An Autoregressive Distributed Lag (ARDL) Model Approach for Nigerian GDP, Exchange Rate and Foreign Import Trade

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ABSTRACT

This study examined the relationship between GPD and Exchange Rate, Foreign Trade using ARDL approach. The data used for the study was obtained from the CBN statistical Bulletin. The test of stationarity performed on the variables indicated that they are all on stationary at levels and the order of integration are (2), (1) and (1) for GDP, exchange rate and Foreign Trade respectively. The results revealed that a long-run relationship between foreign import trade, GDP and foreign exchange. The speed of adjustment to equilibrium; when there was a shift and suggested that it could take about 86.3% of previous years for it to return to a stable state. The study recommended that government should strengthen foreign exchange policies, foreign trade for a sustained economic growth.

Keywords: Adjustment, Autoregressive, Exists, Lag, Relationship,

INTRODUCTION

Economic growth and prosperity has been the goal of every nation worldwide. Developing economies like Nigeria are faced with various kinds of structural transformations as a result of the dynamic nature of Foreign exchange policies. Exchange Rate policies are sensitive and controversial to the Economic Growth of a nation, and therefore nations, put extra effort in the management and articulation of Foreign exchange policies. A Strong Exchange Rate is often considered to be an indication of good economic strength which implies a very strong growth in a nation's economy. It is also regarded as the nation's mark of pride and economic buoyancy. Econometricians assumed that the series is stationary or at least stationary with mean and variance that is time invariant. However, with recent advancement in the economy, most of the financial variable that defines the economy are not stationary as

they exhibit different features with respect to time (Nkoro and Uko, 2016).

El Aboudi et'al (2023) in a study "ARDL modeling and analysis of the impact of the interaction between the exchange rate and inflation on economic growth in Morocco" reported that short-term economic growth is significantly affected by the interaction between the exchange rate and inflation; and that economic growth does not always rely on exchange rate and inflation in the long-run. According to Labibah et'al (2020); revealed that inflation and the economic growth in neighbouring countries of China and Japan has a positive sign and significant effect on Indonesian exports in the long-run, while in the short-run us GDP and exchange rate affect Indonesian export positively. Adenomon (2016) examined the relationship between agriculture and GDP using difference regression approach model for Nigeria. He

reported that the agricultural sector contributed about 90.8% to the Nigerians GDP for the period under consideration and recommended that government should redirect the effort towards investment in the agricultural sector for a sustained economic growth in Nigeria.

The interest rate, money supply, and the exchange rate effectively influenced economic prosperity in Nigeria during the period understudy. Similarly, monetary policy did not explain economic growth over the past thirty (30) years in Nigeria (Ekong and Ukoha, 2018). Zestos et'al (2014) examined the determinant of Chinese economic growth and trade: an ARDL approach positioned that exports, imports, and the exchange rate does Granger-cause real Chinese GDP growth. Similarly, GDP of the world, Chinese imports, and the exchange rate does Granger-cause Chinese exports. Farouk et'al (2021) determined that the Inflation rate has significant impact on Nigeria Economic Growth negatively in the long and short run dynamics model estimations and recommended that combined and concerted efforts is needed seriously; both from policy makers in the private and public sectors of the economy to increase and improve the level of turnover in all vital sectors of the economy. Long run relationships exist between institutions and economic growth. Economic growth and Institution granger causes each other; however, poor institutional structure is negatively affecting the general income (Yusuf, 2013).

Anuya et'al (2019) investigate the relationship between Public Sector Credit and Economic Growth in Nigeria using ARDL modeling approach and reported that "in the long run relationship exit between public sector credit and economic growth, controlling for the influence of credit to private sector, interest rate and inflation". They recommended that

policies and the capacity of the banking sector and the financial market should give long-term credit to the public sector for be to strengthen. Udoh and Ogbuagu (2012) studied Financial Sector Development and Industrial Production in Nigeria (1970-2009): ARDL cointegration approach and concluded that "The inefficiency of the financial sector is responsible for the adverse impact on industrial production" and recommended that appropriate and effective measures should be taken to mitigate the constraints and challenges faced by small and medium scale enterprise (SME) with respect to funding schemes, so as to stimulate the Nigerian industrial sector.

