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The Effect of Exchange Rate on Gross Domestic Product (GDP) on the Nigerian Economy using ARDL-ECM approach.

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Abstract: *This paper investigates the effect of exchange rate on gross domestic product (GDP) on the Nigerian economy from 1981-2021. The data was obtained from the CBN annual statistical bulletin. The application of the ARDL-ECM procedure for the analysis indicated that GDP in Nigeria is not responsive to exchange rate movement on the long run. A short run relationship was found to exist between GDP and exchange rate which is statistically significant. The Error correction mechanism (ECM) was found to have a short run dis-equilibrium adjustment of about 68.75% for correcting any deviation from the long run equilibrium. The model did not have a serial correlation but was found to be stable, which indicated that the result maybe appropriate for policy stipulation. Findings from the data obtained confirmed that policy makers should not completely rely on exchange rate manipulation as an instrument to boost the economy but should consider other economic variables to strengthen the GDP of the economy.*

Keywords: *Auto-regressive distributed lag, error correction model, official exchange rate, gross domestic product.*

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1.0 Introduction

There is no country in the planet that has complete economic independence. The world economy economies of the world are interrelated in one way or the other be it in terms of import, export, Forex, foreign direct investment and many more. In most economic relations that exist between countries. The foreign exchange plays an important role. The price (value) of foreign currency in terms of local currency is actually very important in understanding the growth of all the countries. Strong evidence abounds on strong alignment between exchange rate and growth of per capital output in developing nations (Babatolu, 2015; Ahmed *et al.* 2019).

In developing countries, exchange rate policies are often sensitive and controversial,

mainly because of the kind of structural transformation required, such as reducing imports or expanding non-oil exports, which invariably imply a depreciation of the nominal exchange rate. Such domestic adjustments, due to their short-run impact on prices and demand, are perceived as damaging to the economy. Ironically, the distortions inherent in an overvalued exchange rate regime are hardly a subject of debate in developing economies that are dependent on imports for production and consumption (Akpan, 2010).

The Exchange rate reflects the ratio at which one currency can be exchanged with another currency, namely the ratio of currency prices. It is the value of a foreign nation's currency in terms of the home nation's currency. It also specifies how much one currency is worth in terms of the other.

A correct or appropriate exchange rate is one of the most significant factors that can develop nations. Also, uneven or unpredictable fluctuations in exchange rate has to the economic growth of most developing countries in Africa, including Nigeria (ref). Since Nigeria's independence in October 1960, her monetary authorities has pursued vigorously the objectives of internal and external balance in a desperate bid to raise the standard of living, alleviate poverty and acquire economic and political power, stability and prestige. They did this by administratively adjusting the foreign exchange rate of the domestic currency *Vis-a Vis* the peculiar and prevailing economic situations (Osuka & Osuji, 2008).

Literature have shown that several flexible exchange rate systems have been introduced and the dynamic effect on economic growth and development has not been even across the different countries in the same vein, explanations as to which macroeconomic variable(s) is significantly affected by the exchange rate volatility in a particular economy have also received considerable attention to provide policy guidance to economic managers of different countries (Bala & Asemota, 2013).

Changes in the economy and structural shifts in production are the key factors that brought about the evolution of the foreign exchange market in the Nigerian economy. Private sectors and commercial banks earned and held foreign exchange by acting as local agents during which agricultural export was the main source of foreign exchange receipt (Babatolu, 2015).

A comprehensive exchange rate came to bear in Nigeria around 1982, despite that the foreign exchange was deficient in yielding an adequate means of foreign exchange alleviation in line with the requirement of internal balance. These resultant shortfalls brought about the introduction of what is called as Second Tier Foreign Exchange Market (SFEM) in 1986; through which market forces dictate exchange rate and budget allocation. In 1989, the scope of the exchange rate bureau was broadened.

Yet another reform was introduced in 1994 due to volatility in the exchange market, which include official pegging of the Naira exchange rate, centralization in the Central Bank of Nigeria (CBN), restriction on Bureau De Change, the reaffirmation of the illegality of parallel market, discontinuation and bills of payment. The introduction of an Autonomous Foreign Exchange Market (AFEM) brought about the liberalization of the foreign exchange market in 1995 by the CBN. In October 1999, the foreign exchange witnessed yet another liberalization with the introduction of the Inter-Bank Foreign Exchange Market (IFEM) (CBN, 2014), (Akpan & Atan, 2010).

