SSR
Social Science Research

Causality between exchange rate fluctuation and export volume in Nigeria

[1]Okeke, Onyinye Rita & [2]Okeke, Daniel C; Ph.D

[1]Department of Economics, Chukwuemeka Odumegwu Ojukwu University, Igbariam & [2]Department of Agricultural Education, Nwafor Orizu College of Education, Nsugbe. [1]onyinye_rita@yahoo.com, [2]olisdon@yahoo.com

Abstract

The study investigated the causality between Naira exchange rate (EXR) and export volume (EX) in Nigeria. Economic researchers and policy makers have been concerned about the significant impact of exchange rate fluctuations on the economy in general and trade, in particular. However, theoretical and empirical works on the subject have produced mixed results. This study used annual data spanning from 1983 to 2020. Applying the econometrics tools of unit root test, co-integration, error correction model (ECM) and pair-wise Granger causality test, EX became stationary at first differencing whereas EXR became stationary at level. The co-integration test identified two co-integrating equations. The ECM result is negative and significant as desired. The Granger causality test shows a uni-directional causality flowing from exchange rate to export which may imply that a change in exchange rate will bring about change in the export volume, holding other factors constant which may imply that a fall in the currency value of the country makes export cheaper, ceteris paribus, while no causality running from EX to EXR. Nigeria, as a country which its only major exportable is crude oil, export may not deeply be a major factor that affects the variations in exchange rate as there are many other factors that could be responsible for the fluctuations. This study recommended a flexible but favorable naira exchange rate, diversification in all sectors of the economy and employment of sustainable trade policies that will promote exportation and trigger economic growth.

Keywords: Export volume, Granger causality, Johansen co-integration, Naira exchange rate, Nigeria.

Introduction

Export performance is of paramount importance because it contributes to the economic development of nations by influencing the amount of foreign exchange reserves as well as the level of imports a country can afford. By exportation, it refers

to goods produced domestically and sold in the world market. This enhances industrialization, increases productivity and creates rooms for employment opportunities. The exchange rate is also seen as a measure of the value of the national currency against other countries, which reflects the economic situation of the country compared to other countries (Obandan, 1994). In an export-led growth economy, a major interest will be to make its export sector open to external shocks, especially in regards to exchange rate volatility. With the Nigerian economy in a state of exchange rate fluctuation, especially with fluctuations in the currency of her major trading partners, questions arises as to whether trade can continue to be a reliable source of economic growth for Nigeria.

Consequently, government and relevant authorities all over the world employ the exchange rate as a policy tool to manage the volume of net export as well as the general price level in an economy. Dania and Ogedengbe (2019) noted that the impact of the exchange rate volatility on exports flow especially in developing countries like Nigeria has been described as one of the main sources of economic instability and uncertainty. The unexpected swing in the exchange rate of the naira has been enormously identified as volatile. Based on the study, a series of recent academic papers have touched on sustainability of exchange rate in relation to general export (oil and non-oil) forgetting the fact that the quality and price of oil export is not determined by domestic countries.

The year 2009 was overcast by the global financial and economic crisis which was precipitated in August 2007 by the collapse of the sub-prime lending market in the United States. The crisis led to the crash of most other sectors and markets across Europe with consequent effect on developing economies especially oil-export dependent countries like Nigeria. The spiral effect of the global economic crisis on

Nigeria economy continued in 2009 with the exorbitant lending rate mounting pressure on the stock market as a result of massive borrowed fund in the market. The rush by stock investors to liquidate their investment to repay their loans in order to avoid the excessive lending rate caused the Nigerian stock market to crash. This decline was also driven by concerns over unrealistically high valuations in practically all sectors. Regulatory intervention in the equities market only served to erode investor confidence further, especially among institutional investors, as the measures failed to address the fundamental issues. It has been asserted that Naira is largely delinked from the productive capacity of the real sector resulting in the Naira exchange rate being adjudged to be misaligned. Nonetheless, the possibility of the presence of negative relationship between exchange rate (EXR) and export (EX) growth (as a proxy for productive capacity of the real sector) has led to the emergence of the issue of causality. It is possible that depreciation or devaluation in the international value of Naira (EXR) will lead to rapid growth of export performance, or that growing export have positive effect on Naira value (EXR). Neither of these possibilities can be ruled out, hence the need for empirical studies on the subject.

This study aimed at examining the impact of exchange rate fluctuation on export in Nigeria over a period of 38 years, 1983 - 2020. The error correction model is used to estimate the model. Granger causality test is thereafter applied to identify the presence or otherwise of causality between the two variables.