Timothy et'al, (2020) opined that exchange rate volatility has a significant negative impact on Nigerian exports. Though, there is positive relationship between exchange rate volatility and import which is contrary to economic theory. Keho (2021) in a study of the Effects of Real Exchange Rate on Trade Balance revealed that the effects of changes in real exchange rate are not equivalent in both time horizons and further stated that exchange rate appreciations stimulate deteriorate the of trade balance inversely real depreciations improve it. Therefore, in the light of the empirical literatures reviewed, this study examined the relationship between GDP, Exchange rate and Foreign Trade utilizing; An Autoregressive Distributed Lag (ARDL) Model Approach for Nigerian. This is because previous studies have objectively captured that or explored adequately.

MATERIALS AND METHODS

A time series technique of ARDL was employed in investigating the relationship between Exchange Rate and Import trade on the GDP. ARDLs are a standard least squares regressions approach that includes the lags of both the response variable and explanatory variables as regressors (Greene, 2008). The model adopted in the study was explicitly

specified below (equation 1) the long run relationship, co-integrating relationship and the bound test were performed. To test for the long run response of the dependent variable to a change in explanatory variables and whether the ARDL model contains a level (or long-run) relationship between the independent variable and the regressors.

The data used in this study was obtained from the Central Bank of Nigeria (CBN) Statistical Bulletin for the period of 1994-2023 on Gross Domestic Product (GDP) Foreign Exchange and Foreign Import Trade.

Model Specification

From empirical studies of the relationships between GDP foreign exchange and foreign trade

$$Y_t = \alpha + \sum_{i-1}^{p} \theta_i y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{q_i} x_{j,\,t-i} \beta_{j,i} + e_t \tag{1}$$

is the general ADRL (p, q) model

Then for the purpose of the study the following is specified as:

$$\Delta FIT = \alpha + \sum_{i=1}^{p} \vartheta_t \Delta FIT_{t-1} + \sum_{j=1}^{q_1} \beta_t \Delta ER_{t-j} + \sum_{k=1}^{q_2} \gamma_t \Delta GDP_{k-i} + \varphi ecm_{t-1} + e_t \tag{2}$$

where:

FIT= foreign Import Trade, ER= Exchange Rate, GDP= Gross Domestic Product and ecm= error correction mechanism.

ϑ, β, γ are the short term coefficients and φ is the speed of adjustment

RESULTS AND DISCUSSION

Several ARDL models were fitted and of the 48 models e, ARDL (3, 0, 0) was selected as the most appropriate because is has the minimum Akaike's Information Criterion (AIC). The model selected was then estimated as presented in tables below.

Table 1 presented the descriptive statistics for the variables under consideration. The results indicate that the Exchange Rate was 65.21115 on the average for the period; Foreign Import Trade was 2175.073 and GDP of 112.1791 on the average.

Table 1: Descriptive Statistics

	Exchange Rate	Foreign Import Trade	GDP
Mean	65.21115	2175.073	112.1791
Median	21.88610	837.4000	94.45750
Maximum	157.4994	10995.90	237.5275
Minimum	0.610000	6.000000	56.81250
Std. Dev.	62.68289	3194.597	51.10704
Skewness	0.274824	1.609479	1.002630
Kurtosis	1.270441	4.338338	2.930589
Jarque-Bera	4.528546	16.71015	5.535594
Probability	0.103906	0.000235	0.062800
Observations	33	33	33

The table 2 above presents tests for the stationarity of the three variables. The results indicated that they are all non-stationary and are suitable for this kind of study (Adenomon, 2016).

Table 2: ADF Test for Stationarity.