Following the failures of the variants of the flexible exchange rate mechanism (the AFEM introduced in 1995 and the IFEM in 1999) to ensure exchange rate stability, the Dutch Auction System (DAS) was re-introduced on July 22, 2002. The DAS was to serve the triple purposes of reducing the parallel market premium, conserve the dwindling external reserves and achieve a realistic exchange rate for the naira. The DAS helped to stabilize the naira exchange rate, reduce the widening premium, conserve external reserves, and minimize speculative

tendencies of authorized dealers. The foreign exchange market has been relatively stabilized since 2003 (NDIC, 2015).

Although economic theory suggests that the type of exchange rate arrangement may matter for growth, it does not clearly ascertain what type of arrangement would be more likely to promote growth. It not noticeably articulates how the exchange-rate regime and particularly the exchange-rate peg affects economic growth. Instead, arguments typically focus on its impact on investment and international trade (primarily exports).

Mamuda *et al.* (2021), researched on the effect of exchange rate on economic growth from 1986 to 2019. The author used regression analysis of ordinary least square to analyse the data. The result revealed that exchange rate has significant positive effect on economic growth while interest rate and inflation rate have significant negative effect on economic growth. The author concluded that exchange rate promotes economic growth. Therefore, in order to maintain a surplus balance of trade, it is recommended that government should encourage export promotion strategies and also provision of conducive environment, adequate security, and effective fiscal and monetary, as well as infrastructural facilities should be available in order to attract foreign Investors to invest in Nigeria.

Iheanachor *et al.* (2021), also worked on the consequence of exchange rate fluctuation on Nigeria's economic performance using an Autoregressive distributed lag approach. The Authors empirical results revealed that exchange rate, net direct foreign direct investments, and inflation rate had a significant adverse impact on Nigeria's economic growth in the long run. By implication, the net effect of this study established that excessive exchange rate fluctuations are detrimental to Nigeria's economic growth.

Hassan *et al.* (2020), investigated the impact of Exchange rate volatility on the South African Government bond market and the economy as a whole. The author utilised a quantitative technique with a Johansen co-integration estimation technique to determine whether the variables were co-integrated and to determine the effect of exchange rate volatility on the bond market and the economy. GARCH was used to generate exchange rate volatility from rand/US dollar exchange rate series, which was then used with other variables in a VECM for the main estimation. Monthly datasets from January 2000 to December 2018 were analysed with variables such as exchange rate, bond yields, real GDP and CPI included The result indicated that exchange rate volatility is one of the factors limiting the Potential of the economy's bond market by discouraging foreign investment in the market. To this end, both the monetary and fiscal authorities in the country need to work together to formulate and implement policies that would reduce the volatility in the South African currency.

Achouak *et al*. (2018), treated the impact of exchange rate volatility on economic growth. An empirical investigation based on a sample of 45 developing and emerging countries over the period of 1985-2015 was conducted using the difference and system generalized method of moment's estimators. The Authors result suggested that the generalized autoregressive conditional heteroskedasticity-based measure of nominal and real exchange rate volatility has a negative impact on economic growth. Also, the effect of exchange rate volatility depends on the exchange rate regimes and financial openness, that is, volatility is more harmful when countries adopt flexible exchange rate regimes and financial openness.

Babatolu *et al.* (2015), treated how the exchange-rate regime impacts on growth which shows no impact in the short run. The authors stated that the theoretical literature on the subject was quite thin and usually derived from studies that were indirectly linked to growth, such as export growth or currency crises. The linkage between the regime and economic growth exists, but the sign of the influence is blurred. Advocates of exchange-rate aging (hereafter ERT) strategy usually highlight that by the reduced policy uncertainty and lowered interest-rates

variability. From their results, the strategy promotes an environment that was conductive to growth. On the contrary, an exchange-rate target does not provide an adjustment mechanism in times of shocks, thus stimulating protectionist behaviour, distorted price signals and therefore misallocation of resources in the economy.

Kalu and Ogunjo (2015) examined the causal relationship between exchange rate and Gross Domestic Product using the pairwise Granger causality and also estimate the Error Correction Term (ECT) in a Vector Auto-Regression (VAR) model environment. The result showed that there exists a unidirectional causality running from exchange rate GDP and that the exchange rate deregulation has negatively influenced the GDP in Nigeria.