Literature Review

In accordance with Marshall-Lerner condition, which is relevant in developing countries like Nigeria, takes into consideration many channels through which an exchange rate change passes to affect the balance of trade. The condition states that,

for a currency devaluation to have a positive impact on trade balance, the sum of price elasticities of exports and imports (in absolute value) should be greater than 1 (ηxe + ηme >1),where ηxe and ηme are common notation for the elasticity of exports and imports with respect to the exchange rate respectively. As a devaluation of exchange rate means a reduction in the price of exports, quantity demanded for these will increase. At the same time, price of imports will rise and the quantity demanded will diminish.

Also, in accordance with exchange rate theory based on export and import elasticity approach, there is a positive correlation between rate of exchange and export and negative correlation between rate of exchange and import. If domestic currency is depreciated toward foreign exchange, export will be upgrading competitiveness for bearish cost in market export. Then, it will cause upgrading export demand which be followed foreign exchange supply in domestic. In other hand, demand of import will be down as sequence of import cots upgrading in domestic. Furthermore, foreign exchange demand will be down if domestic currency appreciated so export will be down for upgrading cost in the export market and foreign exchange supply will be upgrading in domestic. However, import will be up for bearish cost of domestic currency, foreign exchange demand will also be up for import budgeting. This condition will stop if equilibrium in foreign currency market is reached (Salvatore, 2013).

Aro-Gordon (2017) investigated the causal relationship between currency exchange rate (EXR) and export growth (EXP) in Nigeria. The study used econometric tools for the analysis based on statutory annual data over the period 1970-2014. It is shown that EXR and EXP are not co-integrated. The Granger causality test shows significant absence of short run nexus between EXR and EXP but there is a uni-directional causality running from EXR to EXP with no feedback. Uduakobong and Williams

(2018) analyzed the relationship between exchange rate volatility and non-oil exports in Nigeria using annual data covering the period of 1970 to 2015. The study employed the Johansen test of co-integration, error correction model and the Granger causality test to achieve the objectives. The results indicate that there exists a long run relationship between exchange rate and non-oil exports. The Granger causality test revealed that there existed uni-directional causality running from EXR to non-oil exports. Yinusa (2008) investigated the relationship between nominal exchange rate volatility and dollarization in Nigeria by applying Granger causality test for the period 1986-2003 using quarterly data. The study revealed a bi-causality between them but the causality from dollarization to exchange rate volatility appears stronger and dominates. Oyinbo *et al.,* (2014) examined the causal relationship between exchange rate deregulation and the agricultural share of the GDP in Nigeria from an econometric perspective, using time series data spanning a period of 26 years, 1986-2011. Data on EXR and GDP were analyzed using Augmented Dickey Fuller unit root test, unrestricted vector auto regression, pair-wise Granger causality and vector error correction model. The authors' result showed a existence of uni-directional causality from exchange rate to agricultural share of GDP and also exchange rate deregulation had negative influence on agricultural share of GDP in Nigeria. Fapetu and Oloyede (2014) examined EXR and the Nigerian economic growth from 1970-2012 using Central Bank of Nigeria(CBN) sourced data and OLS estimation technique with error correction model framework, and found out that EXR was not statistically significant. Obinwanne *et al.,* (2015) examined EXR and economic growth in Nigeria using Granger causality approach. The paper attempted to model the Nigerian economy as a function of exchange rate and other macroeconomic variables deploying unit root and co-integration tests to determine the suitability of the variables. The vector autoregressive (VAR) model was used to estimate the model. Granger causality was

used to identify the presence or otherwise of causality among the variables. Adeniran *et al.,* (2014) examined the impact of exchange rate on economic growth in Nigeria from 1986 to 2013 using the correlation and regression analysis of the ordinary least square (OLS) to analyze the data. The result of the work showed that EXR had no significant impact on national economic growth. Tatliyer and Yigit (2016) investigated how exchange rate volatility influences foreign trade in Turkey. The study used quarterly time series data covering the period 1990 to 2015. The Johansen co-integration test, VECM as well as VAR Granger causality test was employed for the study. The finding showed that exchange rate volatility had no long run effect on exports in Turkey. Erdal *et al.,* (2012) conducted an empirical study on the effect of real effective exchange rate volatility (REERV) on agricultural export (AGX) and agricultural import (AGM) in Turkey. The study period covered 1995 to 2007. The GARCH model, Johansen co-integration test was used. The direction of the relationship, on the other hand, was determined using pair-wise Granger causality. The results indicate that there exist a positive long-term relationship between exchange rate and agricultural export, while there was a negative long-term relationship between exchange rate and agricultural import.

