transportation network will enhance the movement of equipment to mining sites and evacuation of solid minerals for sales and export.

b) There is the need for adequate security to be provided in the solid mineral sector. The North Central, North East and North West regions are known to have some of the country's major solid mineral deposits. Due to the persistence plaque of terrorism and tribal/religious conflicts, mining activities in these areas are adversely affected. Improved security in these areas will not only stabilize mining activities but also guard against illegal mining and smuggling of solid minerals.

c) Artisanal mining of solid minerals has significantly reduced the potential of the solid mineral sector to contribute to the economic development of Nigeria. To reduce the incidence of artisanal solid mineral mining in the country, there is the need to integrate the informal artisanal miners into the formal mining sector through training and equipment supply, adequate funding, enlightenment on safe mining practices, etc.

d) To improve the performance of the solid mineral sector in Nigeria, there is the need to provide adequate funding through provision of credit facilities to investors

in solid mineral production and export. To achieve this, there is the need to establish solid mineral development bank in the country.

e) There is a need for improvement in geo-scientific data gathering and processing with regards to solid mineral exploration and exploitation in the country. To this end, the Nigerian Geological Survey Agency (NGSA) and other government agencies in the mining sector should be adequately funded to enable them execute their statutory responsibilities.

f) The Central Bank of Nigeria should adopt better strategies to manage the exchange rate so as to reduce its adverse effect on the development of the economy.

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