2.0 Materials and Methods

The research used the econometric method of autoregressive distributed lag and Error Correction Model (ARDL-ECM) to examine the co-integration or long-run relationship between GDP and exchange rate in Nigeria. The research adopts the method of Idris *et al.* (2016), Adamu *et al.* (2021). Data was sourced and obtained mainly from the 2021 statistical bulletin of the Central Bank of Nigeria (CBN). The sample covers a period from 1981-2021.

2.1 Model specification

The model used in this research work had the following specification:

The functional form is: *GDP = f* (*EXR*)

Where, GDP is Gross Domestic Product at 1990 constant basic principle in Billion Naira.

EXR is the official exchange rate of the Nigerian naira against the United States (U.S) dollar.

The econometric form of the Auto-Regressive Distributive Lag (ARDL) is:

- *GDP = f* (*EXR*)

where GDP is Gross Domestic Product in Billion Naira.

- EXR is the official exchange rate of the Nigerian naira against the United State (U.S) dollar.
- The econometric form of the Auto-Regressive Distributive Lag (ARDL)-Error Correction Mechanism (ECM) is;
- $\Delta GDP = \propto_0 + \propto_1 \Delta GDP_{t-i} + \propto_2 \Delta EXR_{t-i} + \propto_3 GDP_{-1} + \propto_4 EXR_{-1} + \varepsilon_t$

  Where;
- ΔGDP_{t-i} Is the first difference GDP at the appropriate lag as indicated by the Akaike and Schwatz criterion.
- ΔEXR_{t-i} Is the first difference EXR at the appropriate lag as indicated by the Akaike and Schwatz criterion.
- $\propto_3$ And $\propto_4$ are the estimates for the long run relationship in the model.
- The Error Correction Mechanism (ECM) model is given by;
- $\Delta GDP = \propto_0 + \propto_1 \Delta GDP_{t-i} + \propto_2 \Delta EXR_{t-i} + \propto_3 ECT_{-1} + \varepsilon_t$

where ECT is the Error Correction Term which measures the speed of adjustment form the long run dis-equilibrium back to the long run equilibrium. The variable used is the residual derived from the ordinary least square (OLS) regression of the data at levels.

2.2 Analysis of Data

In this study, we employed quantitative tools (Usman *et al.* 2017a; Usman *et al.* 2017b; Zakari *et al.* 2018; Usman *et al.* 2021) for data analysis which included, the Augmented Dickey-Fuller (ADF) unit root test for stationarity, followed by estimating the Co-integration regression to determine if the variables have a long-term or equilibrium relationship using the Auto-Regressive Distributive Lag (ARDL) method. The Error Correction Mechanism (ECM) was used to determine the short run disequilibrium adjustment while the Wald test was used to test for the short run relationship. The ECM model was tested for adequacy by the serial correlation test.

3.0 Data Analysis and Findings

3.1 Unit root test

Unit root tests are tests for stationarity in a time series. A time series has stationarity if a shift in time doesn't cause a change in the

Table 1: Augmented dickey-fuller test statistics

Variable	ADF	1%	5%	10%	P-Value
GDP(level)	0.968377	-3.614578	-2.941115	-2.608046	0.8943
1st diff GDP	-2.180395	-3.614578	-2.941115	-2.608046	0.1945
EXR(level)	2.148255	-3.610551	-2.938667	-2.607912	0.9789
1st diff EXR	-4.131791	-3.614587	-2.941275	-2.609056	0.0017

***Significant at 5%**

shape of the distribution; unit roots are one cause for non-stationarity. The Augmented dickey-fuller test is one of the powerful test used to check for stationarity as shown in Table 3 below**.**

The stationarity test was conducted on the variables using the Augmented Dickey-Fuller methodology t the results gotten are presented in Table 1. The result shows that the GDP is not stationary at levels and at the first difference since the calculated p-values are greater than the α-value (0.05). However, the EXR is stationary at the first difference but not at the levels. These observations are consistent with the expectation of using the Auto-Regressive Distributive Lag (ARDL) methodology.

3.2 Lag selection

To determine the lag length appropriate for the model. Three (3) criteria were selected, including the Akaike, the Schwarz and the Hannan-Quinn information criterion. Starting from lag 0 to lag2, their values are given in Table 2 below,

Table 2: Lag Length Selection

Lag	AIC	SC	HQ
0	27.73270	28.12489	27.96776
1	21.54144	21.81200	21.73473
2	**21.18201***	**21.61386***	**21.50132***

From Table 2, it is indicated that the selected lag length is two (2), because lag 2 has the smallest values for the Akaike, Schwarz and Hannan-Quinn information criterion.