Methodology

The exchange rate of Naira (EXR) and the total volume of exports (EX) form the two main variables for the empirical causality analysis. The empirical analysis was based on time series for the period from 1983-2020 having the span of 38 years of secondary data sourced primarily from the Central Bank of Nigeria Bulletin and World Development Indicators (WDI).

Data were processed and analyzed by applying econometric tools and techniques supported by E-View9.0 statistical package. The analysis comprised of (a) testing the

stationary of data using Augmented Dickey Fuller (ADF) Unit Root Test Method, (b) testing the co-integration between EXR and EX growth rate by applying Johansen's Co-integration Test, (c) fitting an error correction model (ECM) if co-integration was established, and (d) proceeding to testing the presence of causal relationship between EXR and EX by administering the Granger Causality Test upon confirmation of variables being co-integrated.

After getting an initial feel on the possible nature of the time series between EXR and EX growth rate, the study proceeded with the next test of stationarity based on Unit Root Test using the ADF which basically consisted of estimating the following regression: $Y_t = \beta_0 + \beta_1 X_t + \mu_t$ .....(1) where, Y_t represents the time series to be tested, X_t is the independent variable, β_0 is the intercept term, β_1 is the coefficient of intercept and μ_t is the stochastic error term. The functional form of the model is written as; $EX = F(EXR)$ ..... (2)

The econometrics form of the model is written as: $EX_t = \beta_0 + \beta_1 EXR_t + \mu_t$ .....(3)

The model is rewritten in a log form as: $\log EX_t = \beta_0 + \beta_1 \log EXR_t + \mu_t$ .....(4)

The stationary condition under ADF test requires that p-value must be less than 1.The decision rule is to reject the null hypothesis if the ADF statistics value exceeds the critical value at a chosen level of significance (in absolute terms). If stationary of all the series in the same order is obtained, the researcher will proceed to ascertain the presence or absence of any long run relationship among variables using Johansen co-integration technique. The decision rule is to reject the null hypothesis of no co-integration if the Trace statistic value exceeds 5% critical value and accept if otherwise.

Given that EXR and EX growths are typical time series and that there might be some disturbance or disequilibrium in the short-run, ECM was used to measure the speed of correction or convergence into the long-run steady of equilibrium. Thus, the ECM is stated as follows: $D(\log EX)_t = \beta_0 + \beta_1 D(\log EXR)_t + ECM(-1) + V_t \ldots\ldots\ldots\ldots\ldots\ldots (5)$

This study mainly tends to determine the direction of causality between variables. The study employed the Pair-wise Granger Causality test of 1969. The causality outcome can be a uni-directional or a bi-directional one. In the present study based on two variables, namely, EXR and EX, the decision rule states that the p-value is a number between 0 and 1, where a small p-value (usually ≤ 0.05) indicates strong evidence against the null hypothesis, leading to rejection of the null hypothesis. A large p-value (>0.05) suggests weak evidence against the null hypothesis. If a variable granger causes another, then it means that causality runs from the former to the latter. If the null hypothesis is rejected, it implies that we accept the alternate hypothesis and conclude that granger causality exist between both variables.

The following null hypotheses will be tested for this study:

H_1: Exchange rate (EXR) has a unit root.

H_2: Export volume (EX) has a unit root.

H_3: There is no co-integration between EXR and EX.

H_4: EX does not Granger-cause EXR

H_5: EXR does not Granger-cause EX

Results and Discussion

Unit Root Test: The result of the ADF Unit Root Test conducted is presented in Table i below. The results show that the null hypotheses H_1 and H_2 that EXR and EX have unit roots is rejected since the p-value (0.0000) is less than 0.05 at first difference at 5% level of significance in the case of export. For EXR, the p-value (0.0024) is less than 0.05 at level at 5% significance level. Therefore, EX and EXR is said to be stationary and the

alternate hypotheses accepted. Hence, the stationary of the variables to be analyzed has been established.

Table 1: The ADF Unit Root Test Results for EX and EXR

Variable	ADF Statistic	Level of Significance	Lagged difference	Critical Values	Order Of Integration	Probability value
LOGEX	-5.981105	5%	2	-2.945842	I(1)	0.0000
LOGEXR	-4.175907	5%	2	-2.945842	I(0)	0.0024

Source: Author's Computation using E-view 9.0

Co-integration Test: Table 2 below presents the results of the co-integration test conducted using Johansen co-integration technique to ascertain the presence or absence of any long run relationship between variables. The decision rule is to reject the null hypothesis of no co-integration if the Trace statistic value exceeds 5% critical value and accept if otherwise. Based on the table below, the test indicates 2 co-integrating equations at the 0.05 level of significance which shows that our p-values (0.0035 & 0.0078) are less than 0.05 and our T-statistic value exceeds the 5% critical value. Therefore, we reject the null hypothesis of no co-integration and conclude that EX and EXR co-integrates.