Variables	Levels		1st Difference		2nd Difference		Order of stationarity
	Intercept	Intercept and the trend	Intercept	Intercept and the trend	Intercept	Intercept and the trend	
Exchange Rate	-0.134772 (0.9370)	-2.14265(0.5034)	-5.297675(0.0001)	-5.25750(0.0009)	-	-	I(1)
GDP	9.456534 (1.0000)	2.516180(1.0000)	-1.189570(0.6650)	-3.389497(0.0712)	-7.74511(0.0000)	-7.604279(0.0000)	I(2)
Foreign import trade	3.366231 (1.0000)	1.873267(1.0000)	-4.597959(0.0009)	-5.123564(0.0014)	-	-	I(1)

The long-run coefficients are as shown in table 3. It is obvious that the coefficients are positive for foreign import trade at lag 1, and 3 as well as the GDP and significant at 1% and 5%. While it is negative for foreign import trade at lag 2 and exchange rate. Foreign import trade at lag 2 is significant as well at 1% and 5% while exchange is not significant. The results suggested that foreign import at lag 1, 2 and 3 and the GDP contributes significantly to the stimulation and growth of the Foreign Import trade.

Table 3: Estimates of the Long-run Coefficients Using Autoregressive Distributed Lag Technique.

Variables	Coefficients	Std. Error	t-Statistic	P-Value
FOREIGN_IMPORT_TRADE(-1)	0.602272	0.188519	3.194754	0.0039
FOREIGN_IMPORT_TRADE(-2)	-0.758012	0.268465	-2.823502	0.0094
FOREIGN_IMPORT_TRADE(-3)	0.992274	0.384002	2.584031	0.0163
GDP	34.18607	13.32030	2.566464	0.0169
EXCHANGE_RATE	-6.159051	4.956011	-1.242743	0.2260
C	-2476.277	980.9873	-2.524270	0.0186

The results in the table 4 is a bound test for the null hypothesis that there is no long-run relationship existing between the explanatory and response variable. The critical values for F-statistics are reported for k=2 and two sets of critical values are equally provided for I(0) and I(1) i.e there is no co-integration among the variables under study and there is co-integration among the variables under study respectively. The calculated F-statistic is 6.8687 which far greater than the upper bound for significance at 1%, 2.5%, 5% and 10% respectively. This implies that there is a long-run relationship between the response and explanatory variables under study.

Table 4: ARDL Bound Test for Co-integration.

Test Statistic	Value	Significance Level	I(0)	I(1)
F-statistic	6.8687	10%	2.63	3.35
K	2	5%	3.1	3.87
		2.5%	3.55	4.38
		1%	4.13	5

From table 5 it was observed that foreign import trade at lags 1 and 2 will have a short-run impact on the foreign import trade. The ecm coefficient is -0.863465[p=0.000]; it is negative and very significant. This indicates that a short-run disequilibrium of 86.3% from the past year will be brought back to long-run equilibrium in the present year.

Table 5: Error correction (ECM) representation of the ARDL model selected.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(FOREIGN_IMPORT_TRADE(-1))	-0.234262	0.158300	-1.479861	0.1519
D(FOREIGN_IMPORT_TRADE(-2))	-0.992274	0.228121	-4.349765	0.0002
ecm(-1)*	-0.863465	0.029402	-5.559603	0.0000

The residuals from the model are normally distributed as in the figure below. No serial correlation, Heteroscedasticity not significant as presented in table 6.

Table 6: Diagnostic test for VECM.

R-squared	0.961502
Adjusted R-squared	0.955799
Serial correlation	0.121539 (0.8861)
D.W	2.022368
Heteroscedasticity	2.0015(0.1148)