3.3: Bound test for co-integration

To determine if there exist a long-run relationship among the variable, a bound test for co-integration must first be conducted and hence using the F-test or T-test to check for joint significance as shown in Table 3 below.

Table 3: Results of ARDL bounds test

F-Bounds Test			**Null Hypothesis: No levels relationship**	
Test Statistic	**Value**	**Sig.**	**I(0)**	**I(1)**
T-statistics	0.113071	5%	Asym. critical value for rejecting the null hypothesis	
F-statistics	0.692850	10%	4.04	4.78
		5%	4.84	5.70
		2.5%	5.67	6.64
		1%	6.74	7.64

The result from the table above shows that the value of the F-statistic (0.692850) is less than the $I(0)$ bound values for all levels of significance, this implies that the null hypothesis for no levels relationship is not rejected. Regarding the T-statistic, the absolute calculated value (0.113071) is also lower than the critical values of the lower bound for all level of significance considered and hence according to the above result, it implies that there is no co-integration among the variables. Therefore, it can conclude that

between GDP and EXR there exist only a short run relationship. The modelling of these relationship can be done using the short run ARDL model.

3.4: Short-run ARDL Model of GDP in relation to EXR.

After checking for long-run relationship, then a short-run is required to validate the nature of the relationship that exist between the variables of interest as shown below.

The coefficient of the ARDL short-run in table 4 shows that GDP in billions of naira is statistically significant and influenced by its own value for both lags. From the coefficient column, it shows that average exchange rate is positive but has no significant influence on GDP. The R-squared value of 0.987582 shows that the model is of good fit i.e 98.7582% of the variation of the dependent variable can be explained through the ARDL model. According to the Fishers test, the short run ARDL model of GDP in relation to EXR is statistically significant since its p-value is less than 0.05.

Table 4: short run ARDL test

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GDP_IN_BILLIONS_OF_NAIRA(-1)	1.556787	0.143524	10.84687	0.0000
GDP_IN_BILLIONS_OF_NAIRA(-2)	-0.511755	0.159676	-3.204950	0.0030
AVERAGE_EXR	-1.539880	0.917872	-1.677664	0.1029
C	-111.4508	58.77335	-1.896282	0.0667
@TREND	14.80975	5.925343	2.499391	0.0176
R-squared	0.987582	Mean dependent var		1005.127
Adjusted R-squared	0.984925	S.D. dependent var		1578.211
S.E. of regression	123.0071	Akaike info criterion		12.58444
Sum squared resid	499314.6	Schwarz criterion		12.79991
Log likelihood	-234.1044	Hannan-Quinn criter.		12.66110
F-statistic	1514.440	Durbin-Watson stat		2.189579
Prob(F-statistic)	0.000000			

3.5: Model selection criteria table and graph

Model selection criteria are rules used to select a statistical model among a set of candidate models, based on observed data. Typically, the criteria try to minimize the expected dissimilarity measured by the Kullback-Leibler divergence, between the chosen model and the true model (i.e., the probability distribution that generated the data). In this paper the Akaike's information criteria is used and taken into account because it has the list value as shown in Table 5 below.

Table 5: Model Selection Criteria

Model	AIC*	BIC	HQ	Adj. R-sq	Specification
3	12.584440	12.799912	12.661104	0.993925	ARDL(2, 0)
2	12.601613	12.860179	12.693609	0.993954	ARDL(2, 1)
1	12.626285	12.927946	12.733613	0.993931	ARDL(2, 2)
5	12.736064	12.951536	12.812728	0.992931	ARDL(1, 1)
4	12.788695	13.047261	12.880691	0.992710	ARDL(1, 2)
6	12.802800	12.975178	12.864131	0.992269	ARDL(1, 0)

From Table 5, we consider the Akaike information criteria for the model selection, and it can be observed that ARDL (2,0) has the smallest lag value and hence it's the most appropriate model amongst the six of them. ig 1 is shown in other to illustrate a clearer view**.**

3.6: Model diagnostic checking

A diagnostic check is appropriate in order to establish whether the model can be accepted for policy formulation or not. The serial correlation test and the stability test are conducted to establish the model robustness as shown in Table 6.