Table 2: The Unrestricted Co-integration Rank Test (Trace) Results

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.364398	24.55461	15.49471	0.0017
At most 1 *	0.204584	8.240033	3.841466	0.0041
Trace test indicates 2 co-integrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				

Source: Author's Computation using E-view 9.0

Error Correction Model: The ECM is initiated in order to identify the speed of adjustment from the short run equilibrium to the long run equilibrium state. The greater the coefficients of the parameter, the higher the speed of adjustment of the model from the short run to long run. The study represents eqn (5) in an error correction form that allows for inclusion of long run information. Thus, the ECM equation is stated as follows;

$$D(\log EX)_t = \beta_0 + \beta_1 D(\log EXR)_t + ECM(-1) + V_t \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Table 3: The Error Correction Model Results

ECM(-1) Coefficient	-0.069113
Prob. (0.05)	0.0168
Standard Error	0.027485
T-statistic	-2.514570
R^2	0.188142
DW	2.180464
Prob. (F-statistic)	0.028917

Source: Author's Computation using E-view 9.0

Based on the table above, The ECM is no spurious regression model as indicated by the R-squared and Durbin-Watson statistics. It is also negative and statistically significant (p-value 0.0168) as desired. With the negative sign and significant values

of the ECM, it validates the long run equilibrium relationship existing between the variables of the model.

Granger Causality Test: The causality outcome can be a uni-directional or bi-directional one. The results from the Table iv below shows a uni-directional causality running from exchange rate to export where its p-value (0.0396) is less than 0.05 significance level while no causality running from export to exchange rate as its p-value (0.2966) is greater than 0.05 significance level.

This shows that over the 38 years under study, the Nigeria export performance have been significantly influenced by exchange rate variations. Therefore, the H_4 null hypothesis, that EX does not Granger-cause EXR will be accepted. This shows that the volume of export does not granger-cause the variations of the naira exchange rate.

Then, the H_5 null hypothesis that EXR does not granger-cause EX will be rejected and the alternate hypothesis of causality from EXR to EX will be accepted. This tends to imply that variations in exchange rate and many other factors are indicated responsible for the determination of export in the economy.

Table 4: The Pair-wise Granger Causality Test Results

Pair-wise Granger Causality Tests

Date: 04/15/22 Time: 19:16

Sample: 1983 2020

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
LOGEX does not Granger Cause LOGEXR	38	1.26412	0.2966
LOGEXR does not Granger Cause LOGEX	38	3.58836	0.0396

Source: Author's Computation using E-view 9.0

Summary of Findings

The research empirically investigated the causal relationship between variations in exchange rate and export volume in Nigeria using the annual time series data from 1983 to 2020. In order to achieve this, series of econometrics tests was employed to ascertain the stationary of variables by employing the Augmented Dickey-Fuller test; the long run relationship by using Johansen co-integration test, which when obtained, the ECM was applied to account for the speed of adjustment from short run equilibrium state to long run equilibrium state. Then, the Granger Causality test was conducted using Pairwise Granger causality test to account for the causality relation between EX and EXR. Based on the unit root test conducted using Augmented Dickey Fuller test, both EX and EXR are stationary. The Johansen Trace test co-integration indicated existence of a long run relationship between EX and EXR. Having obtained this relationship, the ECM was carried out which came out negative and statistically significant as desired. The granger causality test showed a uni-directional causality running from exchange rate to export. The result also indicated that export does not granger cause exchange rate in the given period of study. This existence of causality flowing from EXR to EX identifies that a change in exchange rate will bring about change in the export volume, holding other factors constant which may imply that a fall in the currency value of the country makes export cheaper, which attracts more foreign buyers and encourages more production, ceteris paribus. For many years, Nigeria has experienced low level of non-oil exports and a situation where changes in the Naira value are linked to the real sector of the economy. Apparently, for the value of Naira to be sustainable, there has to be a strong diversification in all sectors of the economy in order to trigger production, processing, and packaging of the country's products for international market. This effect can widen sources of foreign exchange earnings to remove pressure on the Naira.