Series: Residuals
Sample 1984 2013
Observations 30

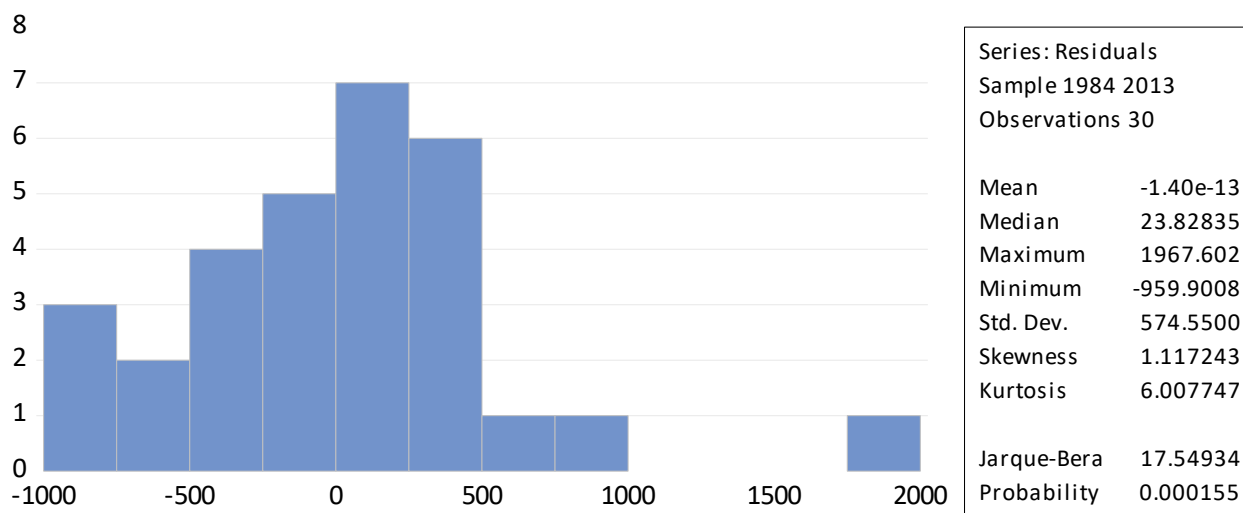|	
Mean	-1.40e-13
Median	23.82835
Maximum	1967.602
Minimum	-959.9008
Std. Dev.	574.5500
Skewness	1.117243
Kurtosis	6.007747
Jarque-Bera	17.54934
Probability	0.000155

Figure 1: Normality Test.

The Jarque-Bera test for normality indicated that the residuals for the model are normally distributed

DISCUSSION

The investigated the relationship between GDP, Exchange rate and foreign trade in Nigeria. The preliminary test of stationarity conducted using ADF test revealed that the variables are no-stationary at level, but are stationary at first difference for Exchange rate, Foreign Trade and second difference for GDP. ARDL (3,0,0) model was the most appropriate for the relationship based on the minimum AIC. There is a relationship between the selected of GDP, Foreign Import and Exchange Rate. Foreign import and exchange rate influence GDP and are therefore important factors that will shape the economy. This is in line with findings of Shittu et,al 2012.

ARDL bound test was used to examine the co-integrating relation between variables and it revealed that there is a long-run relationship among the variables considered in the study.

The lung-run coefficients estimates show that the coefficients are positive for foreign trade at lag 1 and 3, but negative at lag 2 and the GDP.

However, the ecm showed that a short-run disequilibrum of 86.3% the past year will be restored the previous year. This is in

agreement with the findings of Ekpo (2023). The residual diagnostic shows no serial correlation and are homoscedastic. The Figure above shows the residual are normal.

CONCLUSION

Reference to the results and discussions presented in the preceding sections, the following are concluded: The influence of foreign import trade cannot be overemphasized being an indispensable tool for the overall development of any economy especially a developing nation. The one, two and three-period lag on the dependent (FOREIGN_IMPORT_TRADE) variable remains high, coefficients of the independent variables at are all significant and that the long-run impact of a change in EXCHANGE_RATE and GDP has essentially don't have lagged-effects on FOREIGN_IMPORT_TRADE. The results revealed that there is a long-run relationship between foreign import trade, GDP and foreign exchange. This implies that the speed of adjustment to equilibrium; when there was a shift and thus suggested that it could take about 86.3% of previous years for it to return to a stable state. We conclude that a good and sustainable GDP and foreign exchange will be capable of stimulating a significant growth in the Foreign Import trade sector of the economy.

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