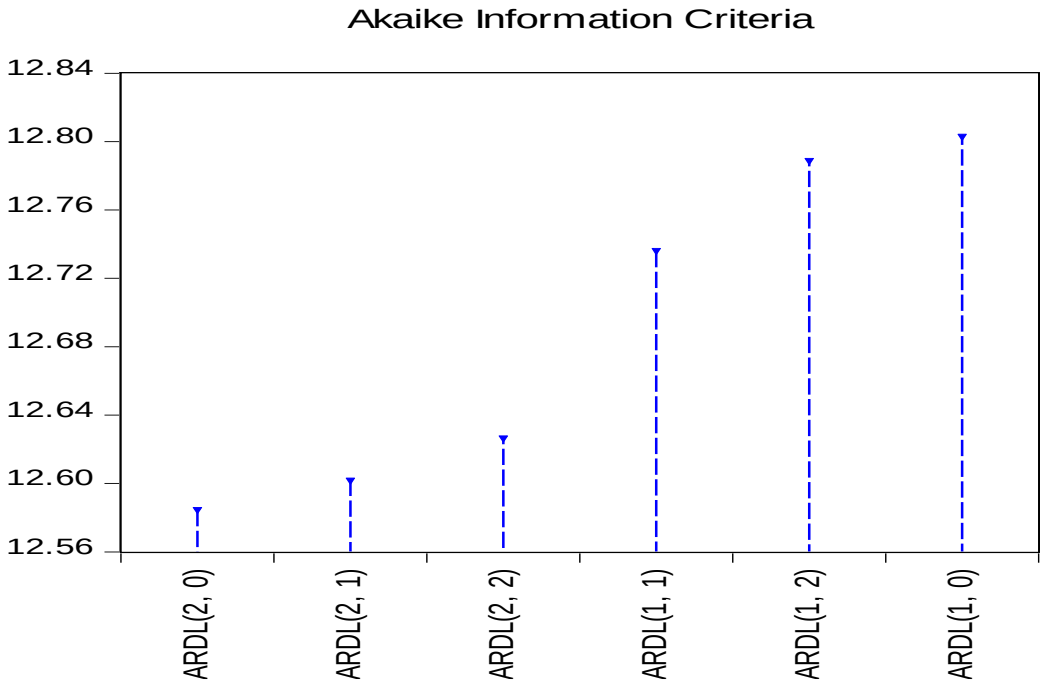

Fig 1: Model Selection Graph.

Table 6: Breusch-Godfrey serial

F-statistic	0.894609	Prob. F(2,31)	0.4932
Obs*R-squared	2.051409	Prob. Chi-Square(2)	0.3780

Correlation LM test.

From the table above, the result of the F-statistic with a p-value of 0.4932 and the observed R^2 (0.3780) indicates that the null hypothesis of no serial correlation is not rejected at 5% level of significance. This indicates that the model has no serial correlation it is appropriate for forecasting.

Stability Diagnostic Test (CUSUM)

From fig 2 it can be observed that the model is stable since it lies between the 5% boundary. Hence the model can be used for policy formulation.

3.7 ECM and Short-run Causality

The Error Correlation Mechanism (ECM) is used to determine the short run disequilibrium adjustment of the model since the model is stable and not serially correlated. To verify the robustness of the model, a pairwise granger causality test is applied as shown in Table 7.

Information presented in Table 7 shows that the ECM estimate is positive and statistically insignificant since its p-value (0.0902) is greater than 0.05, which implies that the GDP and EXR do not move together in the long run. The ECM estimate simply means that the short run dis-equilibrium between official EXR and GDP of Nigeria is adjusted at a speed of 65.67% and is statistically significant. Hence the Wald test will be conducted to determine if there is a causal effect.

3.8 Short-run Causality

A short-run causal effect using the wald test is used to test the significances of the Error

Correction term in the model as shown in Table 8 .

From the results obtained for Wald test (Table 7), the null hypothesis of no causal effect is rejected, which implies that there is a short run causality between GDP and EXR at 5% level of significance. Hence, we can infer that there is a short run relationship between the two variables.