Conclusion and Recommendations

The study identified uni-directional causality from exchange rate of Naira to export volume over the 38 observed years. It indicated that Nigeria exchange rate has a significant impact on the export growth. A single commodity dependent emerging market like Nigeria who trades more of crude oil in the overseas market, the thesis that devaluation of currency enhances exportation is empirically supported. Sequel to the findings and conclusion, the research study, recommends that:

For the value of Naira to be favorable and sustainable, there has to be a diversification in all segments of the economy. The non oil sectors have to be expanded in order to widen sources of foreign exchange earnings. Also, the government should provide the citizens and serious entrepreneurs with basic infrastructures, business-friendly environment, incentives, investment-friendly tax regime, flexible exchange rate policy, power supply and among others so that the infant and medium industries can contribute to exportation, job creation and economic growth of the nation. The study also recommend that government should employ trade policies and conditions that will promote domestic production in the economy, satisfy local consumption, reduce demand and pressure on the naira exchange rate, and stabilize the rate while increasing productivity, boosting inventory of export goods, growth and income in the economy.

References

Adeniran, J.O., S.A. Yusuf and O.A. Adeyemi, 2014. The impact of exchange rate fluctuation on the Nigerian economic growth: An empirical investigation. *International Journal of Academic Research in Business and Social Sciences*, 4(8): 224-233.

Aro-Gordon, S. (2017). Econometrics analysis of exchange rate and export performance in a developing economy. *Asian Economic and Financial Review, 7*(4): 334-348.

Dania, E. N. & Ogedengbe, F. A. (2019). Impact of exchange rate volatility on non-oil export performance in Nigeria. *Open Journal of Economics and Commerce, 2*(1): 32-39.

Erdal, G., Erdal, H. & Esengu, K. (2012). The effects of exchange rate volatility on trade: evidence from Turkish agricultural trade. *Applied Economics Letters,* (19): 297-303.

Ewetan, O.O. & H. Okodua, 2013. Econometric analysis of exports and economic growth in Nigeria. *Journal of Business Management and Applied Economics*, 2(3): 1-14.

Fapetu, O. & J.A. Oloyede, 2014. Foreign exchange management and the Nigerian economic growth(1970-2012). *European Journal of Business and Innovation Research*, 2(2): 19-31.

Obadan, M. I. (2016). Overview of Nigeria's exchange rate policy and management, Lagos: *C.B.N Publications, 2004.*

Obinwanne, E.E., Chidi, O.U. & Agartha, O.N.(2015). Exchange rate and economic growth in Nigeria: A causality approach. *Programme Details and Initial Book of Abstracts, International Symposium on Mathematical and Statistical*

Finance, Training the Next Generation of African Financial Mathematicians, Ibadan, September 1-3, 2015, Paper 25, pp: 17.

Oyinbo, O., F. Abraham C., & Rekwot, G.Z. (2014). Nexus of exchange rate deregulation and agricultural share of gross domestic product in Nigeria. *CBN Journal of Applied Statistics*,5(2): 49-64.

Salvatore, D. (2013). International Economics (8thEd.).New York:John Wiley and Son Inc.

Tatliyer, M. & Yigit, F. (2016). Does exchange rate volatility really influence foreign trade? Evidence from Turkey. *International Journal of Economics and Finance, 8*(2): 33- 43

Uduakobong, S. I. & Williams, A. O. (2018). Non-oil exports, exchange rate volatility and co-integration: Evidence from Nigeria. *International Journal of Economics, Commerce and Management, 6*(6) 567-586.

Yinusa, D. O.(2008). Between dollarization and exchange rate volatility: Nigeria's portfolio diversification option. *Journal of Policy Modeling, 30*(5): 811-826.

Appendix

Table A1: Unit Root Test result for Export at first difference

Null Hypothesis: D(LOGEX) has a unit root

Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.981105	0.0000
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Table A2: Unit Root Test result for EXR at level

Null Hypothesis: LOGEXR has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.175907	0.0024
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

Table A3: ECM result
Dependent Variable: D(LOGEX)
Method: Least Squares
Date: 04/15/22 Time: 19:21
Sample (adjusted): 1984 2020
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.192590	0.064150	3.002157	0.0050
D(LOGEXR)	-0.179283	0.183431	-0.977388	0.3353

ECM(-1)	-0.069113	0.027485	-2.514570	0.0168

R-squared	0.188142	Mean dependent var	0.203044
Adjusted R-squared	0.140386	S.D. dependent var	0.419004
S.E. of regression	0.388481	Akaike info criterion	1.024461
Sum squared resid	5.131199	Schwarz criterion	1.155076
Log likelihood	-15.95252	Hannan-Quinn criter.	1.070509
F-statistic	3.939635	Durbin-Watson stat	2.180464
Prob(F-statistic)	0.028917		