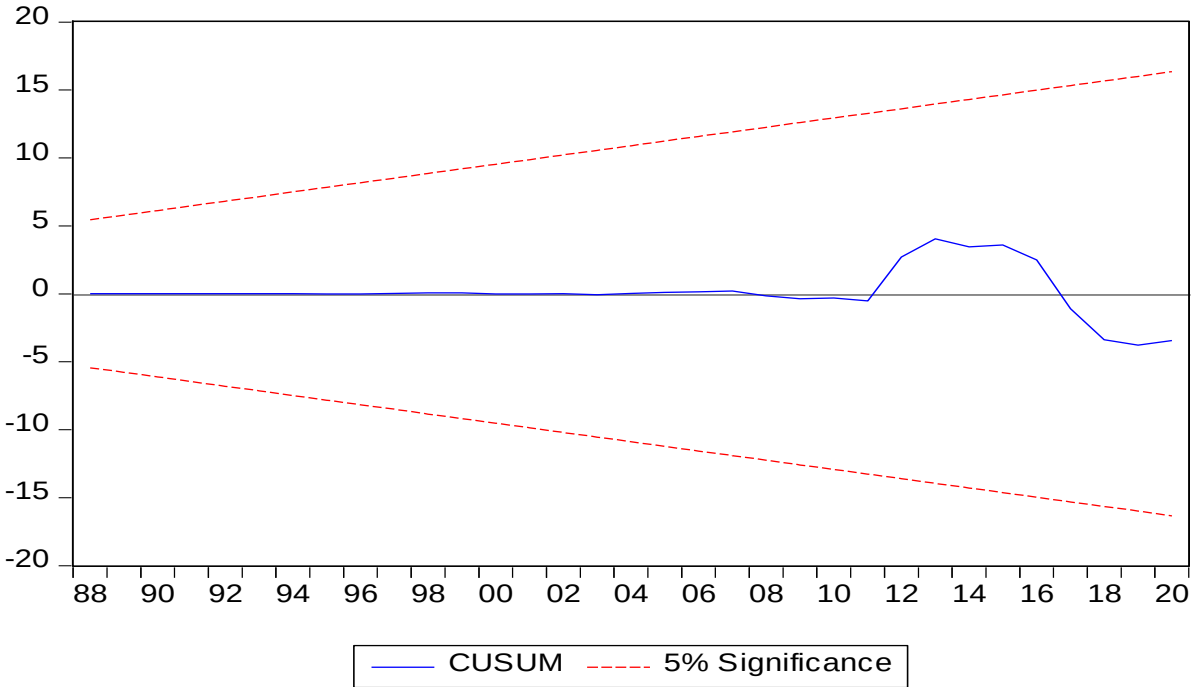

Fig 2: stability Diagnostic

Table 7: D (GDP IN BILLIONS OF NAIRA (-1))

ECM Regression

Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-111.4108	56.03108	-1.989089	0.0510
@TREND	14.80975	5.809025	2.549438	0.0156
D(GDP IN BILLIONS OF NAIRA(-1))	0.511755	0.138503	3.694910	0.0008
ECM(-1)*	0.045032	0.025801	1.745386	0.0902
R-squared	0.684585	Mean dependent var		131.8721
Adjusted R-squared	0.687584	S.D. dependent var		204.8650
S.E. of regression	121.1847	Akaike info criterion		12.53181
Sum squared resid	499314.6	Schwarz criterion		12.70419
Log likelihood	-234.1044	Hannan-Quinn criter.		12.59314
F-statistic	24.59815	Durbin-Watson stat		2.189579
Prob(F-statistic)	0.000000			

Table 8: Wald Test for Causality.

Test Statistic	Value	Df	Probability
F-statistic	492.1836	(2, 33)	0.0000
Chi-square	987.3612	2	0.0000

4.0 Conclusion

This study reveals that gross domestic product and official exchange rate of naira to dollar in Nigeria have short-run relationship which is statistically significant. That is, the official exchange rate and the gross domestic product move together in the short-run and the movement is significant. In suite of the perceived economic gains expected from currency depreciation, the shortcomings observed does not ascertain the Nigerian GDP to benefit from the official exchange rate in the long-run activities due to the unrealistic tendency of the exchange rate, low level of confidence in governance, high risk and high running cost of production (due to infrastructural decay and other factors). Consequently, it is most likely that there could be a short-run relationship between exchange rate and GDP in Nigeria if some operation factors are adjusted to their best positions. The government, policymakers, regulatory authorities and the participant must jointly and rigorously pursue measures that can enhance growth in the country's GDP.

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